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"THE MECHANIC," "SCIENTIFIC OPINION," AND "THE BRITISH & FOREIGN MECHANIC."

ILLUSTRATED WITH NUMEROUS PRACTICAL ENGRAVINGS.

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INDEX TO VOL. XLV. ENGLISH MECHANIC.

ABBE, Prof., on sunspots, 267
Accident: at Carlisle, 86, 84
  at Harringay Park, 248, 273, 821, 345, 369, 395, 418
Accumulator: defective, 16
  Montaud, 169
  pocket, 89, 109, 215
  Woodward's spongy lead, 133, 182
Accumulators: 280, 320
  charging by primary batteries, 128, 182
Achromatic condensers, 300
Acid-proof gilding, 38
Acoustic telephones: 159, 182, 280, 300
  call-bell to, 422
Adulterated olive oil, 345, 370
Advances, microscopical, 1, 93, 331, 379, 427, 475, 547
Adze, bansoolah or Indian carpenter's, 250
Æolian harp, 589
Aërostation, 420
Agatharsides, 174
Air: burnt, 12, 34, 84, 103, 250, 276, 345
  optical effects of saturated, 569
Air-balls, indiarubber, 471
Air-compressor for refrigeration, 181
Alarm, electric burglar, 542
Albert Hall organ, 17
Albumen: coagulation of, 423
  keeping, 15
Alcohol: amylic, 159
  in dissolving aniline dyes, 409
  sugar to produce, 469
Alcoholism, inherited phenomena of, 318
Alcor, proper motion of, 124
Aldebaran, occultation of: 32, 61, 78, 100, 228, 510
  daylight, 485
Ale, brewing Scotch, 541
Algebraic geometry, 252, 278
Alkaline solution, electrolysis of, 277
Alloy, tin, 326, 350, 423, 447
Almanon, 79
Almucantar, the, 412
Alternating currents, phenomena of, 505
Altitudes, endowment for observation at great, 123
Alumina, silica and, 90
Aluminium: 89
  bronze, soldering, 497
  new method of extracting, 95
Amateur: metal founding, 525, 560
  workshop, 3, 26, 117
Amateurs: electrical instrument making for, 47, 429, 550, 597
  practical electric lighting for, 610
  saw-table for, 150
Amber: 319
  dissolving, 227
America, technical education in, 370
American: exhibition, 365
  — shingle house at the, 478
  organ, 18, 38, 85, 87, 134
  — of the latest type for churches, 488
Ammeter: 201
  calibration, 185
  constant, 205
Ammeters: and voltmeters, 13, 14, 33, 47, 112
  electric cautery and, 83
Amylic alcohol, 159
Anacalypsis, Higgins's, 78
Analysing diaphragm, Lighton's, 434
Analysis: of bleaching powder and soda-ash, 255
  of lime, 14
  spectrum, 420
  technical, exercises in, 47, 308, 380, 573
Analysts, to, 85
Analytical chemists, to, 14
Anchor ice, 18, 88
Aniline dyes, alcohol in dissolving, 409
Animals: food for, 132, 156
  John Bright on kindness to, 340
Ankles, weak, 447, 469
Annum, hours of daylight per, 293
Antares, 426, 458
Anthelmintic, another, 561
Anthelmintics, more about, 586
Antidote for white-lead poisoning, 111, 134
Antiferment, 423
Antipyretic, oxygen as an, 385
Antiseptic dressing, 255, 279
Ants, winged, 592
Aperture and magnifying power, 123, 134, 149, 180
Aplanatic eyepiece, 267
Apparatus: dividing, 59
  electrical, 37, 62, 65, 106
  — constant temperature, 581
  for illustrating Foucault's currents, 599
  for obtaining density of solids, 121
  illustrating law of reflection of light, 286
  lathe screwing, 104
  Niblett's new screw-cutting, 23, 45, 105, 178, 293, 317, 343
  paraffin imbedding, 455
  Perron's photographic, 454
  seismographic, 96
  specific gravity, 262
  train signalling, 121
  twist drill, 40, 108, 156, 180
  Wenham's screwing, 177
Apses, moon's, and wet and drought, 583
Aquarius and Pegasus, star-drift in, 175
Aqueous vapour, 108, 129, 156, 177, 201, 220, 250, 276
Arachis hypogæa, 397, 420
Arachnoidiscus Ehrenbergii, structure of, 11, 33, 85, 101, 129
Arc: lamp, small, 229
  light dynamo, 302
  of the meridian, length of the visible, 365
Arcadia, Sidney's, 226
Arcs, circular, 134
Arietis, alpha, 80
Armature: Burgin, 42
  burning of coils in, 106
  relation between amount of wire on, and its voltage, 392
  resistance of, 110, 183
  ring, 494
  Siemens, 134
Armatures: burning of coils in, 106, 153
  laminated, 299, 321, 345
  proportional sizes of F.M.'s and, 206
Arsenic, tests for, 521, 542
Arsenical wall-papers, 456, 513
Artificial: vortices, experiments with, 236
  whetstones, 266
Artist's clinometer, Stanley's patent, 262
Asthma, acute spasmodic, 302, 326
Astrology, 31
Astrometroscope, 231
Astronomers in dis-united states, 314
Astronomical: 124, 149, 174, 510
  directory of M. Lancaster, 123
  notes, 93, 190, 284, 404, 500, 596
  (Saturn), 268
Astronomy: and mathematics, 123, 134, 182, 219
  exercises in practical, 389, 444, 458, 531, 557, 584
  physical and a paradoxer, 314
  works on gravitational, 314
Atlas and Hercules, 34, 79
Atmosphere, micro.-organisms in the, 95
Atmospheric electricity, 396
Attemperator, aqueous distributor, or refrigerator, 390
Audsley, Mr., a musical evening with, 465
Australia, Western, 398
Automatic: commutator for incandescent lamps, 362
  microtome, Ryder's, 213
  movements, 236
Axles: driving, breaking of, 225
  wheels and, 111
Azaleas, cultivation of, 207, 228

B 277, B 71, B 31, 291
Back-gear for foot-lathes, simple, 410
Backlash in slide-rest, 65
Backwoodsman, to, 349
Bacon, machine for slicing fat, 352, 375
Bacteriology, 157
Balcomb tunnel, length of, 351
Balloon, a great, 149
Balloons, varnishes for, 310
Balsam, Gurjun, 397
Bands: lathe, 328, 374, 398
  leather, joining, 351
Bansoolah, the Indian carpenter's adze, 250, 308, 326, 351
Barnard's comet, 372
Barrels: exhaust tumbling, 359
  pump, 447
  rifle, care of, 490
  tumbling, 359, 567
Baryta, manganate of as a bleaching agent, 147
Bath: electric, 15, 36, 62, 85, 106
  heater, a French, 225
Bathometer, Siemens', 273
Baths, Turkish, 373
Batteries: charging Leclanché, 393
  economical, 481
  electric lighting by, 16, 63, 86, 197, 204, 226
  electrical output of, 135
  electromotive force of, 568
  on the laws, reactions, and construction of some forms of, 208, 220, 276, 292, 320, 347, 606
  on primary, 98, 128, 153, 175, 197, 220, 247, 461, 485
  porous pots for, 264
  secondary, thermopile and, as a convenient means of producing electricity for medical and surgical purposes, 215
  solution for, 548
  storage, durability of, 504
Battery: amalgamating plates of, 616
  and coil, medical, 112
  Bunsen, 39, 64
  cells, acid-proof, 329
  chloride of silver, 323
  chromic acid compounds in the, 164
  Clamond and Gaiffe's, 567
  connections, protecting, 39
  corrosions, 64
  Daniell's, 351
  dynamo and coil, 88
  Erhard's circulating, 239
  for lamp, 17, 38, 63, 107
  for surgeon's lamp, 230
  Frankland's electrical storage, 193
  miniature, 66, 112
  Niaudet's, 67, 544, 567
  oxide of copper, 17, 494
  Pabst, 41
  Post-office, 278, 300, 373
  powerful, 407
  regulating primary, 313
  residues, 164
  secondary, 301
  silvering without, 448
  simple form of water, 29
  solution, new, 267
Battery: standard Daniell, 435
  thermo, 280
  Woodward's spongy lead, 109
Beam: centre, 255
  engine, 255
  spring of, 16, 38
Bearing paint, Crookes's, 500
Bearings: metal for, 92
  shaft, 427
Beat, lever watch in, setting, 18
Beer: 96
  affected by thunder, 469, 509
  cane-sugar in, 469, 514, 539
Bees, or what? 446
Bell: "Boss" electric indicating, 430
  chuck, 199
  electric, 519, 542
  — tramway, 65
  faulty electric, 544, 567, 591, 615
  for acoustic telephone, 423
  telephone call, 446, 469
Bellows: 378
  lamp and, for blowpipe, 205
  organ, 227
  — leather for, 227
  — noisy, 567
  repairing, 17
Belt holes and belting, 596
Belting: belt holes and, 598
  link, 578
Bending: brass tubing, 131
  zinc tubes, 520, 543
Bengal light, blue, 251
Bevel, Witter's improved, 148
Beverages, tea and coffee as sanitary, 562
Bibliographie générale de l'astronomie, 509
Bicycle: Centaur Ranger safety and direct-steering tricycle, 5
  head, brazing, 109
  hubs, drilling, 392, 616
  making, 616
  tricycle and, shelters, portable, 334
Bicycles, rear-driving safety, 66, 87, 299
Bill: technical instruction, 504, 577
  — and Science and Art Department, 577
Billiard: cue tips, 229
  cushions, softening, 255
Bills of sale, 299, 308, 326, 357, 374
Binocular telescopes, 178
Bisschop gas-engines, 254
Bits: centring, 487, 512
  drills and, 82
  half-round, 352, 375
Bitumen of Judæa, 351
Black: dead, for brass, 255, 279, 300, 325
  dyeing, of ivory, 580
  varnish for iron, 397, 458
Black-bronzing brass, 110
Blacking: cast-iron frames, 255
  moulders' mineral, 397
Blacksmith's work, how to do, 362, 414, 464, 486, 563
Blacksmiths, Indian, 346
Blake transmitter, 17
Bleaching: manganate of baryta for, 147
  powder, analysis of, 255
Blindness, colour, 180
Blistered feet, 568, 590, 615
Blocks, pulley, 329
Blood, method of staining and fixing the elements of, 528
Blow, force of, 400
Blowpipe, Costa's patent, 99
Blowpipes, spirit, 180
Blue: laundry, 86
  paint for bricks, 88
  prints, Prof. Cleave's method of making 438
  varnish for steel, 376
Boat: carriage, 112, 134

Boat : electric, storage cell for, 278
  Nordenfelt submarine, 312
  Una, 615
  varnish, 373
Body, velocity of falling, 412
Boiler : 159, 254, 304, 328, 521, 591
  and engine, 254
  front paint for, 182
  gauge-glass, 88, 109
  iron washing, rust in, 568
  marine, 207
  Nori patent vertical multitubular, 120
  thickness of plates for, 66
  tubes, brass, 349
  — ribbed, 311, 347, 419, 441
  vertical, 160, 184
Boilers : locomotive, 132
  proportions of model engines and, 86
  steam, petroleum for, 182
  — water-level indicators for, 261
Boiling oils, 109
Bones, dissolved, 568, 590, 615
Bookcase, 589
Book-rest, invalid's, 366
Books, effect of electric light upon, 483
Boot and shoemaking : machinery, 346
  "ab intra" system of, 541
Boötis (34) : 291, 315
  zeta, 314, 341
Boracic acid, 447, 492, 588
Bore holer, 110
Boring : 184
  glass, 483
  gun-barrels, 63
  holes in gas tubing, 432
  machine, Dryden's, 166
  pinholes in card, 556
  tubes, conical, 617
  wood, 325
Borneo, "Mandau" of, 298
Boss electric indicating bell, 430
Botany, works on, 40
Bottle envelopes, straw, 41
Bottles : glass, spiral cracks in, 207
  paper, 290
Bottone's medical coil, 254
Bow latch, improved, 328
Box, improved letter, 29
Boxes, turning wood, 376
Boxwood blocks, photo. etching upon, 508
Bracelets, 589
Bracing climate, 592, 615
Bracket, cheap and handy, 319
Bradley's improved floor-jack, 482
Brake : holder, Striffler's patent, 131
  L. and Y. vacuum, 350
  stops, diagram of, 298
  trial at Ipswich, 16
  Webb's automatic air, 87
  Westinghouse, improvements in, 536
Brakes : and indicators, 501
  continuous, 197, 224, 243, 297, 321, 344, 350, 369, 395, 415, 439, 463
  on the L. and N.W., 36
  railway, 98, 130, 155, 158, 179, 197, 272, 296, 326, 344, 350, 369, 417, 440, 464
Brass : black bronzing, 110
  dead black on, 255, 279, 300, 325
  figures, cleaning heads of, 112
  foundry, 111
  lacquering, 420
  pinny, 251
  salvers, cleaning Indian, 66
  tubing, beading, 134
  uniting carbon to, 494
  wheels, cutting, 328, 351
Brasses : lining, 111, 157
  worn, filling, 542
Brazing : band saws, 376
  bicycle head, 109
  compound, 69
Breaker, contact, 251
Breechloaders, rebrazing lumps of, 398
Brewing Scotch ale, 541
Bricks, glaze for, 300
Bridge, Wheatstone's, 39, 220
Bright, John, on kindness to animals, 340
Briquettes, coke-dust, 149
Britain, the making of, 145
Brompton, latest "little bill" from, 556
Bronzing : iron, 15
  metals, 54
Browning steel and iron, 218
Bulb mite, 263
Bunsen battery : 39
  amalgamated zincs for, 398
Burgin armature, 42
Burglar alarm, electric, 542
Burial, civil, 255
Burmese lacquered ware, 394
Burner : exploding gas, 112, 227
  for injector furnace, 472
Burning coils of armatures, 106, 153
Burns : carbolised oil for, 488, 514
  scalds and, 561, 586, 612
Burnt : air, 12, 34, 84, 103, 250, 276, 345
Burnt-in varnishes, 293
Business, electrical, 302, 325
Butter, 544
Butterflies, relaxing, 41, 64
Butterine, 200
Buttons, shirt, 107
Buttress and V threads, 345, 418

CABLE : 88
  tramway, 499
Caen stone, cleaning, 251, 278, 299
Caister castle, 591, 615
Calcium : chloride solution, boiling point of, 323
  crystals of chloride of, 543
  light, 420
Calculus, the, 15, 37, 106, 154
Calibration, ammeter, 135
Calipers, improved, 259
Calver reflector, observations with a 12½in., 315
Camera : a handy, 127
  a new photo-micrographic, 213
  celestial photography with ordinary, 509
  shutter, improved, 359
  stand, adjustable, 382
Cameras without lens, 471, 493, 520, 542, 566
Cams, grooved, face and box, 48
Candle, capricious, 582
Cane-sugar in beer, 469, 514, 539
Canoe : engine for, 420
  racing, 37
Canoeing from Oxford, 470, 492
Cantilever, oak, 18
Carbolic acid as a safeguard against insects, 445
Carbolised oil, 467, 488, 514
Carbon : in iron, 508
  plates, platinising, 616
  to brass, uniting, 494
Carbonic acid gas, making, 616
Card : boring clean holes in, 556
  mounted flexible glass films, 239
Cardboard plates for the Wimshurst machine, 271
Carlisle accident, 36, 84
Carpentry, joints used in, 356, 415
Carriage : boat, 112, 134
  tool, 263
Carriages, warming railway, 24
Carrying capacity of wires, 386
Cartwright's plane, 494
Casehardening, 421
Cassini's division, 365
Cassiopeiæ, V, new variable, 61
Cast : iron, blacking, 255
  — fluidity of, 40, 64
  — softening, 86, 108
  steel jumpers, tempering, 184, 300
Casting : iron upon lace, &c., 358
  malleable, 423, 469
  zinc, 89
Castings : filling for, 67
  finishing brass, 493
  planing, 280
  shrinkage of, 179
Castor, double star near, 66, 78, 87
Castor-oil : as a lubricant, 415
  how to take, 478
Catalogue : of new double stars, 412
  of stars with remarkable spectra, Mr. Espin's, 458
Catastrophe : happily averted, 173
  of fifty centuries ago, 55, 78, 80, 102, 196, 244
Cats, poisoning of, 467, 490, 509
Cautery, electric, 13, 14, 62, 83
Celeste action, 469 491, 517
Celestial : Mrs. Harris, 173
  photography with an ordinary camera, 509
Cell : Leclanché type of, 183
  plate secondary, 39
  storage, 254, 278
  wooden, lining for, 39, 86
Cells, new voltaic, 612
Celluloid, 206
Cement : for rubber, 352
  metallic, for stone, 377, 397
  turner's, 446
Centaur Ranger safety bicycle and direct-steering tricycle, 5
Centre : beam, 255
  grinder, friction-driven, 382
  of pressure, 16, 38
  punch, Cushman, 310, 343, 370, 393
Centres for soft wood, 319, 338, 345, 372
Centring bits, 487, 512
Cerate, encaustic, 251
Chain, surveyor's, 123, 134
Chamber organ, 103, 278
Charcoal making, 37
Chasing screws, 245, 510
Chemical : 62
  experiments : easy, 602
  precipitate, 156, 204
Chemistry, photographic, 423, 447
Chemists, to analytical, 14
Chess : 21, 44, 70, 92, 114, 138, 161, 186, 209, 232, 257, 282, 305, 331, 353, 378, 401, 424, 450, 473, 498, 523, 546, 571, 594, 618
Chilian nitrate of soda beds, 289
Chilled iron rolls, turning, 278
Chimes for clock, 62
Chimney, dimensions of, 376
Chinese paper varnish, 201
Cholera, prophylactics to, 587
Chromic acid compounds in the battery, 164
Chuck : bell, a, 199
  corrugated, 178
  Essex, 276, 296, 326, 350
  geometric, 13
  oval, 36, 85, 156
  pattern-maker's, 52
  screw centre, 289
  tap for wooden, 516
  Yorkshireman drill, 448
Chucks : tiny, 294
  useful, 318, 348
Church organ : an American, of the latest type, 488
  notes on the, 71
Circuit, telephone, wires, &c., for, 448
Circular : arcs, 134
  saw kinks, some, 432
  saws, table for lathe, 105
Circulating battery, Erhard's, 289
Cisterns, corrosion in hot-water, 65
Civil burial, 255
Clack box, 423
Clamond and Gaiffe's battery, 567
Clamond's improvements in the transformation of heat into electricity, 430
Claw weeder, 84
Clarifying muddy water, 458
Cleaning : dry, 566
  gold and silver dials, 64
  Indian brass salvers, 66
  journal oil, 19
  stone floor, 519
Cleave's, Prof., method of making large blue prints, 433
Clefts, lunar, 205, 219, 251, 267, 323, 365
"Clementsy," showing but little, 509
Cleomedes, 79
Climate, bracing, 592, 615
Clinometer, Stanley's patent artist's, 262
Clock : and gravitation, 515
  chimes for, 62
  driving, for telescope, 123
  electric, for factory, 159, 183, 205, 227, 251
  musical, 205, 323
  pendulum, 326, 350
  sun before or after, 509
  time-checking, 171
  wonderful, 350
Clockwork arrangement, 447
Cloth, painting designs on, 302
Coach, painting a, 478
Coach-builder's lift, 182
Coagulation of albumen, 423
Coal : and water, 17
  economy, 16, 37
  in New South Wales, 67
Coal-pit, bright star seen at mid-day from bottom of a, 241
Coal-tar, new uses for, 212
Cockles, diatoms in, 299
Cocoa, influence of, on digestion, 238
Codfish with a pocket-knife, 172
Coffee : influence of tea, cocoa, and, on digestion, 238
  tea and, as sanitary beverages, 562
Cogs for patterns, 230
Coil : and battery, medical, 112
  Bottone's medical, 254
  core, 327, 374
  faulty, 302
  induction, 88, 109, 156, 180, 204, 255, 470, 544
  medical, 351
  microphone, 255, 279, 325
  Mr. Higg's, 34, 61
  reel, 423, 447
  7in. spark induction, 258
  sparking, 538
  street medical, 62
Coils : dynamo, 111
  galvanometer, 40, 64, 108
  in armatures, burning of, 106, 153
  resistance, 39, 64, 86, 108, 559
Coinage, decimal, 368, 390, 440
Coins of the present reign, 352, 398, 421
Collars and pulleys, safety set-screw for, 288
Colliery grease, 276, 300, 323
Collision, a remarkable railway, 243
Coloration of metals, electro-chemical, 599
Colour-blindness and ignorance of colour names, 130, 155, 180
Colouring : copper, 398
  statues, 15
Colours : photographic, 348
  — printing in, 477
  photography in natural, 334, 408
  photogravure in, 532
Comet : Barnard's, 372
  great Southern, 174
  watery, proving a, 583, 604
Comets : and meteors, 412
  B and D 1887, 79
  meteors and relation between, 316
  orbits, 133
Commutator, dynamo, 135
Compass for navigation, 588
Compensating pendulums, 539
Compound : engine, 135, 446
  engines, modern, 403, 441, 489
  for welding steel, 5
  goods tank, L. and N.W., 513, 539
  locomotive, N.E., 519, 613
  locos., 63
  steam engine, 422
Compress pad, 226, 375
Concert-room organ, notes on the, 523, 571, 608
Condensation in the cylinder, 456
Condenser : 64, 86
  achromatic, 300
  for coil, 254
Conductivity, electrical, 457
Cones : Guthrie's, 85
  mensuration of, 592, 604
Configuration, planetary, 32, 98
Congo, a tributary of the, 217
Conical tubes, boring, 617
Conjunction of the planets, 78
Connections, electrical, 399, 421
Conservation of sun's energy, 32
Consumption, creasote in, 207, 229
Contact breaker, 251
Continuous brakes, 197, 243, 297, 321, 344, 369, 395, 416, 439, 463
Copper : colouring, 398
  detection of, 471
  oxide of, battery, 17, 494
Core for coil, 327, 374
Corner pieces to picture frames, 184
Correctness, taking measures to insure, 31
Correspondent : pleasant news of an old and valued, 507
  who cannot let well alone, 267
Corrosion in hot-water cisterns, 65, 181
Corrugated chuck, 178
Costa's patent blowpipe, 99
Cotton belting, 205
Cotton-mill engine, gigantic, 9
Cotton-seed oil in olive oil, 260, 318
Counterbalancing flywheel of lathe, 276, 318, 348
Coupling, Hill's automatic, 563
Couplings, railway, 345, 369, 417, 441, 464, 488
Court, tennis, 516
Crab : 40, 86
  lifting, 135, 158
Cracks : in glass bottles, 207
  in stoves, repairing, 14
Cranes, 559
Crank and flywheel, 5
Cream : from milk, separation of, 184, 206 350
  furniture, 470
Creasote in consumption, 207, 228
Cremation, 31, 41
Cremona violins, varnishing, 179
Critical velocity of rotation, 422
Crookes's bearing paint, 500
Crucibles, plumbago, 40
Crumlin viaduct, 134, 157
Crystal spheres, manufacture of, 158
Crystals : in leaf, 16
  quartz, 180
Cue tips, billiard, 229
Culture, tobacco, 99
Cure for rheumatism, 268
Current : break, 516, 543
  continuous, and dynamo, 135
  heating insulated wire, 16
  of wires, safe working, 135
Currents : alternating, phenomena of,
  induced, 206, 228
Curvature of a lens, finding, 458
Curves, equations to, 302
Cushions, billiard, 255
Cushman centre punch, 310, 343, 370,
Cutter : universal, Birch and Co.'s, 318
  Waltham Watch Co.'s, 394
Cutters, circular, 568, 590
Cutting : and drilling frame, 246
  brass wheels, 328, 351
  grooves, 130
  racks, 178
  screws, 246, 301, 519
  — Murchey's taps for, 335
  tools, 502
Cycle lamps, 592, 615
Cygni, Beta, minute stars near, 605
Cylinder : condensation, 456
  engine, 111, 230, 254
  flute, 227

DAGGERS, Eastern swords and, 390
Dammar, 392
Damp, exposure of an object-glass to, 267
Damp-proof glue, strong, 337
Daniell battery : 351
  standard, 435
Darkness, supernatural, on the first Good Friday, 156, 173, 180, 201, 219, 224, 296
Dark-room, a holiday, 607
Dark-tent, portable, 144
Davis's interlocking for signal arms, 396
Day and night in nebulæ, 61, 78
Daylight : age of earth, sun, and, 10, 31
  hours of, per annum, 293
  how to adjust an equatoreal by, 371, 397
  observing double stars by, 178
  occultation of Aldebaran, 485
  stars visible in, 268, 314, 316, 365, 368, 389, 412, 436, 458, 558, 583
Day's work, a good, 396
Daytime, can stars be seen in the, from the bottom of a well? 173, 219, 241, 366, 389
Dead dipping, 300
Dead-beat galvanometer, 278
Deafness, 447, 494, 518, 542, 566, 590, 615
Death by electricity, 238, 410
Decay of timber, 200
Decimal coinage, 368, 390, 440
Declination, 31, 41
Degeneration of the teeth, 604
Deliquescency, 420
Demagnetising : watch-case, a, 97
  watches, 171
Density of solids, apparatus for obtaining the, 121
Dentists Act, 88, 109, 133, 181, 204, 226
Deodorisation, disinfection v., 267
Design for hot-air engine, 225
Deterioration of yeast, some of the causes of, 529
Developer, ferrous oxalate, 470
Developers, photo., 17, 159, 302
Developing troubles, 591, 615
Device for cutting grapes, 271
Dewing of object-glass, 63
Dhall, rob, and lentils, 158
Dhao, the, 371
Diagram : brake stops, 298
  indicator, 16, 18, 38, 63
  Zeuner's slide-valve, 520
Dial, horizontal, 78
Dials : cleaning gold and silver, 64
  printing numbers on, 375, 446
Diameter : of Mars and other planets, 509
  of star discs, 31
Diameters of planets, computation of, 531, 556
Diamond ink for writing on glass, 193
Diamonds, glazier's, 446
Diaphragm, Lighton's analysing for polariscope, 434
Diatomaceæ, mounting the, 597
Diatoms : in cockles, 299
  in the Thames, 276
Die-sinking, mechanical, 569, 615
Diet and training, 121
Differential screw, 165
Diffraction, ancient and modern, 331, 379, 427, 475, 547
Digestion, influence of tea, coffee, and cocoa on, 238
Dioptric telescope, 267

Genteel occupations, manual labour v., 460, 485, 509
Geology of the Suffolk Coast, 267
Geometric chuck, 13
Geometry, algebraic, 252, 278
German yeast, 568
Germany, longevity in, 266
Gh, pronunciation of Irish, 400, 422, 446
Gherkins, 41, 64
Gilding: acid-proof, 88
  micro., 328
Gimlets, Norwegian, 273
Girder, bent, 159
Glasgow and S.W. locomotives, 17, 182, 205
Glass: boiler gauge, 88, 109
  boring, 483
  bottles, spiral cracks in, 207
  diamond ink for writing on, 193
  films, card-mounted flexible, 239
  Schott and Co.'s new optical, 249
  silvering, 471
  stencilling on, 87, 108
  tenacity of spun, 9
  tubes, breaking, 170
  working, 616
Glass-cloth, fastening to drums, 32
Glasses, water-gauge, 400
Glaze for bricks, 300
Glazier's diamonds, 446
Globular lightning, 159
Glue, strong damp-proof, 337
Gluten, 372
Gold: amalgamating, 516
  and silver dials, cleaning, 64
  chloride of, to make, 457
  melting, 423
  paint, 37
  printing, 376, 491
Good Friday, the supernatural darkness on, 156, 173, 180, 202, 219, 224, 272
Governors, engine, 159, 182, 304
Grain-drying machine, new, 509
Gramme dynamo, 89, 184
Granite, turning, 184, 206, 228
Grapes, device for cutting, 271
Gravitation: clocks and, 515
  heat, force and, 36, 128
Gravitational astronomy, works on, 314
Gravity, specific, 219, 228
Grease, colliery, 278, 300, 323
Great Eastern: compound, 613
  locomotives, 279
Great Western: locomotives, 62, 85
  so-called expresses, 488, 513
Green Japan, 613
Greenwich visitation, 359
Grinder, friction-driven centre, 382
Grinding: and shaping machine for tools, Sellers's, 579
  twist drills, Smith's apparatus for, 309
Grindstone, using the, 239
Grooves, cutting, 130
Guano, 228
Guide, blade screw propeller, 142
Gun-barrel boring, 63
Gun-metal, yellow lacquer for, 519
Gurjun balsam, 397
Guthrie's cones, 85
Guttapercha, 90

HACK-SAW: frame, 230
  Star, 158
Hackworth's gear for locomotives, 181
Half-crowns, Lima, 496
Half-round bits, 352, 375
Hall: heating small, 304
  mark, 68
Hand signals for drivers, 369
Hand-chasers, self-leading, 563
Hand-drill, a good, 201, 245, 294
Hand-planer, wood-turner's, 303
Handy: camera, 127
  switch, 295
Harbour loans, 155
Hard water, 65, 87, 108, 135
Hardening: and tempering steel, 163, 200, 248
  metals, 382
Harmonium: 87, 109, 133, 277, 299, 323, 349, 373, 374, 420, 445
  more wind wanted for, 545
  swell, 569
  vibrators, 351, 374, 398, 421, 446, 469, 491, 516, 541, 565
Harness varnish or reviver, 304
Harp, Æolian, 589
Harringay Park accident, 243, 273, 321, 345, 418
Harris, the celestial Mrs., 173
Hat, about a, 536, 562
Hour, 89
Heart and lungs, physiological connection between, 288
Heat: and power, comparative value of steam and hot water for transmitting, 600
  conductivity of metals, 287
  evaporating without, 159, 182
  force and gravitation, 36, 128
  into electricity, Clamond's improvements in the transformation of, 430
  light and, 520
  loss of from steam pipes, 143
  measuring, Immisch's apparatus for, 476
Heating: by hot water, 158
  of platinum wires, 15
  Polmaise system of, 567
  purposes, high pressure steam for, 18
  small hall, 304
  surface, 184
  water, 543
  — Fletcher's improvements in, 236
Heliostat, 314, 412
Heliotype, 251
Hercules and Atlas, 34, 61, 79, 195, 437
Herreshoff yacht, 28 knot, 556
Herring, migration of, 208
Herz telephone, the, 205, 347
Hides, raw, 34
Higgins's "Anacalypsis," 78
Higgs's, Mr., coil, 34
Hill's automatic coupling, 563
Hints for microscopists, 11
Hippalus, cleft near, 174
History, natural, strange bit of, 490
Holes: and belting, 598
  bore, 110
  drilling, 18
  enlarging, 156
  in gas-tubing, boring, 422
  squaring, 351
Holiday dark room, 607
Honey, test for, 207, 253, 278
Hook tools, 271, 293
Horizontal: dial, 78
  sundial, 133
  windmills, 11, 57, 62
Horse-power of locomotives, 135, 159
Hose-pipe, 251, 300
Hot-air: engine, 42, 205, 225, 270, 328, 346, 510, 533, 586
  oven, 87
Hot-beds, gas-wells as, 147
Hot-water: cisterns, corrosion in, 65, 181
  comparative value of steam and, for transmitting heat and power, 600
  heating by, 158
Hours of daylight per annum, 293
House: duty, 541
  lighting by electricity, 349
  shingle, at the American exhibition, 478
Houses, paper, 558
Howorth's flood, 562
Huamanripa, 410
Human nature, divisions of, 269
Humanity, fashion v. science and, 552
Huyghenian eyepieces for 33in. object-glass, 267
Hydraulic: leathers, 373
  machinery, 89
  press, 451
  ram, 207, 228
Hydraulics, 591
Hydrocarbons, effects of vapours of, 468
Hydrochloric acid, 544, 567
Hydrogen, peroxide of, 206
Hydrophobia, 463
Hydrophone, the, 215
Hydroxyquinol, 591
Hygrometer: 12
  another, 56
  simple, 35, 83, 106, 176
Hypnotism, the legal aspects of, 191
Hypopus vulgaris, 85

ICE, anchor, 18, 38
Ice-house or refrigerator, 589
Idealism, evolution of, 496
Iguana skin, 224
Illuminated fountains, 255
Immisch's apparatus for measuring heat, 476
Imperial Institute, the, 31
Imperishable paste, 12
Incandescent: lamp, 110, 328
  lamps, automatic commutator for, 364
  — varnishing, 144, 176
  light, 18
  wire, running, 541
Income-tax, 280, 301, 325, 520
Incubator, thermostat for, 206
India, matting, staining, or dyeing, 130
  punkah, or wind-fan of, 270
Indian: blacksmiths, 346
  brass salvers, cleaning, 66
  kites, 154
  remedy for tapeworms, 530
  tinwork, 397
  toys, 293
  turner, 342
Indiarubber air-balls, 471
Indicating engine, 184
Indicator: diagram, 16, 18, 38, 63
  pendulum, 592, 615
  water-level for boilers, 261
Indicators, brakes and, 501
Induced currents, 206, 228
Induction coil: 88, 109, 156, 180, 204, 256, 328, 471, 544, 567
  7in. spark, 253
Industrial partnerships, 137
Industry, primitive, 546
Ingluvin, 494
Inhalent, 280
Injector furnace, burner for, 472
Injectors, 134
Ink: for stylographic pen, 66, 78
  for writing on glass, diamond, 193
  spots, removing, 491
Insecticide, gas-lime as an, 418, 445
Insects: carbolic acid as a safeguard against, 445
  electro-plating flowers and, 240
  parasites of, 540
Insomnia and noises in the ears, 341
Institution: of Mechanical Engineers, 548
  of Naval architects, 524
Insulated wire, current heating, 16
Intellectual activity, phosphorus and, 555
Intensification, 420
Intensity coil, 255
International screw thread, 211
Inter-oceanic railway, 458
Inundations, theory of periodic, 248, 268
Invalid's book-rest, 266
Ipswich, brake trial at, 16
Irish: gh, pronunciation of, 400, 422, 446
  moss, 447
Iron: and Steel Institute, 308
  black varnish for, 397
  bronzing, 17
Iron: browning steel and, 218
  carbon in, 508
  casting, upon lace, &c., 358
  fluidity of cast, 40, 64
  inlaying with silver, 352
  rolls, turning chilled, 278
  smelting, 14
  steel and, test, 592
  turning, 111
  washing boiler, 566
Isochromatic emulsion plates, Vogel's, 7
Ivory: black dyeing of, 530
  etching, 159

JACK, Bradley's improved floor, 482
Jackdaw, lame, 16
Japan, green, 613
Jew's pitch, 566
Job: a wood-turning, 456, 482, 553
  the Office of Works on an attempted, 458
Jobbing, watch, 18
Joints: on railways, loose, 180, 198, 273, 298, 347, 394, 440, 487
  steam-tight, 587, 605
  used in carpentry, 356, 415
Journal: of the Liverpool Astronomical Society, 365
  of the R.M.S., 173, 201, 219, 242
Journal oil, cleaning, 19
Jubilee: of the telegraph, 283
  science, 276
Judæa, bitumen of, 351
Jumpers, tempering cast steel, 184, 300
Jupiter, 389
Jupiter's first satellite, 195

KALEIDOSCOPIC pictures on screen, 157
Kepler's third law, 123, 134
Key-bedding, 415
Key-beds, 400
Keyless watches, 319, 345, 367, 397
Kidney disease, 541
Kiln, 613
Kite: electric, 375, 398
  musical, 74
Kites: Indian, 154
  Russian, 74
Knee-joint, dislocated, 471
Knife, a workshop, 242
Krupp's big gun, 194

LABORATORY tromp, new, 74, 123
Labour, manual, v. genteel occupations, 485, 509
Lace, casting iron upon, &c., 358
Lacquer, yellow, 519
Lacquered ware, Burmese, 394
Lacquering, brass, 420
Lake: district, 470
  oval, 41
Laminated armatures, 299, 321, 345
Lamp: and bellows for blowpipes, 204
  battery for, 17, 63, 107
  — for surgeons, 230
  cycle, 592, 615
  incandescent, 110
  oils, 109
  small arc, 229
  soldering, 66, 109
  spirit, 38, 64
Lamps: safety of modern oil, 527
  varnishing incandescent, 144, 176
Lancashire and Yorkshire vacuum brake, 350
Lancaster's: astronomical directory, 123
  oval bore rifle, 399, 421
Language: Dutch, 421
  English, 492, 517, 541, 566, 589
Lantern: microscope, 50
  optical, Tyndall's, 227
  slide, novel, 554
Latch, improved bow, 323
Lathe: at Saltaire, 275
  attachment, 296
  bands, 328, 351, 374, 398
  boring in the, without slide-rest, 342
  centre, 159
  circular cutters for, 590
  circular saws, table for, 105
  counterbalancing flywheel of, 276, 343
  English Mechanic, 18
  head, a 5in., 223
  mandrel, Edmunds', 108, 151, 246, 274, 318, 418, 438, 487, 511, 539, 564, 605
  mandrels, 150, 176, 199, 275, 342
  matters, 13, 83, 129, 200, 221, 245, 295, 342, 370, 393, 394, 418
  planer for five shillings, 179
  screw-cutting, 180
  screwing apparatus, 104, 223
  speeding-up of, 111
  three-legged, 481
  throw for 5in., length of, 351, 374
  tools for amateurs, 82
  tools, tempering, 37
  watchmaker's, rusty, 494
  Wenham's screw-chasing arrangement for foot, 115, 177
Lathes: milling, wheel-cutting, slotting, &c., in, 318, 370
  turret, milling tool for, 602
Latitude: 78
  occultation limits of, 531
Launch engines, 400
Laundry: 300
  blue, 86
Laval cream separator, speeding, 301, 350, 373
Law, parochial, 219, 228, 278
Lawn-tennis: 616
  tournament, 19
Laws, reactions, &c., of some forms of primary batteries, 203, 230, 276, 292, 320, 347, 606
Lead: in varnish, 41
  pipes, action of water on, 144
  poisoning, antidote for, 111
  seams, soldering, 288
Leat, crystals in, 16
Leather: bands, joining, 351
  preserving, 496
  stain on cloth, 517
Leathers, hydraulic, 373
Leclanché: battery, 39, 159
  — charging, 392
  — for quantity, 612
  type of cells, 183
  zincs, 471
Leg out of joint at knee, 471
Legal: bees, 448
  bills of sale, 299
  dentist, 88, 109, 133, 157, 181, 204, 227
  marriage settlement, 184
  mortgages, 446
  nuisance, 228
  paving, 15, 112
  poor-rate, 448
  property tax, 255, 520
  rent, 568
  revenue, 16
  tenancy, 158
  tolls, 219, 229
  trustees, 254
Lemon: decoction in malaria, 497
  soles, 66, 78, 87
Lens: camera without, 471, 493, 520, 566
  curious, 367
  for both reflection and refraction, 443
  "Optimus" camera, 54
  orthoscopic, 488
  radius of, 302, 314, 458
Lenses: photographic, 228
  Voightländer, 393, 418, 438, 467
Lentils: dhall, and rob, 158
  dishes with, 298
Leonis: alpha, 173
  65P^3, 97
Letter-box, improved, 29
Levelling: combination tool for squaring, &c., 215
  machinery by spirit level, 279
Lever watch in beat, setting, 18, 38
Leverage, 304, 326, 399
Leyden jar and fulminating pane, 544
Libel on the Eskimos, 127
Library statistics, 225
Lick equatorial, the great, 219, 412
Life, loss of, at sea, 270
Lift: coachbuilders', 183
  for well, 590
Lifting crab, 135, 158
Light; and heat, 520
  effect of electric, on books, 483
  incandescent, 18
  magnesium, for photographic purposes, 549, 612
  oxyhydrogen zirconia, 168
  reflection of, law of, 286
  speed of 323
  submarine, for catching fish, 134, 158
  velocity of, 365
  zodiacal, 98
Lighting: by batteries, electric, 16, 41, 65, 204, 226
  electric, 368
  — of railway carriage, 473
Lightning: globular, 159
  Siamese temples and, 543, 567
Lighton's analysing diaphragm, 431
Lights, railway signal, 35, 84, 130
Lima half-crowns, 494
Lime: analysis of, 14
  carbonate of, solubility of, 555
Limelight, 226
Linear diameter of the planets, 556
Lining for wooden cell, 39, 86
Link: belting, 578
  movements, 260, 487
Linseed oil, vapour of, 253
Liquid: etching for steel, 304
  gelatine, 304
Liquid, specific gravity of, apparatus for determining, 262
Literature, 590, 615
Liverpool Astronomical Society's: Journal, 365
  observatory, publications of the, 61
Loans, harbour, and construction, 155
Lock facing-point, Kirby's, 394
Locks, 518
Locomotion, electric, 189
Locomotive: boiler explosions in the U.S., 172
  boilers, 132
  engine, model, 183
  goods tank, L. and N.W., 513
  model, 280
  N.E. express, 243
  repairs, 348
  Webb's compound goods tank, 539
Locomotives: 421, 541, 566, 613
  drawings of, 565
  gear for Hackworth's, 181
  G. and S.W., 17, 182
  G.E., 279, 469
  G.W., 62
  horse-power of, 135, 159
  L. and N.W. compound, 12
  L. and S.W., at Newcastle exhibition, 469
  Midland, 469
  proportions of, 68
  tank, 569
  the "Comet," 84
Logarithms: 66, 458
  five-figure versus seven-figure, 490, 509
London and N.W.: compound locomotives, 12
  goods tank, 513
  railway, brakes on, 35

Picker, fruit, 319, 345
Picture frames, affixing corner-pieces to, 184
Pinhole photographs, 512, 520, 542, 566
Pink saucers, 293
Pipeclay, 302
Pipes: lead, action of certain waters on, 144
  loss of heat from steam, 143
  patent, 549
  preserving hose, 300
Pitch: Jew's, 506
  pipe, 228
  striker, 313, 372, 414, 539
Pit-saw, 592
Pivoting watch, 19
Plane: cartwright's, 494
  iron, how to sharpen a, 385, 485
Planer: lathe, for five shillings, 179
  new, and surface gauge, 191
  wood-turner's hand, 200
Planetary configurations, 32, 98
Planets: computation of the linear diameters of, 531, 556
  conjunction of the, 78
Plants, philosophy of watering outdoor, 455, 489, 512
Plates: amalgamating battery, 616
  for transparencies, improved, 380
Plating: nickel, 143
  carbon, 616
Platinising: metals, cheap method of, 112
Platinum: in filings, 135, 200
  test for, 568, 590
  wires, heating of, 15
Plato, 34
Plumbago crucibles, 40
Plumbers, useful recipes for, 8
Pocket accumulator: 89, 109
  how to make a, 215
Pocket-knife, a codfish with a, 172
Poisonous trees, 445
Poisoning: of cats, 467, 490, 509
  white-lead, 111
Polariscope: Lighton's analysing diaphragm for, 434
  simple, for toy microscope, 337
Polish, painting on, 156
Polishing pebbles, 521, 543
Pollak's battery, 134
Polmaise system of heating buildings, 567
Poor-rate, 448
Porous pots for batteries, 264
Portable: dark tents, 144
  engine, 63
Posidonius, 241
Post-office battery, 278, 309, 373
Potash: antimoniate of, 228
  oxalate, 495, 519
  permanganate as a staining medium for micro. objects, 346
  pure carbonate of, 591
Potatoes, frying brown, 184
Potential, static and, 15
Power: for flour-mills, 497
  of engine, 111, 134, 157, 158
  of a telescope, 314, 347
  transmission of, at Manchester Exhibition, 336
  water, 229, 253
Predictions, earthquake, 31, 78, 90
Preserving leather, 496
Press, hydraulic, 451
Pressure: centre of, 16, 38
  gauge, 109, 157, 181
Pressures are dynamic effects, 128, 225
Primary batteries: 154, 175, 196, 220, 226, 292, 347, 461, 486, 606
  and charging accumulators from them, 128, 153, 247
Primula culture, 446
Printing: gold, 376, 491
  plates, zincography and zinco, 192
  press, reproducing photos in the, 164
Prints: blue, Prof. Cleave's method of making large, 483
  toning, 471
Problem, Watson's, 134
"Problem," the L. and N.W. loco., 615
Producer gas, 616
Projectiles, 135
Promissory notes, 184, 230
Pronunciation of the Irish gh, 400, 422
Propeller: pitch of, 325
  screws, Trouvé's method of constructing, 7
  Vogelsang, 486
  Yarrow's guide-blade screw, 142
Propelling steamships: 366, 394, 415, 467, 535, 560, 586, 607
  Marshall's method of, 381, 416, 441, 514
Property, income-tax upon, 301
Prophylactics to cholera, 557
Proportions of locomotives, 63
Public libraries in the United States, 147
Pulleys: 280, 301, 325, 329, 350
  balancing fast running, 205
  speed, 206, 301, 325
Pulp, wood, 399
Pump: force, 39, 59
  new mercury, 193
  rotary, for oil, 280
  surgical suction, 606
Pumping, windmill for, 205
Pumps, 64, 184
Punch: Cushman centre, 310, 343, 370, 393
  self-centring slide, 83
Punkah, the, 270
Putty and stopping, 131
Puzzles, two, 89, 109, 133, 157
Pyrogallic acid and its uses in photography, 384
Pyrotechnics, 251

QUERY, railway, 326
Quick: drying paste, 39
  writing of notes, 16

RACING canoe, 37
Racks: method of cutting, 178
  toothed wheels and, 140
Radiation and reflectors, 83
Radius of lens, 302
Rail-joints, suspended fish-plates for, 198
Railroads, street, electricity for, 482
Railway: brakes, 98, 155, 179, 197, 272, 344, 369, 396, 417, 440, 464
  carriages, warming, 24
  collision, a remarkable, 243
  couplings, 345, 369, 417, 464, 488
  joints, 440, 487
  lubrication, 9
  query, 350, 374
  Shutt-end, 541, 588
  signal lights, 35, 84, 130, 180
  signals, 394
  — electric locking for, 36
  speeds and myths, 197, 244
  working, 589
Railways: electric and electric motors, 259
  loose joints of rails on, 180, 273, 394
Rain-water, 230, 254
Raising water an unlimited distance, 59, 129
Ram, defective hydraulic, 207, 228
Raw hides, 34
Recipes for plumbers, 8
Reeds, harmonium, 541, 565
Reflector, 494
Reflectors: observations with, 366
  radiation and, 83
Reform, road, 12
Refuse, slag, 226
Registration, 350, 374
Regulus and Sigma Orionis, 267
Repairs: vice, 229, 254
  violin, 374
Report on the working of the new Patents Act, 46
Repoussé work, finishing, 158, 182, 227, 278
Reservoir for oil, 40
Residues, battery, 164
Resistance: coils, 39, 64, 86, 108
  of wire, 65, 87
Reversing gear, 41
Reviews:
  A.B.C. Five-figure Logarithms, by C. J. Woodward, 404
  A Practical Treatise on Petroleum, by Benj. J. Crew, 139
  A Treatise upon Cable or Rope Traction as applied to the Working of Street and other Railways, by J. Bucknall Smith, 499
  Arc and Glow Lamps, by Julius Maier, 188
  Labour, Leisure, and Luxury, by Alex. Wylie, 404
  Life of Charles Darwin, by G. T. Bettany, 444
  Miscellaneous, 2, 188, 404
  On Gas-engines, by T. M. Goodeve, 2
  On the Conversion of Heat into Work, by W. Anderson, 1
  Practical Electricity, by W. E. Ayrton, 188
  Practical Handbook on Pump Construction, by P. R. Björling, 2
  The Electric Motor and its Applications, by T. C. Martin and J. Wetzler, 259
  The Mechanics of Machinery, by Alex. W. B. Kennedy, 187
  The Portable Engine, by W. D. Wansbrough, 188
  The Steam-Engine, by G. C. V. Holmes, 188
  The Storage of Electrical Energy, by Gaston Planté, 451
Rheumatism, a cure for, 268
Rhubarb, acids of, 136, 159, 255, 267
Ribbed boiler tubes, 311, 347, 419, 441
Ribs, fiddle, 352
Rifle: barrels, care of, 490
  Lacaster oval bore, 399
  Winchester repeating, 400
Ring armature, 494
Rings, Nobili's, 63
Road: pavement, a new, 575
  reform, 12
Rob, dahl, and lentils, 158
Rock-boring, tempering cast-steel jumpers for, 184
Rock-crystal spheres, 221
Rocks, testimony against the, 125
Rod, troublesome zinc, 544
Romsey observatory, 352
Roofs, painting, 325
Roses, 41, 64, 277, 316
Rosewood, imitation, 257
Rowland's water battery, 89
Rubber: cement for, 352
  fabrics, colouring, 261
Rupture truss, 128, 279
Russian kites, 74
Ryder's automatic microtome, 213

SACCHARINE and its uses, 574
Saddle, safety, 166, 301, 349, 368
Safes, 89, 109
Safety: bicycles, rear-driving, 66, 87, 299
  saddle, 166, 301, 349, 368
Salad dressing, delicious, 563
Salol, 97
Salt: as food, 444
  bed, remarkable, 53
  should we eat? 310, 367, 419, 468, 489, 513, 563, 566, 608
Saltaire, lathe at, 275
Salvers, cleaning Indian brass, 66
Sand figures, 16
Sanitary: aspect of trees, 168
  beverages, tea and coffee as, 562
Sanitary: science, 30
Santonine, 447
Saponification of fixed oils, 241
Sardines, 585
Sash-cord, metallic, 154
Satellites of Jupiter, 195
Saturn: 10, 33, 61, 79, 97, 123, 149, 174, 341
  as seen through 8¼ equatoreal, 34
  outer ring and shadow of, 173
  satellite of, 10, 33
Saw: electric, 323
  frame, hack, 230
  kinks, some circular, 432
  pit, 592
  star hack, 153
Saw table, amateurs, 150
Saws, brazing band, 376
Scalds and burns: 561
  soda in case of, 612
Scales: in drawing offices, 131, 316
  organ, 63
Schanschieff's salt of mercury solution for batteries, 134
Schott and Co.'s optical glass, 249
Science: and Art exams., 88
  and metaphysics, 59
  and the supernatural, 248, 268
  Jubilee, 276
  of the tea-kettle, 580
  sanitary, 30
SCIENTIFIC NEWS, 9, 30, 54, 77, 97, 122, 148, 171, 194, 218, 240, 266, 289, 313, 340, 364, 388, 411, 435, 457, 483, 508, 530, 555, 582, 603
Scientific Societies:
  Liverpool Astronomical, 76, 171, 265, 507
  Royal Astronomical, 53, 147, 265, 363
  Royal Meteorological, 75, 193, 289, 387
  Royal Microscopical, 75, 217, 288, 387
  Western Microscopical Club, 148, 364
Scorpii, 412
Scorpions, 540
Scraps from my workshop, 152, 200, 244, 292, 372, 397, 415
Screen, kaleidoscopic pictures on, 157
Screens, folding, 229, 254
Screw: 591
  centre, chuck, 239
  cutting, 246
  propeller, Yarrow's guide-blade, 142
  tangent, and wormwheel, 165
  taps, 66
  thread, an international, 211, 605
  — cutting, 519
Screw-chasing arrangement for a foot-lathe, 115, 198
Screw-cutting: 301
  apparatus, Niblett's new, 23, 45, 66, 105, 130, 178, 223, 245, 317, 343
Screw-down taps, 617
Screw: gear, 317, 393
  lathe, 180
Screwing: apparatus, Wenham's, 152, 177, 223, 293
  device, "Silke's," 318
Screws: chasing, 245
  Murchey's improved taps for cutting, 335
  propeller, Trouve's method of constructing, 7
  steel, 135
Sea: loss of life at, 270
  telephony, Edison's experiments in, 121
Secondary: battery, 301
  cell, 39
Sections, new method of fixing, 263
Seismographic apparatus, 96
Selenographical, 79
Sensitised paper, 304
Sensory circles, minima visibilia and, 28, 51
September, astronomical notes for, 596
Set screw, safety, for collars and pulleys, 238
Settle's electric safety lamp, 285
Sewing-machine: 181, 204
  electric motor for, 38
Sextant and its uses, 200, 219, 224, 242, 276, 292, 346
Shaping machine, Seller's tool-grinding and, 579
Sharpening twist-drills, 85
Sheepskin, to cure with the wool on, 112
Shellac: stonemason's, 15
  varnish, white, 253
Shelters, portable bicycle and tricycle, 334
Shingle house at the American exhibition, 478
Ships, fires in, 183
Shirt buttons, 107
Shop arrangements, 117
Short sight, 250, 271
Shrinkage of castings, 179
Shunter's puzzle, 439
Shutt-end railway, 541, 588
Siamese temples and lightning, 543, 567
Sidney's Arcadia, 226
Siemens: armature, 520
  bathometer, 273
Sight, short, 250, 271
Sight-feed lubricators, 352
Signal: arms, Davis's interlocking for, 398
  lights, railway, 35, 84, 298, 469
  returns, railway, 563
Signalling, train, apparatus, 121
Signals, electric, locking for, 36
Silica: and alumina, 90
  in fluor spa, 160, 184, 200
Silicon, gaseous, 89
Silk: mildew in, 206
  properties of, 602
  underclothing, 255, 280
Silver: cell 15
  cleaning filigree, 494
  film of Newtonians, 58
Silver: inlaying iron with, 352
  nitrate of, stains, 160, 173, 184
Silvering: glass, 471
  without battery, 448
Singing flames, 205
Siphon for fountain, 160, 184
Size of accumulator, 616
Sketching, lunar, 278
Skin, iguana, 224
Slag: refuse, 226
  utilisation of, 157, 227
Sleepers, longitudinal and across, 440
Slide: punch, self-centring, 83
  sections to the, new method of fix 263
Slide-rest, back-lash in, 65
Slide-valve: 422, 470, 493
  diagram, Zeuner's, 520
Sluice gate, 251, 278, 298
Smelting: 566
  iron, 14
Smith's: apparatus for grinding tw drills, 309
  work, 3
  — and miner's tools, 493, 518, 542
Smoke abatement and gas as fuel, 2
Smoking, 376
Snake-bites and their remedies, 437, 460
Soda: acetate of, warmers, 85
  ash and bleaching powder, 255
  in cases of scalds and burning, 612
Softening: cast-iron, 86
  leather, 520
Solder: fusible, 298
  silver, 400
Soldering: 249, 298, 322
  fluid, 111
  lamp, 66, 109
  lead seams, 288
Soles, lemon, 66, 78, 87
Solidified oil, 326
Solids, apparatus for obtaining the densi of, 121
Solution: for batteries, 543
  for coating oil tanks, 230
  neutral, 542
Solutions, sugar, 300
Soundpost, violin, 520, 543
Sour yeast, 326
Southern comet, great, 174
Spark coils, 256
Sparrows, 251
Specific gravity: 219, 228, 262
  of spirits, 63, 219
Spectroscope, a simple photographic, 5
Spectroscopy, stellar, 314
Spectrum: analysis, 420
  experiments with the, 527
  of lightning, 604
Speed: of light, 323
  of vessels, 617
  pulley, 206
Speeding-up of lathe, 111
Speeds, railway, 197, 244
Spheres, manufacture of crystal, 153, 2
Spill machines, 12
Spindle, drilling plain horizontal, 39
Spiral wheels, 255, 300
Spirit: blowpipes, 180
  lamp, 38, 64
Spirits, specific gravity of, 63
Spiritualism, the Seybert commission o 453, 509, 536, 556, 584
Spokes, loose, 498
Sponges, cleaning, 38
Sprained ankle, 469
Spring of beam, 16, 38
Springs: 448, 494
  door, 229
  repairing sofa, 520
Squabble, great telescope and a small, 1
Squaring: and levelling, combinati tool for, 215
  holes, 351
Stafford-Eaves' dynamo, 137
Stages, microscope, 134, 157
Stamping sheet metal, 589
Stand, an adjustable camera, 382
Standard mandrel, 199
Stanley's patent artist's clinometer, 26
Star: (D. M., 1, 169), 241
  discs, diameters of, 31
  drift in Pegasus and Aquarius, 175
  double near Castor, 78, 87
  hack-saw, 153
  missing, 61, 97
Star-finder, 291
Stars: double, 436
  in daylight, visibility of, 314, 316, 412, 436, 458, 558, 583
  near 45 Geminorum, proper motion 61
  observing double by daylight, 149, 2
  visible from well, 62, 173, 219, 241, 389
Static and potential, 15
Statistics, library, 225
Statuary, rebronzing, 251
Statues, colouring, 15
Steam: 160, 206, 207, 228, 251, 376, 445, 469, 568, 590, 616
  and the valve, 183
  aqueous vapour and, 220, 250
  boilers, water-level indicator for, 26
  force of outlet, 376, 393
  high pressure for heating purposes,
  launch engines, 400
  pipes, loss of heat from, 143
  raising, Fletcher's improvements in,
  superheated, 181
Steam-engine: compound, 422
  economies, 432
Steamer, Fulton's first, 81
Steamships, propelling, 366, 394, 415, 467, 514, 536, 607
Steam-tight joints, 587, 605
Stearine, refining, 327

iron, browning, 218
r, 592
arnish for, 376
d for welding, 5
g and tempering of, 163, 200,

, Institute, 308
ed wrought-iron, 590, 615
, 89
g, 616
hard, 135
and rods of hard, 152
sheet, 589
tempering of, 106
npering, 230
rallax, photographic measure-
f, 267
termination of, 556
phy, 31, 33
opy, 314
on glass, 87, 108
raph, the, 53, 120
l, 591
and its applications, 383, 407,

aishing walking, 230
92
, 251, 278
n's shellac, 15
riting and, 38
drains, 303
putty and, 131

atteries, durability of, 504
Frankland's, 193
278
ng, engineer's, 470
airing cracks in, 14
ing wire, 15, 62
laze in teapot, 323
lopes for bottles, 41
1, 62
, electricity for, 482
atent brake-holder, 121
ch, 343, 372, 414
olin, 180
f Arachnoidiscus Ehrenbergii,

vision, 341, 389, 412, 557
ic pen, ink for, 66, 78
: boat, Nordenfelt, 312
catching fish, 134
st, geology of the, 267
2
514
, 300
acid bulbs, 323, 373
of earth, daylight, and, 10, 31
of, 592
f Aug. 19, 31, 40, 173, 605
moon and, simultaneously, 365
f, conservation of, 32, 80
till, commanding, 371
18, 541, 566, 589, 613
al, 133
large 372, 413
bé on, 267
ral: darkness, 201, 219, 224, 272
nd the, 248, 268
echanical, 38, 64
easurement of, 183, 251
lamp, battery for, 230
494
pump, 606
chain, 123, 134
monium, 569
lephone, 356
ephone, 37, 183
exposure, 329

: amateur saw, 150
circular saws, 105
ornamental, 111
0
107
alvanometer, 65, 108, 374
motives, 539, 569
gas, 398
asuring taper, 445
for coating oil, 230
oden chuck, 516
, Indian remedy for, 530
rchey's improved, for cutting
, 335

wn, 617
ent, 521, 543
s, 280, 301, 325, 520
coffee as sanitary beverages, 562
nd cocoa, the influence of on
ion, 238
the science of the, 580
ainer, glaze in, 323
season's, 442, 490
analysis, simple exercises in, 47,
0, 573
n, 442, 460, 485, 509, 512, 532
erica, 372
e in photography, 580
on and the Science and Art de-
nt, 577
on bill, 504, 577
considered as a part of a com-
nd generous education, 552, 575
: jubilee of the, 233

: 159
159, 182, 280, 300
to, 422, 446, 469
48
al, 41

Telephone: microphone coil and, 279, 325
  new Herz, 205, 345
  on the theory of the, 337
  Phelps's improved, 575
  switch, 37, 183, 543
  the Swinton, 356
  willow wood for, 157
Telephonic, 204, 613
Telephony, duplex, 139
Telescope: 229, 412
  dioptric, 267
  eyepieces, 40
  how to adjust equatoreally by daylight, 371, 397
  o.g.'s, 42
  power of, 325
Telescopes: a cheap steadying rod and garden stand for small, 413
  great, 583
  powers of, 347
Telescoping of carriages, 566
Temperature, 87
Tempering: and hardening, 163, 200, 248
  by electricity, 613
  cast steel jumpers, for rock-boring, 184
  of steel tools, new, 106
  steel tubes, 230
Tennis: court, 516
  lawn, 616
  tournament, lawn, 19
Tents: portable dark, 144
  roomy and comfortable, 243
Test, iron and steel, 592
Tests: for arsenic, 521, 543
  platinum, 568, 590
Thames, diatoms in the, 276
Theory: of machines, 5, 25, 48, 116, 140, 165, 236, 260, 332, 370, 397, 427, 461, 487, 501, 550, 572
  of periodic inundations, 248, 268
  of the telephone, 337
Therapeutics, electrical, 560
Thermo battery, 280
Thermopile and secondary batteries as a convenient means of producing electricity for medical batteries, 215
Thermopiles, 41, 108, 205, 400, 519, 591
Thermostat, Westinghouse and Moore's, 73
Thread: an international screw, 211, 605
  screw, 519
Three-legged lathe, 481
Thunder, beer affected by, 469, 509
Time-keeping in a factory, 278
Timber, decay of, 200
Tin alloy, 423
Tinman's prices, 446, 469
Tins, preserving food in, 110
Tinworks, Indian, 397
Tips, billiard cue, 229
Tobacco: culture, 99
  for nicotine, assay of, 568
  growing in England, 28
  paper, 366
  scenting, 513, 589
Tomatoes, 569, 590, 615, 617
Toning prints, 471
Tool: a good record for a turning, 214
  bar, the "Ongar," 284
  carriages, 263
  for squaring, levelling, &c., 215
  grinding and shaping machine, Seller's, 579
  milling, for turret lathes, 602
Tools: and weapons, primitive, 250
  cutting, 502
  hook, 271, 293
  how to keep in condition, 169
  in the machine shop, special, 29
  miner's, and smith-work, 493, 518, 542
  steel, tempering of, 106
  woodturning, 587
Tours in Norway, 376, 399, 443
Tracing paper, 616
Train: runs in U.S., long, 251, 299
  signalling apparatus, 121
Trains, express, 197
Tramcars, electrically propelled, 332, 396, 556
Tramway, Volk's electric, 42
Tramways: cables, 499
  electricity on, 432
Transmission of power at the Manchester Exhibition, 337
Transmitter, Blake, 17
Transmitting heat and power, comparative value of steam and hot water for, 600
Transparencies: improved plates for, 380
  varnish for, 37
Trawl nets, 520, 542
Treatment of burns, 586
Trees: from a sanitary aspect, 168, 392
  poisonous, 445
Tricycle: Centaur direct-steering, 5
  electrical, 302, 325
  enamel, 38
  shelters, portable, 334
Tricycles, 616
Trigonometry, 267, 301
Triple expansion, 545, 568
Tromp, new laboratory, 74, 123
Trouvé's method of constructing propeller screws, 7
Trumpet, Zigang's electric, 382, 589
Truss, rupture, 128, 279
Tubes: bending zinc, 520, 543
  brass boiler, 349
  conical, boring, 617
  cracking glass, 170
  ribbed boiler, 311, 347, 419, 441
  tempering steel, 230
  weight of, 135, 158

Tubing: bending brass, 134
  boring holes in gas, 422
Tumbling barrels, 567
Tuning dulcimer, 492
Turbines, 399, 421
Turkish baths, 373
Turner, the Indian, 342
Turning: chilled iron rods, 278
  granite, 184, 206, 228
  iron, 110
  organ pipe feet, 421
  ornamental wood staining and, 229
  wood boxes, 376
Turntable: microscopic,, 376
Turret: clock, 205
  lathes, milling tool for, 602
Twilight, duration of tropical, 448, 458
Twist drill apparatus, 204, 226, 251
Twist drills: 226, 317
  and screw-cutting apparatus, 40
  apparatus for making, 108, 132, 152, 158, 180
  sharpening, 35
  Smith's apparatus for grinding, 309

UNA boat, 591, 615
Uncovered wire, 65
Universal cutter, by G. Birch and Co., 318
Ursæ majoris, alpha, 10
Utilisation of slag, 227
Utilising waste ends, 254
Utility of gas in the workshop, 312

VALVE: expansion, 66, 493
  gear, 229
  gearing, 253, 325, 350
  slide, 422, 470, 493
Vapour: 37
  aqueous and steam, 220
  of linseed oil, 228
Varnish: boat, 378
  Chinese paper, 201
  for fishing-rods, 85
  for transparencies, 37
  lead in, 41
  shellac, white, 253
  to stand heat, 63
Varnishing: Cremona violins, 179
  fishing rods, 106
  incandescent lamps, 176
Velocity: of a body falling from space, 412
  of light, 365
  of rotation, critical, 422
Veneer, walnut, 204
Vertical boiler, 160, 184
Vessels: Marshall's method of propelling, 381, 467
  propulsion of, 533, 560, 566
  speed of, 617
Vesta and Uranus, 195
Viaduct, the Crumlin, 134, 157
Vibrators, harmonium, 446, 469, 491, 516, 541
Vice: machinist's, 73
  Massey's patent, 142, 196
  repairs, 229, 254
Violin: 180
  repairing, 230, 329, 374
  soundpost, 520, 543
  strings, 180
Violoncello, 323
Violins, finger board of, 376
Visibility of stars in daylight, 314, 365, 366, 436, 558, 583
Vogel's isochromatic emulsion plates, 7
Voightländer lenses, old, 393, 438
Volk's electric tramway, 42
Volt and ammeter, 112
Voltaic cells, new, 612
Voltmeters, ammeters and, 13, 14, 33, 34
Vortices, experiments with artificial, 236

WALKING stick, 230
Wall-papers, arsenical, 456, 513
Walnut veneer, 204
Warmers, acetate of soda, 85
Warming railway carriages, 24
Washing: boiler, iron, 566
  machines, driving, 254
Wasp's nest, 592
Watch: faulty, 541
  irregularity of, 205
  jobbing, 18, 38
  pivoting, 19
  setting lever in beat, 18
Watches: keyless, 319, 345, 367, 397
  magnetism in, 286
  memorandum on, 99, 131
Watchmaker's lathe, rusty, 494
Water: battery, simple form of, 29
  coal and, 17
  engine, 541
  filtration, 420, 516
  gauge glasses, 400
  hard, 65, 87, 108, 135, 543
  heating by hot, 158
  mark, 349
  power, 229, 253
  rain, 230, 254
  raising, 129
  an unlimited distance, 59, 84
  supply, 519, 567, 589
  well, 348
Water-boatmen, respiration of, 503
Watering outdoor plants, the philosophy of, 455, 489, 512
Water-level indicator for steam boilers, 261

Waterproofing: fishing lines, 112
  textile fabrics, 516
Waters, the action of certain on lead pipes, 144
Waterwheels: 111, 494
  speed of, 112
Watery comet, proving a, 583, 604
Wave motion, 399
Waves, oil for stilling, 476
Wax, stopping, 230
Way, keying permanent, 207
Weak ankles, 447
Weather: milk in hot, 545
  the moon and the, 187
Webb's: automatic air brake, 87
  compound goods tank locomotive, 539
Weeder, claw, 82
Weight; of flywheel, 323
  of iron in dynamo, 280
  of tubes, 135, 158
Weights and measures and percentages solutions, 385
Welding: hot and cold iron, 516
  Mushet's steel, 616
  steel, compound for, 5
Well: Abyssinian, 446
  lift for, 568, 590
  stars visible from, 62, 173, 241, 276, 291
Wenham's screwing apparatus, 152, 177
Western Australia, 398
Westinghouse: and Moore's improved thermostat, 73
  brake, 526
Wheatstone's bridge: 39
  new form of, 270
Wheel: cutting machine, 40, 86
  emery, 447
  gearing, 135
Wheels: cutting brass, 328, 351, 446
  mounting small emery, 158, 182, 205, 251, 278
  spirals, 255, 300
  without flanges, 326, 350, 372, 420
Whiskey distilling, 63, 494, 516, 518, 541, 589, 613
Whistles, 157, 205
White: metal, filling brasses with, 542
  shellac varnish, 253
Wimshurst machine: 327
  how to make a powerful, 396
  plates for, 175, 271
  with double sectors, 102, 126, 156
Winchester repeater, 410
Wind gauge, 102
Windmill for pumping, 205
Windmills, horizontal, 11, 57, 62
Winged ants, 592
Wire: for galvanometer coils, 40
  resistance of, 65, 87
  running, 588
  straightening, 15, 62, 106
Wires: carrying capacity of, 306
  heating of platinum, 15
  on dynamo, amount of, 418
  safe working current of, 135
Witter's improved bevel, 143
Wood: boring, 302, 325
  boxes, turning, 376
  centres for soft, 319, 338, 345, 372
  dyeing, 418
  hook-tools for turning and carving, 293
  pulp, 399
  turning, ornamental, 229, 253
  — tools, 587
Wooden: cell, lining for, 39, 86
  chuck, 516
  pendulum, 183, 205, 228, 251, 299
  platters, 375
Woodturner's hand-planer, 200, 302
Woodturning job, 456, 482, 526, 553
Woodward's spongy lead battery, 109, 133, 182
Woodwork, high art in, 81
Work: a good day's, 396
  finishing repoussé, 158, 182, 227, 278
  how to do blacksmith's, 362, 414, 464, 486, 563
  miners' tools and smiths', 493, 518
Working-man's bicycle, 181
Workmen, Eastern, 414
Workshop: amateur, 3, 26, 117
  knife, 242
  scraps, 152, 200, 244, 292, 372, 397, 415
  utility of gas in, 312, 345
Writing: and stooping, 38
  on glass, diamond ink for, 193

YACHT: a 28-knot Herreshoff, 556
  building, fifty years of, 142
Yachts, fast sailing, 617
Yarrow's guide-blade screw-propeller, 142
Yeast: deterioration, some of the causes, 529
  German, 568
  sour, 326
Yellow lacquer, 519

ZEUNER'S slide-valve diagram, 543
Zigang's electric trumpet, 382, 589
Zinc: casting, 89
  rod, troublesome, 544, 567
  tubes, bending, 520, 543
Zincs: for Bunsen cell, unamalgamated, 398, 491
  foul, 326, 445, 469, 491
  Leclanché, 471
Zincography and zinc printing plates, 192
Zoetrope, 349

ILLUSTRATIONS.

LATOR: Montaud, the,

hones, 256, 300
roscopical, 93, 331, 379, 427,

, 250
50
ic burglar, 542
motions of stars of Ursæ
nd, 124
metry, 252
urrents, phenomena of, 505
kshop, 4, 27, 118
table, 150
lectrical instrument making
9, 550, 596
ctric lighting for, 610
hibition, shingle house at,

de lathe, 296

rcles in technical, 380
for illustrating Foucault's
599
edding, 455
otographic, 455
ic and photo-micrographic,

ic, 96
226
us Ehrenbergii, 101
, and comites, 80
mens, 92, 134
minated, 298

es, 34
, aqueous distributor, &c.,

AR for foot-lathes, simple,

nose and collar of, 177
r, joining, 351
ust tumbling, 359
c, 36
nch, 225
Siemens's, 273
struction of, some forms of
606
ens and Halske, 373
aniell, 435
for lathe, 296
ectric indicating, 430

, electric, 399, 616
telephone, 422
578
136
r's improved, 143
taur Ranger safety, 5
ng, 393
rtable, 334
rsal cutter, 318
g, two, 487
32
374
work, how to do, 414
, 134
patent vertical multitubular,

ed, 311

valid's, 366
barrel, 63
without slide-rest, 343
ryden's, 166
lan of, 299

Boss electric indicating bell, 430
Bow latch, Lacey's improved, 323
Box, improved letter, 30
Bracket, cheap and handy, 319
Bradley's improved floor jack, 482
Brake, vacuum, ejector, 350
Brake-stops, diagram of, 298
Brakes and indicators, 501
Brake-holder, Striffler's patent, 121
Breaker, contact, 252
Bridge, new form of Wheatstone, 220
Built-up files, 8
burglar alarm, electric, 542
Butterflies, setting, 64
Brass castings, finishing, 472

CALCULUS, the, 106
Calipers, improved, 359
Call-bell to acoustic telephone, 422, 469
Camera: handy, 127
  shutter, improved, 359
  stand, an adjustable, 382
Cams: edge, 25
  grooved, face, and box, 48
Canvas tent, roomy, 243
Carpentry, joints used in, 357, 415
Carriage: boat, 134
  tool, 263
Cassiopeiæ, new variable near V, 61
Castings, finishing brass, 472
Cell puzzle, 133
Centaur Ranger bicycle and direct-steering tricycle, 5
Centre: grinder, friction-driven, 382
  punch, Cushman, 310
Centres for soft wood, 319, 338
Centring bits, two, 487
Chasers, self-leading hand, 564
Chasing screws, 246, 511
Chuck: bell, 199
  corrugated, 178
  Essex, 245, 296
  fitting to lathe, 83
  geometric, 13
  pattern-maker's, 52
  screw-centre, 239
Chucks: split, 342
  tiny, 294
  useful, 318, 343
Clamond's improvements in the transformation of heat into electricity, 430
Clapham's star-finder, 291
Claw weeder, 82
Cleomedes, 79
Clinometer, Stanley's artists', 262
Clock pendulum, 304
Clockwork arrangement, 424
Coachbuilder's lift, 182
Coil: induction, 204, 253
  medical, 351
Coils, resistance, 86, 559
Comet, the locomotive, 84
Comets, relation between meteors and, 316
Commutator, automatic, for incandescent lamps, 362
Compound goods locomotive, 539
Compress pad, 226
Condenser: for coil, 254
  Morton's ejector, 86
Connections, electrical, 421
Contact breaker, 252
Corrugated chuck, 178
Counterbalancing lathe flywheel, 318
Couplings, railway, "Silke's," 322
Crab, 86
Cranes, 550

Crank: and flywheel, 5
  throw for 5in. lathe, 329
Cream separator, 184, 206
Cross arms of planing machine, 222
Cupboard, drying, 87
Currents: induced, 228
  phenomena of alternating, 505
Curvature of a lens, finding the, 458
Cushman centre punch, 310
Cutter: Birch's universal, 318
  for teeth of pinions, 392
Cutters for lathe, circular, 5 0
Cutting: frame, Webb's, 177
  grapes, device for, 271, 319
  grooves, 130
  screws, 105, 223, 246
  tools, 502

DAGGERS, Eastern swords and, 391
Daniell battery, standard, 435
Dark-room, holiday, 607
Declination, 32
Density of solids, apparatus for obtaining the, 121
Detector galvanometer, 206
Device: for cutting grapes, 271
  screw-chasing, 510
Dhao, the, 371
Diagram: of brake stops, 298
  slide-valve, 184, 521
Diaphragm for polariscope. Lighton's analysing, 485
Die makers, to, 256
Diffraction, ancient and modern, 331, 379, 427, 475, 547
Dividing: and engraving machine, 48
  apparatus for the lathe, 60
  appliance for shaping and milling machines, 73
Drill: another good, 82
  good hand, 201, 295
  Newall's improved machine, 262
Drilling: and cutting frame combined, vertical, 246
  bicycle hubs, 393
Drills and bits, 82
Dry objects, quick method of mounting, 311
Dryden's boring machine, 166
Drying cupboard, 87
Dulcimer tuning, 492
Duplex burner feed wick, 204
Dynamo: eighty c.p., 279
  hundred c.p., 350
  portable hand, 176
Dynamos, 518

EASTERN: saw, 414
  swords and daggers, 391
  tools, 414
Eclipses, occultations and, 101
Edge cams, 25
Edmunds lathe mandrel, 104, 151, 275, 439, 466
Ejector: condenser, Morton's, 86
  vacuum brake, 350
Electric: bath, 36
  bell connections, 399, 616
  burglar alarm, 542
  clock for factory, 183, 251
  experiments, original, 486
  indicating bell, Boss, 430
  lighting for amateurs, practical, 610
  lock, 229
  motor for sewing-machine, 38
  motors, 91
  safety-lamp, Settle's, 286

Electric: seismometer. 481
  trumpet, Zigang's, 383
Electrical: connections, 421
  constant temperature apparatus, 581
  instrument making for amateurs, 48 429, 550, 596
  measuring instruments, 462. 534, 559
Electricity: gas-lighting by. 212
  transformation of heat into, Clamond's improvements in, 431
Electromotor, 516
Emery wheels, mounting small, 158
Engine, Seal's hot-air, 225, 270
ENGLISH MECHANIC lathe, 13
Engraving and dividing machine, 48
Eos's rupture truss, 129, 279
Equatoreal: stand, 422
  star finder, 291
Escapement, an old, 242
Essex chuck, 245, 296
Experiments, original electric, 486
Express locomotive, N.E., 243
Eyepieces, 539

FACTORY, electric clock for, 183, 251
Family oven, 38
Feed-wick, duplex burner, 204
File. Muller's patent, 35
Files, built-up, 8
Five-shilling lathe-planer, 179
Fleuss freezing machine, 454
Flint's punching machine for gas-pipes, 335
Floor jack, Bradley's improved, ·82
Flywheel: crank and, 5
  lathe, counterbalancing, 318
Focal distances of photo. lenses, 300
Foucault's currents, apparatus for illustrating, 599
Franklin's plates, 596
Freezing machine, Fleuss, 454
French bath heater, 225
Fruit picker, 271, 319
Fulminating panes, 596

G. and S.W. locos., steam reversers on, 17
Galvanometer: detector, 206
  simple, 367
  tangent, 108
Gas-lighting by electricity, 212
Gas-pipes, Flint's punching machine for, 335
Gauge: for height of tool point, 394
  planer and surface, 191
  pressure, 109, 157
  wind, 102
Gearing, wheel, 158
Geometric chuck, 13
Geometry, algebraic, 252
Gimlets, Norwegian, 273
Girder, bent, 136
Grapes, device for cutting, 271, 319
Grinding twist-drills, Smith's apparatus for, 309
Grooves, cutting, 130
Gun-barrel boring, 63

HAND: chasers, self-leading, 564
  dynamo, portable, 176
Hand-drill, a good, 201, 295
Handy switch, 295
Head, 5in. lathe, Newall's, 223
Heat: conductivity of metals, 287
  Immisch's apparatus for measuring, 476

Heat: transformation of into electricity, 431
Heater, French bath, 225
Heliostat, the, 412
Hercules, 61, 125, 437
Hercules, Atlas and, 34
Hook tools, 271
Horizontal: sundial, 133
  windmill, two-sail, 57
Hot-air: engine, 270
  — Seal's, 225
  oven, 67
House, shingle, at the American exhibition, 479
Hubs of bicycles, drilling, 393
Hydraulics, 569
Hydrophone, the, 215
Hygrometer, simple, 35, 106

IMBEDDING apparatus, new paraffin, 455
Immisch's "apparatus for measuring heat," 476
Incubator, thermostat for, 206
Indian kites, 154
Indicator, water-level, for boilers, 261
Indicators, brakes and, 501
Induced currents, 228
Induction: coil, 204
  spark, 253
Invalid's book-rest, 366

JACK, floor, Bradley's improved, 482
Joints used in carpentry, 357, 415

KEY bedding appliance, 415
King's Cliffe, tools used at, 271
King's safety saddle, 166, 301, 349
Kirby's point lock, 395
Kite, musical, 75
Kites: Indian, 154
  Russian, 74
Knife, workshop, 242

LABORATORY tromp, new, 74
Laminated armatures, 298
Lamps, incandescent, automatic commutator for, 363
Lantern slide, novel, 554
Latch: Lacey's improved bow, 323
  safety saddle, 349
Lathe: American-made, 295
  attachment, 296
  Ballon, nose and collar of, 177
  bayonet joint for, 296
  boring in the, without slide-rest, 343
  circular saws, table for, 105
  cutters, circular, for, 590
  cutting frame, 177
  dividing apparatus for the, 60
  ENGLISH MECHANIC, 13
  fitting chucks to, 83
  flywheel, counterbalancing, 318
  head, Newall's 5in., 223
  length of throw for 5in., 329
  mandrel, 342
  mandrel, Edmunds', 104, 151, 275, 439, 466
  planer, the five-shilling, 179
  screw-chasing arrangement for foot, 115
  screwing apparatus, 105, 223
Lathes: simple back-gear for foot, 410
  three-legged, 482
  turret, milling tool for, 602
Leather bands, joining, 351
Lens, finding the curvature of a, 458
Lenses: focal distance of photo., 300
  old Voightländer, 438
Letter-box, improved, 30
Levelling, combination tool for squaring, &c., 215
Leverage, 326, 377
Life at sea, loss of, 270
Lift, coachbuilder's, 182
Light, law of reflection of, apparatus for illustrating, 286
Lighton's analysing diagram for polariscope, 435
Limelight, arrangement for, 226
Link: belting, 578
  movements, 260, 487
Liquids, apparatus for determining specific gravity of, 262
Lock: electric, 229
  for railway points, Kirby's, 395
Locomotives: Comet, 84
  M.S. and L. new express, 464
  Midland 30 class, 155
  N.E. express, 243
  Webb's compound goods, 539
Lubricating oils, testing, 380

MACHINE: boring, Dryden's, 166
  drill, Newall's improved, 262
  Fleuss freezing, 454
  for engraving and dividing, 48
  milling, the, 554
  new milling, 73
  planing, cross arms of "J. K. P.'s," 222
  Sellers's tool-grinding, 579
Machine: shop, special tools in, 29
  Wimshurst, with double sectors, 102, 126
  spill, 12
Machines, theory of, 5, 25, 48, 116, 140, 165, 236, 260, 333, 428, 452, 487, 501, 550
Machinists' vice, 73
Manchester, S. and L. new express locomotive, 464
Mandau of Borneo, 299
Mandrel: Edmunds' lathe, 104, 151, 275, 439, 466
  lathe, 198
  — standard, 275
Mandrels, Phillips's improved, 191
Marius, 100
Marshall's methods of propelling vessels, 382, 467
Massey's patent vice, 143
Measuring instruments, electrical, 462, 534, 559
Mechanical support, 64
Mechanics, 472*
Medical coil, 204, 351
Mercury: pump, new, 193
  purification of, 397
Metals, heat conductivity of, 287
Meteors and comets, relation between, 316
Microphone, coil, and telephone, 279, 325
Microscope: objects, mounting dry, 311
  simple polariscope for the, 337
Microscopical advances, 93, 331, 379, 427, 475, 547
Microtome, Ryder's automatic, 214
Midland engines (No. 30), 155
Milling: machine, construction and uses of, 554
  — new, 73
  tool, for turret lathes, 602
Millwork, 333
Mitres, varying, 167, 247
Montaud accumulator, the, 169
Morton's ejector condenser, 86
Motors, electric, 91
Mounting dry objects, 311
Movement wanted, 377
Müller's patent file, 35
Murchey's improved taps for cutting screws, 335
Musical kite, 75

NEBULÆ, notes on, 595
Net, trawl, 496, 542
Newall's: 5in. lathe-head, 223
  improved machine drill, 262
Newtonians, silver film of, 58
Niagara, retrogression of, 538
Niblett's new screw-cutting apparatus: 23, 45, 105, 178
  and screwology, 294
Nori patent vertical multitubular boiler, 120
North-Eastern express locomotive, 243
Norwegian gimlets, 273
Notes on Nebulæ, 595

OCCULTATIONS and eclipses, 101
Odontograph, a new, 526
Oils, lubricating, 380
Ongar tool-bar, 284
Orienting objects in paraffin, 167
Oven: family, 38
  hot-air, 87

PAD, compress, 226
Paraffin: imbedding apparatus, new, 455
  orienting objects in, 167
Pattern-maker's chuck, 52
Pendulum, clock, 304
Perron's photographic apparatus, 455
Phelps's improved telephone, 575
Phenomena of alternating currents, 505
Phillips's improved mandrels, 191
Photographic: apparatus, Perron's, 453
  and photo-micrographic apparatus, 503
Picker, fruit, 319
Pipe, pitch, 228
Pitch: pipe, 228
  striker, 415
Planer: and surface gauge, new, 191
  lathe, the five-shilling, 179
  woodturner's hand, 201
Planing machine, cross-arms of "J.K.P.'s," 222
Pocket accumulators, 110
Points, Kirby's lock for railway, 395
Polariscope: for the microscope, simple, 337
  Lighton's analysing diaphragm for, 435
Portable hand dynamo, 176
Posidonius, 242
Pressure gauge, 109, 157
Primary batteries, construction of some forms of, 606
Propeller: screws, new method of constructing, 7
  Yarrow's guide-blade screw, 142
Propelling vessels, Marshall's method of, 382, 467, 514
Propulsion of vessels, 514, 535, 607
Pump: new mercury, 193
  surgical suction, 606
Punch: Cushman centre, 310
  self-centring slide, 83, 130
Punching machine for gas-pipes, Flint's, 335
Punkah lines, 270
Puzzle: cell, 133
  shunter's, 439

RACKS, toothed wheels and, 140
Railway couplings, "Silke's," 322
Rain-water, cleaning, 230, 254, 565
Reflecting telescope, silver film of, 58
Reflection of light, law of, apparatus for illustrating the, 286
Refrigerator, air, 390
Retrogression of Niagara, 538
Reversers, steam, on G. and S.W. locos., 17
Ribbed boiler tubes, 311
Riffler, Wenham's, 293
Roberts's rainwater cleaner, 230
Ropes, wire-covered, for punkahs, 270
Running wire, 588
Rupture truss, "Eos's," 129, 279
Russian kites, 74
Ryder's automatic microtome, 214

SADDLE: King's safety, 166, 301, 349
  safety, 349
Safety: lamp, Settle's electric, 286
  saddle, the, 166, 301, 349
  set-screw, 238
Saturn, 34, 79, 174
Saw: Eastern, 414
  table, amateur's, 150
Saws, circular, table for lathe, 105
Screens, folding, 254
Screw, Yarrow's guide-blade propeller, 142
Screw-centre chuck, 239
Screw-chasing arrangement on an ordinary foot-lathe, 115, 198
Screw-cutting apparatus, Niblett's new, 23, 45, 105, 178
Screwing apparatus, lathe, 105, 223
Screwology and Niblett's screwing apparatus, 294
Screws: chasing, 246
  new method of constructing propeller, 7
  taps for cutting, Murchey's, 335
Sea, loss of life at, 270
Seal's hot-air engine, 225
Seismographic apparatus, 96
Seismometer, electric, 481
Sellers's tool-grinding and shaping machine, 579
Separator, cream, 184, 206
Set screw, safety, 238
Settle's electric safety-lamp, 286
Sextant and its uses, 200, 219, 242
Sewing-machine, electric motor for, 38
Shelters, portable bicycle and tricycle, 334
Shingle house at American exhibition, 479
Ships, air-bags for, 270
Shunter's puzzle, 439
Shutter, improved camera, 359
Siding, 522
Siemens: armature, 92, 134
  bathometer, 278
Silke's railway couplings, 322
Silver film of Newtonians, 58
Slide: lantern, novel, 554
  punch, self-centring, 83, 130
Slide-rest, boring without a, 343
Slide-valve diagram, 183, 521
Smith, G. P. apparatus for grinding twist-drills, 309
Smith's work, 4
Solids, apparatus for obtaining the density of, 121
Specific gravity of liquids, apparatus for determining, 262
Spectrum, experiments with the, 527
Spill machines, 12
Split chucks, 342
Squaring, levelling, &c., combination tool for, 215
Stand: adjustable camera, 382
  equatoreal, 422
  for telescopes, steadying rod and, 414
Stanley's artist's clinometer, 262
Star: finder, equatoreal, 291
  new variable near V Cassiopeiæ, 61
Starting gear for compound locomotives, Worsdell's patent, 614
Steam reversers on G. and S.W. locos., 17
Steamships, propulsion of, 514, 535, 607
Stereoscope and its applications, 383, 407, 433
Straightening wire, 15
Striffler's patent brake-holder, 121
Sun, commanding it to stay still, 371
Sundial: cruciform, 518
  horizontal, 133
Sunspot, a large, 413
Support, mechanical, 64
Surgical suction pump, 606
Swinton telephone, the, 356
Switch: handy, 295
  telephone, 38, 183
Swords and daggers, Eastern, 391

TABLE: for lathe circular saws, 105
  saw, amateur's, 150
Tangent: galvanometer, 108
  screw and worm wheel, 165
Taps for cutting screws, Murchey's improved, 335
Telephone: arrangement, 329
  call-bell for acoustic, 422, 469
  circuits, 137
  microphone, coil, and, 279, 325
  Phelps's improved, 575
  switch, 38, 183
  the Swinton, 356
Telephones, acoustic, 256, 300
Telescopes, steadying rod and garden stand for, 414
Temperature apparatus, constant, electrical, 581
Tent, roomy and comfortable, 243
Theory of machines, 5, 25, 48, 116, 140, 165, 236, 260, 333, 428, 452, 487, 501, 550
Thermopiles, 108, 429
Thermostat: for incubator, 206
  Westinghouse and Moore's improved, 73
Three-legged lathes, 482
Tiny chucks, 294
Tool: carriage, 243
  combination for squaring, levelling, &c., 215
Tool-bar, the "Ongar," 284
Tool-grinding and shaping machine, Sellers's, 579
Tools: and weapons, primitive, 250
  cutting, 502
  hook, 271
  special, in machine shop, 29
Toothed wheels and racks, 140
Trawl net, 496, 542
Tricycle, Centaur direct-steering, 5
Trigonometry, 256
Tromp, new laboratory, 74
Trumpet, Zigang's electric, 383
Truss, "Eos's" rupture, 129, 279
Tubes, ribbed boiler, 311
Tumbling barrels, exhaust, 359
Turning, wood centres for, 319, 338
Turret-lathes, milling tool for, 602
Twist drill, 226
Twist-drills, Smith's apparatus for grinding, 309

UNIVERSAL cutter, Birch's, 318
Uranus and Vesta, paths of, 195
Ursæ majoris, proper motions of some stars of, 121

VACUUM ejector for brake, 350
Valve-gear, 618
Variable star near V Cassiopeiæ, new, 61
Varying mitres, 167, 247
Vertical cutting and drilling frame combined, 246
Vessels: Marshall's method of propelling, 382, 467
  propulsion of, 535
Vesta and Uranus, paths of, 195
Vice: machinist's, 73
  Massey's patent, 143
Voightländer lenses, old, 438

WARGENTIN, 366
Water: cleaning rain, 230, 254, 565
  power, 208
Water-level indicator for boilers, 261
Weapons, primitive tools and, 250
Webb's: compound goods locomotive, 539
  cutting frame, 177
Weeder, the claw, 82
Wenham's riffler, 293
Westinghouse and Moore's improved thermostat, 73
Wheatstone bridge, new form of, 220
Wheel gearing, 158
Wheels, mounting small emery, 158
Wick, duplex burner feed, 204
Wimshurst machine with double sectors, 102, 126
Wind-gauge, 102
Windmill, horizontal, 57
Wire: running, 588
  straightening, 15
Wire-covered ropes for punkahs, 270
Witter's improved bevel, 143
Wood, centres for soft, 319, 338
Woodturner's hand-planer, 201
Workshop: amateur, 4, 27, 118
  knife, 242
Wormwheel, tangent screw and, 165
Worsdell's patent starting gear, 614

YARROW'S guide blade screw propeller, 142

ZEUNER'S slide-valve diagram, 521
Zigang's electric trumpet, 383

THE ENGLISH MECHANIC

AND WORLD OF SCIENCE.

MICROSCOPICAL ADVANCES.—XVI.

By DR. ROYSTON-PIGOTT, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians; Fell. Cambridge Phil. Society; formerly Fellow of St. Peter's College, Cambridge.

Ancient and Modern Diffraction Lines.

THE story of diffraction is too long to tell in popular articles; yet a great many could be written without the highest mathematics. I may be permitted to sketch the advance of optical knowledge as regards that most important branch—diffraction.

1640-1650.—Grimaldi, an Italian Jesuit, was the first discoverer of the phenomenon.[*] Introducing a ray of sunlight into a dark room, he observed that the shadows of all bodies were enlarged—i.e., larger than if the rays of light passed in straight lines by their edges. Round these shadows he also observed three coloured fringes, and in a very strong light he observed similar coloured fringes, varying from two to four, according to the distance of the shadow from the body. He hence concluded that light is bent or inflected from its rectilineal path in passing by the edges of bodies.[†] Dr. Hooke, in ignorance of this discovery, in 1672 communicated to the Royal Society his discovery, very similar to Grimaldi's, but much more advanced by eight conclusions. Hooke was the first to ascribe the colours of the soap-bubble to undulations. He also distinctly announced the doctrine of interferences of the waves of light—the most important discovery in optical science. Hooke virulently attacked Newton, who considered light was composed of material particles. Huyghens joined Hooke in advocating the undulatory theory as opposed to Newton's emission theory.

Dr. Young, who supported the wave theory of Hooke and Huyghens, was the first to explain diffraction. Newton had used a fine hair placed in the beam of sunlight, and accurately measured all the fringes and shadows. Fresnel[‡] now had the good fortune to explain all the phenomena of diffraction by means of the wave theory of light. Instead of viewing the shadows directly (as was done by Newton), he was able by means of a microscope to measure the dimensions of the fringes with the greatest exactness. He made the remarkable discovery that the inflection or diffraction of light "depended on the distance of the inflecting body from the aperture, or from the focus of divergence."

Contemporary with Fresnel were the refined mathematical investigations of Fraunhöfer, of Munich, who made several important observations on diffraction, especially the effects of gratings, made either of very fine wire or rulings on glass, which performed wonders in developing a grand standard solar spectrum. He succeeded in ruling these lines as close as 30,000 to the inch, but utterly despaired of ever seeing them with the microscope.[*] Nobert afterwards similarly despaired, and concealed the number of the lines ruled on the finer bands. Colonel Woodward, however, sent me beautiful photographs of these bands; but so many spurious lines occupying the margins rendered the counting precarious and unsatisfactory; in fact, diffraction lines abound. In old photos of many diatoms and other objects these lines greatly marred the beauty of the pictures. Dr. Van Heurck has paid me the courtesy of sending me four original prints of Nobert's 18th and 19th bands, retaining the original diffraction specs and a very few spurious lines. In the latest, he has marked and numbered the lines so as to exhibit exactly the number of them concealed a long time by Nobert, as the latter utterly disbelieved anyone could ever descry and count their number. There are in my possession eleven photographs of the Amphipleura pellucida. In four of these the margins have evidently been touched up to improve the sharpness of the pictures. In the other seven the margins are the original negatives, untouched up, taken with the following glasses (W. means *Woodward*):—

1. Powell and Lealand's $\frac{1}{16}$th immersion .... W.
2. Wales immersion $\frac{1}{20}$th .... W.
3. Zeiss' Apochromatic $\frac{1}{13}$th, *Van Heurck*
4. Do. Do. Do.
5. Do. Do. Do.
6. Do. Do. Do.
7. Do. Do. Do.

generally taken with electric light or monochromatic solar light.

As this series is carefully examined with a Browning lens (1in. focus), the diffraction or spurious lines are fainter and fainter as the glasses are more perfect.

Yet in these seven photographs delicate traces of diffraction, either from spots on the slides or diffractions from the margins, are scarcely visible, and in many regions altogether absent. The diffracting centres in *Wales'* pictures are most clear, giving the most incontrovertible evidence that the negatives are virgin and untouched. The same may be confidently asserted of all Zeiss's effects. The projection eyepieces furnish most beautifully accurate images almost free from spurious lines of diffraction. All honour to whom honour is due. The enormous labours undertaken by Carl Zeiss and his son-in-law and partner is worthy of the highest appreciation. No doubt their liberality in placing their new optical glass at the disposal of all opticians is a sign of their far-reaching confidence, foresight, and sagacity. Powell and Lealand, our first makers, have taken it up with great success. For my part, I wish the firm of Zeiss and Co. all the success they can wish themselves.

Any glass which can diminish or reduce diffraction margins is worthy of the highest commendation. The diffraction in the new Zeiss oculars is further diminished by two stops placed between the field lenses and the objective.

(*To be continued.*)

REVIEWS.

On the Conversion of Heat into Work. By WILLIAM ANDERSON, M.INST.C.E., LONDON: Whittaker and Co.

IN this volume, which is one of the "Specialists' Series," the author has embodied the course of Howard lectures he delivered before the Society of Arts during a recent session, in which he endeavoured to explain the doctrine that in heat-engines the work performed is due to the conversion of molecular motion of heat into the visible motion, and to illustrate by numerous examples the applicability of the doctrine of Sadi Carnot to defining the limits within which improvement is possible in the economical working of heat-engines. The work contains a great deal of information, and the method adopted by the author of elucidating his investigations by means of numerical examples will, no doubt, be welcomed by many readers. In parts, the language used might have been clearer, as, for instance, where the student is told that "the weight of a body is a variable quantity, even on the earth, on account of the effect of centrifugal force due to the rotation of the earth—that is to say, a pound weight

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[*] Physico Mathesis di Lumine. (Bologna: Published in 1665, two years after his death.)

[†] Grimaldi also discovered if two pinholes were placed so nearly together that the cones of light intersected one another that a darker spot was formed than when only one hole was used, and drew the following paradoxical conclusion: "That a body actually illuminated may become more dark by adding light to that which it already receives."

[‡] He gained the physical prize of the French Academy in 1818 for a brilliant memoir on this very subject. Lord Brougham when only 18 years of age, communicated to the Royal Society in 1796 an ingenious paper on this subject, and another in 1797. His experiments were made at Cannes.

[*] Sir John Herschel, in his immortal treatise on "Light," Sir George Airy, in his magnificent mathematical tract on the "Undulatory Theory of Light," and a good many others further exhausted the subject.

VOL. XLV.—No. 1,145.

which will stretch a spring balance to one pound at the equator, will stretch it over one pound at the poles." Similarly in describing the phenomena of "interference" of waves, it seems quite unnecessary to travel into Sound, and say that in "musical instruments these minor vibrations are called harmonics or overtones," and rather misleading to assert that the "power necessary to produce the volume of sound which emanates from a large organ is not more than that which one man working the bellows can easily supply." In Chapter III. Mr. Anderson deals with the "laws" and explains the principle of Carnot, whence he proceeds to describe several methods of converting heat into work. The limit of efficiency in the combustion of fuel he puts at ·872—that is, in the most favourable conditions there must be a loss of 13 per cent., and a good steam boiler cannot evaporate more than 11·4lb. of water per pound of coal. A consideration of these facts and others leads to the conclusion that a "decided economy will arise from blowing air into boilers by engine-power, instead of drawing it in by means of a chimney." It is not to be supposed that many readers of this work will misunderstand, but there can be no reason why the matter is not placed beyond misconception by the use of the term "boiler furnaces." The Siemens regenerator and the Cowper stove naturally find a place in this volume, as does a gun, which, as Mr. Anderson says, is the simplest machine in use for the conversion of heat into work, though it cannot, according to Carnot's law, "realise more than 51 per cent. of heat developed in the combustion of powder." A good deal of attention is devoted to the question in connection with guns, and then in Chapter VI. we come to the indicator and heat-engines proper, such as the gas-engine, the hot-air engine, and compressed-air refrigerating machines—the last-named being perhaps the best of all examples for the student to study if he wishes to gain a complete grasp of the subject. The steam-boiler and the steam-engine are fully dealt with, as well as some of their accessories, and the work concludes with a description of the theory and construction of the Parson's engine or steam turbine, which Mr. Anderson thinks will probably prove to be the best and most economical of high-speed motors. On that point, however, there is something more to be said than is included in a consideration of the conversion of heat into motion; but it is in that direction we must look for greater economy than has been obtained at present. From the practical engineer's point of view Mr. Anderson's work is possibly the best that has been published, but it needs revision before it can be accepted as a perfectly satisfactory textbook, for even in the chapters devoted to the steam-engine there are statements which would not be accepted by an examiner in thermo-dynamics or by practical engineers acquainted with the principles underlying their branch of industry. There are minor details which also might be attended to with advantage. For instance, nothing is gained by saying that a No. 8 injector has a steam-jet 8 millimètres or ·32in. in diameter, especially as ·32in. is more than 8 millimètres, and the use of ′ and ″ for ft. and in. should at least be avoided in a book. It is, however, because Mr. Anderson's work is just what has been wanted that we hope to see it made as perfect as possible.

Practical Handbook on Pump Construction. By Philip R. Björling. London: E. and F. N. Spon.

Here we have a valuable little work to all interested in the construction of pumps, for the author writes from a practical experience and from a knowledge that the information he gives is not to be found in book form elsewhere. The book is dedicated by permission to Mr. Henry Davies, of Leeds, who has, it seems, looked it over, but the author modestly says that any suggested alteration which may be deemed at all beneficial to the readers will be gladly accepted and considered with a view to future editions. The pumps described are divided into vertical and horizontal—five kinds in each class, and nearly all are as fully described as any fairly intelligent workman could desire. Two chapters, entitled "Remarks on Designing Pumps" and "Materials of which Pumps should be Made, and the Class of Pumps for Different Liquids," will be of especial value; but the author follows the same method in dealing with the various classes of valves and buckets, illustrating his remarks with some neatly-executed plates. Cup leathers and air-vessels have each a section, and there are some ten pages of "rules and formulas," with examples worked out. The remaining pages are occupied with some useful hydraulic memoranda and tables, and a copious index renders the work complete. It is, in short, exactly what a "practical handbook" should be.

On Gas-Engines. By T. M. Goodeve, M.A. London: Crosby Lockwood and Co.

This is a reprint, with some additions, of the supplement to the author's "Textbook of the Steam Engine," and gives in about 60 pages a great deal of information about the gas-engine in principle and of the Otto form in particular. The designs selected for illustration are the Lenoir, the Otto and Langen, and the Otto—the latter being fully described, with diagrams showing the various parts and the positions of the valve during the cycle of operations. The lighting arrangement is also clearly explained with an illustration, and the methods of calculating the efficiency of the engines described are shown by worked examples. The little book will be useful to those who desire to understand how the gas-engine works.

We have also received *Shoring and its Application*, by George H. Blagrove (London: Crosby Lockwood and Co.), a handbook for the use of students, in which the safest methods of constructing shores for buildings are described, with the complicated cases of underpining and straightening walls. The treatise is one of Weale's series, is neatly illustrated, and treats the subject in a sound and practical way.——*Lessons in Elementary Mechanics*, by W. H. Grieve, P.S.A., late R.N. (London: Longmans), is a little work specially adapted to the requirements of the revised code, which will be found useful by teachers and instructive by pupils.——*Theory of Magnetic Measurements*, by Francis E. Nipher, A.M., (London: Whittaker and Co.), is a little work written by the professor of physics in the Washington University, primarily to assist those engaged in a magnetic survey. It will be found useful by all interested in electrical and magnetic measurements.——*The Artist's Manual of Pigments*, by H. C. Standage (London: Crosby Lockwood and Co.), is a second and revised edition of a work which may be found useful by those engaged in dealing with pigments either as dealers or users.——*The Works Manager's Handbook*, by Walter S. Hutton (London: Crosby Lockwood and Co.), is a third edition, revised, with additions, a fact which is sufficient indication of the value of the work.——*Lockwood's Builders' and Contractors' Price-Book* for 1887, edited by Francis T. W. Miller (London: Crosby Lockwood and Co.), is the annual issue of a work which for many years has been recognised as almost indispensable to all engaged in the trades connected with construction.——*Stanzas and Sonnets*, by J. Pierce, M.A. (London: Longmans), is a collection of graceful verses by a well-known chessplayer. There are, of course, several references to chess; but the author has found many themes for his muse, and in all touches the right chord.——*Celestial Motions*, by William Thynne Lynn, B.A., F.R.A.S. (London: Stanford), is the fifth edition of a work which first saw the light less than three years ago. Nothing more need be said.——*Historic Towns*, edited by E. A. Freeman and W. Hunt (London: Longmans), "Bristol," by William Hunt, and "Exeter" by Edward A. Freeman, D.C.L., LL.D., are two volumes of the excellent series issued under the direction of two able editors, who, without unduly expanding the volume, contrive to give everything of interest in connection with the historic towns above named.——*The Electrician's Directory*, with Handbook for 1887 (London: George Tucker), contains, besides the ordinary matter of a directory, biographies of some more or less distinguished electricians, &c.——*Technical Reporting*, by Thomas Allen Reed (London: F. Pitman), is a collection of phonographic abbreviations for words and phrases met with in reporting legal, scientific, and other technical subjects, which, carefully studied, should be of benefit to the reporter and indirectly to his readers.——*Tabulated Weight of Iron and other Metals*, by G. M. May (Brampton: The Author), is the second edition, revised and enlarged, of a work that cannot fail to be useful to all engaged in the metal trades, or having occasion to make calculations in connection with iron in various forms, steel, copper, brass, and lead.——*Iron Bridges*, by Hamilton Weldon Pendred (London: Crosby Lockwood and Co.), is a useful addition to Weale's series, in which the author gives the result of his professional experience in the construction and erection of iron bridges of moderate span. As a collection of facts from actual work it must be of considerable utility.

We have also to acknowledge the receipt of *A History of the Old English Letter Foundries*, by Talbot Baines Reed (London: Elliot Stock), a work of much research, which will be valued by all interested in the rise and progress of English typography; *Aluminium*, by Joseph W. Richards, A.C. (London: Sampson Low and Co.), a work in which the history, occurrence, properties, metallurgy, and application of aluminium and its alloys are treated at considerable length; *Practical Electricity*, by W. E. Ayrton, F.R.S. (London: Cassell and Co. , the best existing textbook for first-year students of electrical engineering, which will be noticed at greater length.

SMOKE ABATEMENT AND GAS AS FUEL.

At the meeting of the Society of Architects, held last week, Mr. Joseph J. Lish, of Newcastle-upon-Tyne, read a paper on smoke abatement, in which, after referring to the value of coke in avoiding the smoke nuisance, he said: Failing cheap coke for such cases, if we had a good thermal gas, charged at such a price as to equal coal-gas of 16 or 17 candle-power—say at 10d. or 1s. per thousand cubic feet, and laid on to town areas, the question of smoke abatement would be brought some steps nearer the region of "practical politics." The small power users might then, with advantage to themselves, employ gas in place of coal for steam raising and other purposes, or supersede their present steam-engines by the gas-engine, whilst numerous small trades and the householder of modest means might see some prospect of employing gas with economy, where they now use a solid and smoke-producing fuel. Gas is now being applied to the ovens used by bakers, and by glass stainers, and is also employed for brick-burning, with a commendable reduction of the smoke usually seen in such operations. The late Sir William Siemens stated that if ordinary coal-gas was sold at 1s. per thousand cubic feet, ten times as much gas would be consumed for fuel purposes as was sold for lighting; and he startled the gas world some years ago by advocating the manufacture of two kinds of gas, and the duplication of mains for their distribution, so that the consumer might be supplied with a gas for lighting, and another for heating or cooking. The proposal was treated at the time by gas men as one too ridiculous for detailed consideration. One objector asked what Sir William (at that time Dr.) Siemens would do if the supply of heating gas ran short, and the obvious reply, "Make more," had clearly not suggested itself to the mind of that intelligent gentleman. Sir William Siemens lived long enough, however, to see well-known gas-engineers, and their principal technical journal, actually advocating the duplication of mains, and the turning of a portion of the residual coke into a thermal gas, as—"They've got the coke, and got the men, and got the money too!" In 1885 a deputation from the Smoke Abatement Institution waited upon the Gas, Light, and Coke Company, to plead that a reduction might be made in the price of gas for trade purposes. The directors replied that they were "disposed to meet the interests of the public in regard to smoke prevention, but were unable to do so for want of the necessary powers," the "necessary powers" meaning Parliamentary sanction. Now, as a really cheap and good thermal gas—that is, with the minimum of nitrogen and carbonic acid, would be so potent a factor in the reduction of the smoke of our towns, if there is anything of the nature of "back-bone" in the advocacy of smoke abatement, the Institution which has taken this subject under its charge ought to see either that the present companies supply gas at such a price to the consumer as to allow of his using gas in quantity, in lieu of solid fuel; or, failing that, should take the necessary steps to secure Parliamentary sanction to the establishment of works for the manufacture and distribution of a purely thermal gas, which could be supplied to the consumer either in its normal state or under special pressure. Of late years, as you are aware, there has been a tendency to demand more light from our burners, and this has led some to conclude that it must ultimately result in raising the candle-power of the gas in the holder. Instead of enforcing the supply of a rich gas, however, it seems to me that it would be wise on the part of Parliament to reduce the standard to eight or twelve candles (in default of allowing the distribution of a purely thermal gas), so that gas companies might utilise a portion of their coke, should they be so minded, to produce a heating gas which might, if they so wished, be mixed with the rich gas from the retorts distributed through one set of mains, and sold at such a price as would allow the consumer to use it freely as a fuel. This mixing of the gases would, I expect, secure that smell of gas which it is complained that water-gas lacks. Such a gas, when required for lighting, could be enriched or carburetted at the point of consumption, and if the trouble or cost of carburetting be objected to, we have the incandescent devices ready to our hand; one of these ingenious contrivances—that of Dr. Carl Auer von Welsbach—being now in use in London. The incandescent combs of magnesia, the invention of Otto Fahnehjelm, of Stockholm, are, I understand, in successful operation on the Continent, where water gas is in use. Dr. Regnard has employed the cap of platinum gauze for use with air blown through gasoline; and Dr. Benninghoff has used a similar appliance when burning a mixture of natural gas and air—the proportions being, he says, probably as 1 of gas to 100 of air. Mr. Foulis, the gas-engineer to the corporation of Glasgow, and President of the Gas Institute, who, by the way, has devised a gas fire with some commendable features, speaking of the incandescent cap patented by Mr. James Lewis, says: "One strong argument in its favour was that it would not be necessary to use gas of a high illuminating power; cheap gas for heating purposes would be quite as suitable." Indeed, the incandescent burner has come at a time when the demand for a heating, or non-luminous, gas will cause it to be regarded as an important auxiliary. We, in fact, no longer require an illuminating gas at all. We shall be told that such a gas as I am advocating, or a purely thermal gas, would require larger mains for its distribution; but if the consumption of gas becomes so extended even as to necessitate the duplication, or quadrupling, of mains, this ought to offer no practical difficulties. We shall, I hope, ere long see the advisability of providing suitable subways in all the principal thoroughfares of our large towns for gas, water, telegraph, and telephone mains, and electric lighting cables, so as to permit of easy access and inspection, saving the continually recurring expense of having streets broken up and traffic stopped. Rent could be charged for the accommodation provided in such subways, to pay interest on the capital expended in their construction. If the use of thermal gas should become so general as to threaten to occupy too much of the space under our streets, I see no reason why gas, in that case, should be distributed in its normal state. Steam is laid on to New York at a pressure of 90lb. to the square inch in the mains, and natural gas at Pittsburgh has a pressure of 50lb. on the square inch in the mains; whilst Birmingham is just laying down a system by which air compressed to 45 or 50lb. on the square inch is to be distributed to power users and others. Had we had more enterprise amongst gas-engineers, and more competition in the "trade," we might, it seems to me, have been profiting long ere this by a continuous system of carbonisation, and have had a gas retailed to us at one half the present price, or less. Mr. Henry Woodall, when gas engineer to the Leeds Corporation, proposed that coal-gas should be sold for trade purposes at 1s. per thousand cubic feet, and in his report to the gas committee gave the following table of costs:—

Cost of gas in holder......	7d.	per thousand cubic feet.
General charges	1½	" "
Interest	2½	" "
	—	" "
	11d.	" "

Clearly showing that the cost of gas in the holder, general charges, and interest did not exceed 11d. per thousand cubic feet for coal-gas. The gas consumer, he says, is taxed by "costly engineering," and the Act allows of gas companies paying a 10 per cent. dividend upon "a most wasteful and reckless capital expenditure." And, as an illustration of reckless expenditure, Mr. Livesey, a well known gas engineer, states that a certain gas company wasted half a million of money in six years, and did this whilst paying a dividend of 11 per cent. A local coal company offered to undertake the manufacture of coal-gas, and put it into the mains of the Widnes Local Board for 7d. per thousand cubic feet, and a carbonising company at Normanton offered coal-gas at 6d. per thousand cubic feet. Mr. H. Townsend, the gas engineer of Dewsbury, states that, if heating gas (water-gas) be sold at 6d. per thousand cubic feet, there is, to use his own words, "a fortune in the thing." This water-gas, compared in thermal value—volume for volume—with coal-gas, is as 100 to 55. That is, the water-gas is rather more than half the heating value of coal-gas, which would be equal to selling ordinary coal-gas for something under 1s. per thousand cubic feet. But he states further that he now sees his way to producing the water-gas very nearly as powerful in thermal value as coal-gas. And again, he contends, "Either we ought to kill the demand for gas for heating by keeping up the price, or, on the other hand, make a new departure to accommodate it." So much for practice and for prices in the United Kingdom. If we go on to the Continent we find that M. Wybauw, the accomplished and far-seeing gas engineer to the Municipality of Brussels, advised that body to reduce the price of coal-gas for day consumption—what we in this country should denominate for trade purposes—50 per cent. The leading journal of the gas interests in this country, in commenting on this new departure of M. Wybauw, said: "If the experiment succeeds so that M. Wybauw comes forward after a sufficient time of probation has elapsed, and shows proof of the justice of his action, the general adoption of similar principles will be assured." M. Wybauw, after having the principle in actual work for such a time as to demonstrate its practicability or otherwise, writes to say that "The success of the experiment has been complete." What will now be the response of those companies in this country who are asked to reduce the price of coal-gas for heating or for trade purposes? Will they make a substantial reduction in the price of their ordinary coal-gas, or will they proceed to produce "the best grade of fuel gas which coke and steam can yield," and distribute this at a low rate, which, as has been pointed out, may "prevent the present poor trade in residuals from becoming worse by the advent of new competitors"?

THE AMATEUR WORKSHOP.—XXXIV.

Smith's Work (*Concluded*).

HAVING described the most important smiths' tools, we conclude with a few essential hints on the practice of forging.

As a simple example, take the connecting-rod (Fig. 414), one with a forked end being purposely chosen as being more complete for purposes of illustration. This could obviously be made by building up—that is the enlargements at the ends could be welded on a bar of the diameter A, or by swaging down, in which the diameter A would be hammered down from a bar of the sizes B or C of the larger ends; or by jumping up, where the ends would be beaten up or "upset" on a bar of diameter A. Or it can be made by a combination of these processes if a bar of medium dimensions only is available.

Say we have a piece of bar of the dimensions A; we can get on very well with that. We build a fire in such a way as to obtain "a solid core of heat"—that is, we have a central portion in front of, but away at a distance of a few inches from the tuyere, intensely hot, and for the time being open above, but flanked at back and front with two masses of wetted hard caked small green coal or "slack," which partially confine the heat (Fig. 415), and form a reserve supply for the incandescent mass; and the larger the forging the larger the reserve of "stock." Putting that portion of the bar which requires to be heated—in this case the end—into the centre of the fire, cover it over with a mixture of stock and new coal, so as to enclose it completely, localising the heat where required by keeping wet coal over the portion which is not to be heated. Then the blast is put on, and the heat enclosed and intensified around the bar. The bar, especially if large, is to be turned partly round in the fire now and again to equalise the heat, the blast meanwhile hollowing the fire in the immediate vicinity of the bar; now and then, also, it will be partly withdrawn in order to be sure that it does not get burnt. The heat at which it should be taken from the fire varies with circumstances, a full, red heat being suitable for ordinary forging; while for jumping up, and welding, the iron should be white hot, and just beginning to throw off vivid sparks. Beyond this temperature it becomes burnt and spoiled. When our bar is at the white heat, it is removed from the fire by means of hollow bit tongs and transferred to the anvil, whence we will follow the process through, remembering that in smith's work the whole manipulation must be foreseen from the beginning, and the tools all be at hand, so that there shall be no hesitation and loss of time and heat. We will first suppose that the hollow of the forked end is to be slotted out of the solid, and then, for further illustration, we will assume that the hollowing out is to be done at the anvil.

While at a white heat we shall "upset" the iron in order to obtain sufficient breadth for the forked end, and to do this a short heat only will have to be taken on the end of the bar. Thus if the length of the forked portion, C, were 3in., the end of the bar would be heated only to a length of 7in. or 8in. If more length is required, two successive heats should be taken. That portion of the bar, then, which lies beyond the part which has to be upset will not become bent or otherwise distorted during the upsetting process, but remain rigid. The upsetting is performed either by jumping the bar heavily end on to the anvil, the hot portion, of course, being downwards (Fig. 416), hence also called jumping up, or it is hammered with the sledge, swung in a nearly horizontal arc, the smith holding the bar horizontally on the anvil with the tongs, or a heavy cast-iron monkey (Fig. 417) suspended by a chain is swung heavily against the end of the bar. When the amount of jumping up which is required is slight, the first method suffices, for

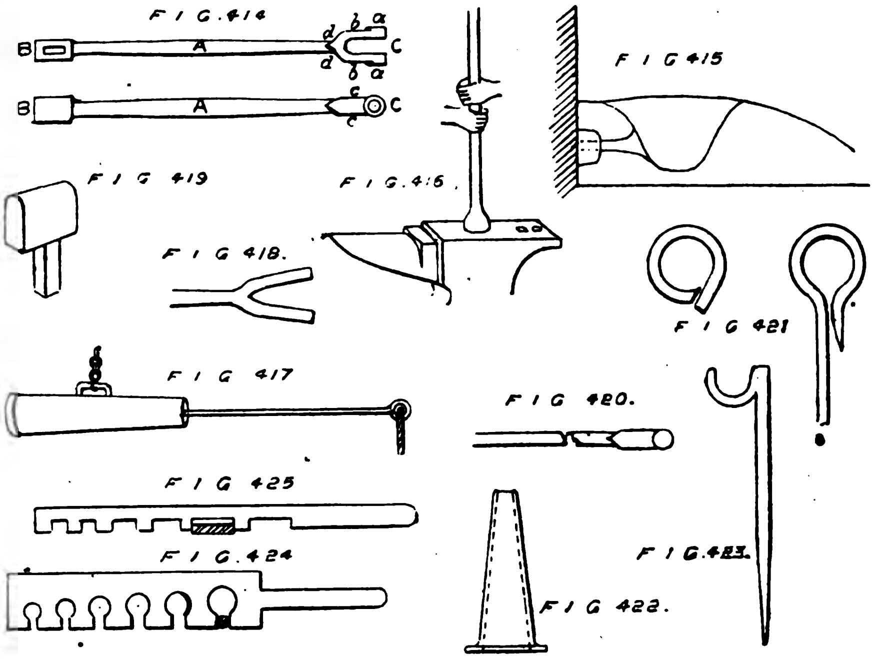


FIG. 414

FIG. 415

FIG. 416.

FIG. 417

FIG. 418.

FIG. 419

FIG. 420.

FIG. 421

FIG. 422.

FIG. 423.

FIG. 424

FIG. 425

heavy work the latter plans are adopted. Upsetting shortens the length, and increases the breadth and thickness, and the enlargement, being very irregular in outline, must needs be made considerably larger than is actually required. At the same time, since the jumped mass will be of a rudely circular shape, being simply an expansion of the shape of the bar, a rough outline of the shape finally required must be imparted to the end by hammering, the hammering and upsetting alternating, so that the iron, still retaining its heat, is hammered approximately level and square on four sides, forming a rectangular block or lump at the end of the round bar, its extreme dimensions being slightly larger than the out and out dimensions of the bosses *a*, *a*. By this time it will probably have lost most of its heat, and will go back to the fire to be made nearly as hot as in the first place. By means of the fuller first, and the flatter afterwards, the hollows around the bosses, and the flats, *b*, will be set down, and similarly the flats *c*, *c*. The outside rounding of the bosses will be imparted by cutting off a portion of the corners with a hot set, then hammering with an ordinary hammer, and smoothing off with a top swage struck by a sledge. The whole of the black dimensions will remain when finished a trifle over the bright finished sizes, to give sufficient allowance for machining. The rounding off at *d*, *d* is first rudely cut with the hot set, or with a gouge tool, the heads of those tools being struck with the sledge, the angularities will be beaten down rapidly with the hammer, and a top and a nicking swage of suitable curves will be used to impart a finished outline.

The bar will now go into the fire again, and a heat will be taken over it extending from the fork to about the centre. A nicking fuller may be used to shoulder down the square bar to a circular section just where it departs from the forked end, or if the bar is small it may be simply hammered at the angles with a hand hammer or sledge. When the diameter is roughly reduced down to the required size next the fork, the original size remaining at the centre, it will be readily finished by swaging, the proper allowance being left for turning. This need not occupy more than one heat. The other half of the rod can be swaged down in another heat. Then there remains the stub end B, which has to take the strap, and this will be jumped up in a short heat similarly to the forked end, finished with the flatter, and neatly fullered down around the neck.

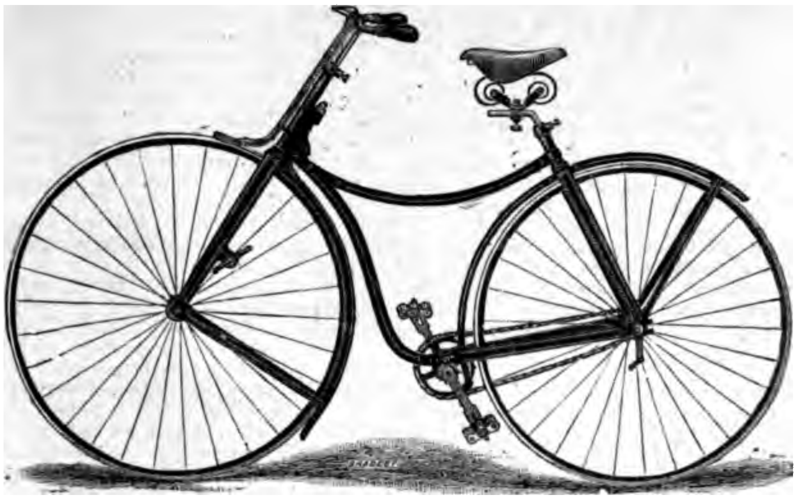
In this illustration we have supposed the space between the fork ends to be slotted or drilled out of the solid. But if the forked ends were so wide apart that the slotting or drilling out of the interspace would be considered a heavy task, or if the end were that of a rough lever or pump-rod which would not pay for machining, the forks would be forged as follows:—If the width of the bar were less than twice the thickness of each fork, it would first require to be jumped up until its width were somewhat more than twice the thickness—that is to say, if the forks were ¾in. thick, the width of the bar should be rather more than 1½in., say, 1¾in. or 2in. As before, a short heat is then taken, extending no farther than just beyond the shoulder; the flat portion is laid on the anvil, and divided through the centre with a hot set, cutting first from one side, then from the other, and meeting in the centre. Sometimes a hole is first punched at the bottom of the hollow. Once divided, it is readily opened out first to the V-shape (Fig. 418), then the hollow is formed by jumping and hammering over a bottom fuller of considerable breadth and depth (Fig. 419), sometimes termed a dresser, or joint dresser, until a rough outline of the bifurcation is obtained. Then the more exact outlines and thicknesses are given in a second heat by judicious hammering, and finishing, partly over the dresser, partly on the flat overhang of the anvil, if the space between the forks is sufficient to permit of this. Finally, when the shaping is done, the forks must be tried for parallelism with the axis of the bar, and if out of truth, they will be set over with the hammer.

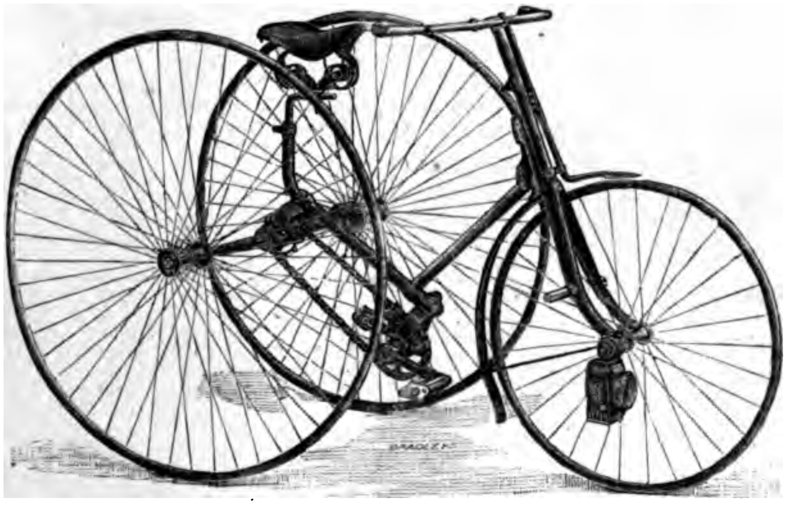
It is easy to see how a difference in relative proportions would modify the method of making which ought to be adopted, and since our connecting-rod is selected, not as of any particular size, but illustrative only of different methods of forging, we will now make it the medium of sundry remarks in reference to the practice of welding. Upsetting is hard work when the quantity of metal to be upset is large, and particularly so when done without the aid of a monkey, or in the absence of a massive plate which is frequently sunk in the floor for the same purpose. Welding is, therefore, much easier in certain instances. But the stub end, B (Fig. 414), is not so much larger than the original size of the bar in the centre, therefore we may upset that very well. Also, when the sum of the widths of the two forks is little more than that of the original bar, and the forks are forged as in the last example, we may accept the jumping up method as being practicable. Moreover, in the first instance described we upset the bar on the supposition that, though the end was solid, it was not of great width, and this would also be applicable to the ends of many light levers. But assuming the end were both solid and wide, measuring, say, over the bosses three or four times the diameter of the bar in the centre, welding then would be preferable because involving less labour.

When making a weld there are three points to be borne in mind: to have a joint of sufficient area, and in suitable direction for hammering up; to have the necessary temperature, and to be sure of perfectly clean surfaces. For the first condition, a scarf joint—that is, one running diagonally with the common axis of the pieces to he shut (Fig. 420), is to be preferred, and is, therefore, commonly employed when practicable. When a scarf joint cannot be used, a vee'd or cleft joint is suitable. When that cannot be employed, a spreading joint, made by fullering down a portion of the bar, is resorted to. A plain butt joint, except when the abutting surfaces are of large area, is seldom used; but flat *surface* shuts are common. The temperature for welding iron is that just now referred to, when the iron begins to sparkle, and to drop off in globules. For steel, the temperature is lower, barely approaching to a white heat. Different qualities of iron and steel require different degrees of heat, and the temperature in each case becomes a matter of experience. When the ends to be welded are taken from the fire any scale adherent to the surface must be detached by striking the bar smartly on the anvil, joint face downwards, or by sweeping away the scale with a muck brush. If any persistently adhering scale remains on the faces the shut should not be made. Fractures occur sometimes from this reason, the weld being perfect near the edges, but faulty in the centre. The joint surfaces are usually dusted with sand, but this is not so essential as it is sometimes stated to be, provided the scale is removed in the manner stated, for numbers of ordinary iron shuts are made without it. The weld is made immediately that the faces are brought into contact, by rapid hammering, every second at the welding heat being of vital importance. When closed together with the hammer the joint of a good weld should not be visible, the presence of a black line indicating that the shut is imperfect. If during hammering the bar becomes reduced or drawn down below its proper size, diameter, width, or thickness, as the case may be, it must be slightly jumped up to thicken it sufficiently, and then swaged circular, or smoothed with the flatter. Iron and iron are easily welded, so are the milder varieties of steel; but some hard and brittle steels require tact and practice to weld properly, and some, if heated over a certain temperature, crumble under the hammer.

In a connecting-rod, the cottar way in the stub end is usually drilled and filed out, but in many instances cottar ways and holes of other shapes are punched and drifted, either to save the labour of drilling previous to filing through, or as being suitable enough for the purpose which they have to fulfil. Before punching the iron is brought to a welding heat, or nearly so, laid upon the anvil, and the punch, struck with the hammer, is made to pass halfway through from one face. It is then knocke back, the iron turned over and punched from the opposite face, the holes meeting, therefore in the middle or thereabout. Then a drift i inserted in the hole, and either driven halfway in from each side, or right through, according to circumstances. While the drift is still in place, opportunity is taken of giving a rough kind of finish to the exterior outline. Punches and drifts become red-hot, and soften and bend if they remain more than a few minutes in contact with the iron, so that it is necessary to remove them once or twice from a deep hole and quench them in water. Punches and drifts are usually picked up with the pliers though the former are sometimes furnished with withy handles. They are circular, oval or rectangular in section, the difference being that while a punch is tapered, a drift is paralle for a considerable portion of its length, and tapers only towards the end.

When bending work, various devices are resorted to. A turn-down edge at right angle would be bent over the edge of the anvil, the flat of the bar lying horizontally across the anvil, the smith grasping the tongs, and steadying them against his leg to resist the force o the endlong blows. The bar is frequently nicked across slightly with a fuller previous to bending, and the fuller having a circular section does not divide the fibre as a set would do. Eye or rings are bent around the beak of the anvil whose tapered outline permits eyes, rings loops, and curves of many different diameter being bent. Fig. 421 shows the method o welding a ring and an eye. Rings of larg diameter are finished on the conical mandre (Fig. 422). Small rings are finished on parallel bar or mandrel of suitable diamete the bar remaining in place while the outside i finished with flatters or swages. When eye are being bent, or other work being performe on bars of considerable length, the trouble o





supporting the opposite end is saved by driving a rest (Fig. 423) into the ground, and placing the bar in the hollow.

When doing forging, it is necessary to take measurements rapidly—not an easy task with hot iron. Hence, gauges notched to different sizes are made of sheet iron, say, ⅛in. thick, the size of each notch being stamped above it, Fig. 424 being a gauge for round, Fig. 425 one for flat bars.

THE "CENTAUR" RANGER SAFETY BICYCLE AND DIRECT-STEERING TRICYCLE.

AMONG the few novelties by leading firms worth notice this year are two introduced by the Centaur Company, of Coventry. The workmanship and construction of these machines are good, as is all we have seen turned out by these makers, and the improvements tend to secure steadiness of steering and pedal action—the great desiderata with all cyclists.

The Ranger safety bicycle is designed to avoid the deflection of parts noticeable in the "Bicyclette" pattern, where the crank bracket is simply attached to a straight arm dropped at right angles from the backbone. The thrust of the pedals, acting on this, forms a natural lever, through which a jerky torsional strain is conveyed to the backbone, and through that to the steering wheel. This causes the difficulty in steering so frequently complained of with this pattern. In addition to this, the strain of the chain upon the fork, instead of being in the same line with it, is applied at an angle which must—particularly under great pressure—cause it to spring. In comparing the merits of the "Ranger" with this type of single-chain safety, the following advantages cannot fail to commend themselves:—1. The arrangement for the perfect adjustment of the chain. 2. The arrangement of the chain, the pull of which is in a direct line with the lower fork. 3. The bottom fork being the point at which there is the greatest side strain, these are made specially strong to resist it. 4. The crown which connects the bottom fork with the lower backbone is a solid steel forging, the neck of which extends 1¼in. up the tube; over this part is fitted the crank bracket, so that nearly the whole of the pedalling strain is localised to the bottom fork, where special provision is made to resist it, so that there is very little torsional strain upon the backbone; what little there is, is neutralised by the cross-stay, or what may be more properly described as the upper backbone. In addition to this, the strain upon the driving wheel is further assisted by the upper fork, which is connected by the cross-stay to the backbone, at its junction with the neck, making the whole into a frame so rigid and compact that deflection from pedal pressure—sufficient to influence the steering—is impossible; and, again, deflection of parts means greater wear and tear, and is moreover a loss of power, as power can only be conveyed to the point where deflection commences.

The Centaur Direct Steerer is a departure in favour of direct steering, versus automatic, in unison with the opinion of many eminent riders. There are other points in its construction which cannot fail to commend themselves to riders, among which may be mentioned a large steering wheel (30in.) with 38in. drivers. A powerful brake—simple in its application—without the complication and additional weight inseparable from those applied to the shaft, which in many cases are not effective, owing to the smallness of the drum upon which they are applied. In simplicity, lightness, and neatness of construction, this machine seems to us the nearest approach to the single-chain safety bicycle of any yet introduced, and as the price is the same as the older type of machine, it will probably be largely ordered.

COMPOUND FOR WELDING STEEL.

AMONGST the "fluxes" used for welding steel, borax has long held a prominent place, though some smiths prefer plaster of Paris simply. Herr K. Küpfer, of Baden, has invented a compound which he considers superior, if we may judge from the fact that he has patented it in this country. He claims not only the composition, but also the process, the latter consisting mainly in a method of "regenerating" the steel after welding. The compound is composed of 25 parts borax rafia (refined borax presumably) in small pieces about the size of peas; 25 parts fine steel filings, and 7 parts sal-ammoniac in powder, chemically pure. After having moistened this mixture by means of 12 parts balsam copaiba of first quality, it is "cooked" slowly in an iron pan until the whole forms a solid body. This body, when cool, is pulverised and kept in a dry place. When the pieces to be welded are cleaned, and powdered with this compound, they are placed in the fire and heated slowly to a red heat, and are then forged by lightly hammering them. They are then again heated and forged a second time. To then regenerate the pieces of steel, welded by the process just described, the patentee uses a powder composed of the following ingredients—viz., 50 parts borax rafia, 40 parts yellow prussiate of potash, 15 parts first quality colophony, 10 parts sal-ammoniac, chemically pure, 6 parts dragon's blood, and 10 parts common salt, very dry, every ingredient being well pulverised, and the whole mixed cold. The welded parts are again heated, removed from the furnace, and then powdered with this mixture. By repeating this operation two or three times, the steel regains its primitive grain.

THE THEORY OF MACHINES.—III.

By FRANCIS CAMPIN, C.E.

The Crank and Flywheel.

THE conversion of reciprocating rectilineal motion into rotary motion will now occupy our attention, the end being attained by means of an ordinary CRANK and connecting rod.

Two cases may be taken in regard to this combination, the first when the rectilineal force is uniform, and the second when the rotative or circular force is uniform.

In Fig. 12 let $a\,d\,b$ be a straight line drawn through the centre, longitudinally, of a connecting rod $a\,d$, jointed at a to a block so controlled that it only admits of motion backwards and forwards on the line $a\,b$, and having its other end jointed to the end d of a crank $c\,d$, capable of revolving along the centre c, and let a force P act upon the block a in the direction $a\,b$. So long as $a\,d$, $d\,c$ are in the same straight line no motion can ensue, and this is termed one of the "dead points" of the crank; but if the crank be slightly on one side of d, then it will revolve under the action of the force P, and the crank will pass through the positions $c\,1'$, $c\,2$, $c\,3$, $c\,4$, $c\,5$, and reach $c\,b$ where it will arrive at its second "dead point"; if the direction of the force P be now reversed the

FIG. 14

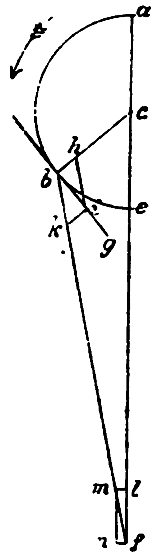
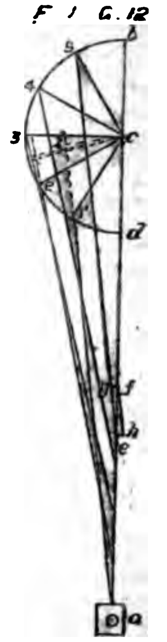


FIG. 12



radius cb being 3in. and the length bf 1ft. As before, in determining variations of pressure, we should first take them in reference to unity of driving pressure, and subsequently fill in the actual quantities. The pressure at b, therefore, acting tangentially to abc will be one pound. Draw bg tangential to abe at b (it will therefore be from the properties of the circle at right angles to the radius cb); make $bi =$ the pressure acting along bg, and complete the parallelogram $bkih$, then bh will represent the pressure on bc, and bk that upon bf; make $fm = bk$, and complete the parallelogram $mlfn$, then $lf =$ the pressure exerted in the direction af, and $ml =$ that upon the guides at the point f, by which its rectilineal movement is preserved.

This diagram not being sufficiently large to show a number of parallelograms, we have measured the values of bh, bk, lf, and ml, for twelve points in the semicircle from one set out four times the size of that shown, and the numbers thus found the student can verify by preparing for himself, as he should in each case, an enlarged diagram.

In the accompanying table, column A shows the divisions of the semicircle, the other columns showing the values above mentioned.

A	bh	bk	lf	ml
1	2·95	3·14	3·11	0·20
2	1·33	1·65	1·63	0·21
3	0·73	1·20	1·19	0·23
4	0·38	1·05	1·00	0·24
5	0·00	1·00	0·96	0·26
6	0·27	1·30	1·00	0·26
7	0·60	1·17	1·16	0·30
8	0·92	1·35	1·34	0·32
9	1·44	1·80	1·77	0·33
10	2·43	2·60	2·59	0·34
11	4·95	5·05	5·00	0·34
12	0·00	0·00	0·00	0·00

VOGEL'S ISOCHROMATIC EMULSION PLATES.

ABOUT fourteen years ago, Dr. H. W. Vogel, of Berlin, made the discovery that chloride and bromide of silver, which are sensitive only to the violet, indigo, and blue light of the spectrum, may be made sensitive to the green, yellow, and red rays by mixing with them substances which absorb the light of that half of the spectrum. He called those substances optical sensitisers, and he and others, after him, have discovered a number of such substances amongst the dyes, notably cyanine, chinoline red, eosine, erythrosine, which are now articles of commerce. The isochromatic gelatine plates so prepared are generally less sensitive to light than ordinary plates, and require a yellow glass interposed between the lens and the plate to diminish the power of the blue light and extend the time of exposure, therefore the sharpness of the photograph is lost, and such plates cannot be used satisfactorily for portrait or landscape photography. Dr. Vogel has recently succeeded in making isochromatic gelatine plates, the sensitiveness of which is twice as great as that of the ordinary gelatine plates, and which, moreover, do not require any yellow plate or screen. He has accordingly obtained a patent in this country for a method of preparing isochromatic emulsion plates without fog or film and spots, which will produce landscapes and portraits superior to those obtained with ordinary plates. Dr. Vogel's process is practically as follows:—Ordinary gelatine plates are bathed in a solution of a soluble salt of silver (1 : 1,000), then in a solution of an eosine dye, or a mixture of eosine dyes, or a mixture of an eosine dye with other optical sensitisers, with or without liquor of ammonia. The solution of the dye can also be used first and the silver solution afterwards, or an emulsion can be mixed with a soluble salt of silver and the dye added to the mixture, or *vice versâ*, and with or without ammonia. A silver eoside is formed by mixing a solution of an eosine dye, or a mixture of different eosine dyes (for instance, ordinary eosine, blue tinted eosine, chrysoline, aureosine, phloxine, Bengal rose, or any other derivative of fluorescine) with a soluble salt of silver, such as sulphate, nitrate, acetate, or fluoride of silver. This eoside of silver can be collected as a precipitate, washed, and mixed with the emulsion, or dissolved in diluted ammonia or diluted acetic acid, and employed as a bath for soaking dry plates; but Dr. Vogel prefers to add liquid ammonia, carbonate of ammonia, or acetic acid, during the process of precipitation, so that the suspended precipitate is dissolved, and to employ the same as sensitising agent for fluid emulsions; or the solution can be diluted with water, and used as a bath for dry plates. The quantity of this solution of eoside of silver to be employed varies according to the quality and kind of emulsion treated with the same, although the following formula will serve as a general guide:—50 cubic centimètres of a solution of an eosine dye (1 part dye to 1,000 parts water or diluted alcohol), 1 cubic centimètre of a solution of nitrate of silver (1 part nitrate of silver to 20 parts of water), 1 to 2 cubic centimètres of liquor of ammonia. This solution is either mixed with the emulsion—that is, 5 to 10 per cent. is added to the emulsion—or the same is diluted with 200 to 500 cubic centimètres of water, and the gelatine plates immersed or soaked in the same for about one minute, and then dried. He also uses other dyes, known as optical sensitisers, which do not chemically combine with silver; but the sensitiveness of which is much improved by the presence of a soluble salt of silver, such, for instance, as cyanine, chinoline red, ceruleine, &c., and mix them with any soluble salt of silver: for instance, 50 cubic centimètres chinoline red, or a mixture of chinoline red and cyanine (solution 1 : 1,000) 1, 5 to 3 cubic centimètres nitrate of silver (solution 1 : 20), 15 cubic centimètres of ammonia liquor. This solution is employed in the same manner as the eoside of silver solution. The solutions are used in varying proportion for improving the sensitiveness for any part of the chromatic spectrum, and the salts of lead are also employed, which produce, when mixed with an eosine dye, eoside of lead, which salts can be employed alone, or mixed with eoside of silver. The insoluble salts of silver, such as the chlorides, tartrates, citrates, &c., dissolved in ammonia or acid, are sometimes used in varying proportions, as are the other salts mentioned, according to special requirements.

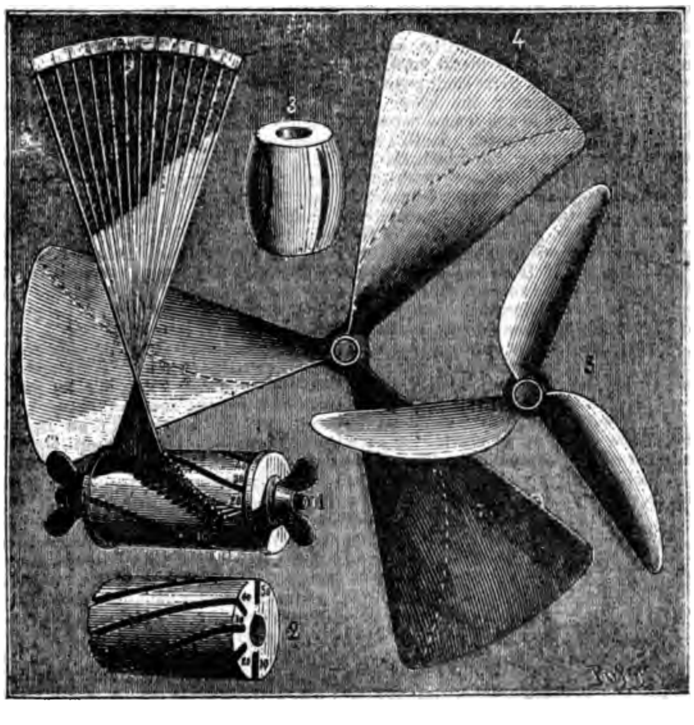
A NEW METHOD OF CONSTRUCTING PROPELLER SCREWS.

ALL who are familiar with the question of screw propellers are aware that every inventor of a new form of propeller believes he has at last hit upon the exact form which will give the best results not only in driving the ship forward through the water, but also in preventing vibration. M. G. Trouvé, who has the advantage of being an experimentalist, gives in *La Nature* a new method of constructing the screws for propellers, which he has evolved apparently from his experiments with his electric boats. He says:—

For several years past I have been engaged in studying the application of electricity to the propulsion of small boats, and I now desire to communicate to readers the conclusions to which I have been led by my experiments upon the operation of the screw, as well as a new method of constructing the latter.

My motor, which, with a minimum weight and size, develops very great power, gives its maximum of performance with a velocity of several thousand revolutions per minute. We have here, then, very different features from those presented by steam motors, which on account of the inertia of their oscillating parts and the limited resistance of certain portions, are unable to practically exceed quite a low speed. Instead of reducing the velocity of the motor by the method of transmission, it has seemed to me more advantageous to allow the screw to have a very high rotary speed. It is well known that the resistance of water rapidly increases in measure as the speed of a body moving in it augments; and, in order to obtain a diminution of the screw's recoil, and reduce the loss of live power due to the whirling of the mass of water set in motion, we ought, therefore, to approximate the conditions offered by a screw that takes its bearing point upon a solid nut. This high speed necessitates a large reduction in the pitch of the helix, which is likewise a favourable condition, since the resultant of the forces due to the inertia of the water, acting upon each element of the surface of the blades, advances towards the direction of the axis—the direction in which the useful effect must exert itself. There likewise results less of a tendency in the water to take on that rotary motion that gives rise to a centrifugal stress, which forces it to escape through the circumference of the helix, and is, as well known, the cause of jarring and loss of live power. Experiment has confirmed this view of the subject, for, upon increasing the rotary speed up to 2,400 revolutions per minute, the performance of the screw very notably increased, while at the same time the boiling of the water astern was observed to diminish, the jarring to cease, and the motion to become perfectly regular and easy.

As these experiments necessitated the trial of a large number of screws of variable shape and pitch, I was led to devise a method of construction much simpler than those that are in use. The making of the mould for a helix is, in fact, an operation that requires quite a deep knowledge of geometry, since it includes the making of working drawings of the blades, of developing and laying down quite a large number of cylindrical sections concentric with the blades, and of cutting out templets, which, when afterwards centred, permit of carving in a wooden mould the curves of the sections that are afterwards connected by surfaces in which the sensation of continuity, and, consequently, the skill of the workman plays a great rôle. The result is that such pieces can be made only by a small number of special workmen, and that the net cost of them is high.



1. Grooved Cylinder. 2. Details of Grooves. 3. Boss. 4 and 5. Three-bladed screws.

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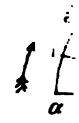

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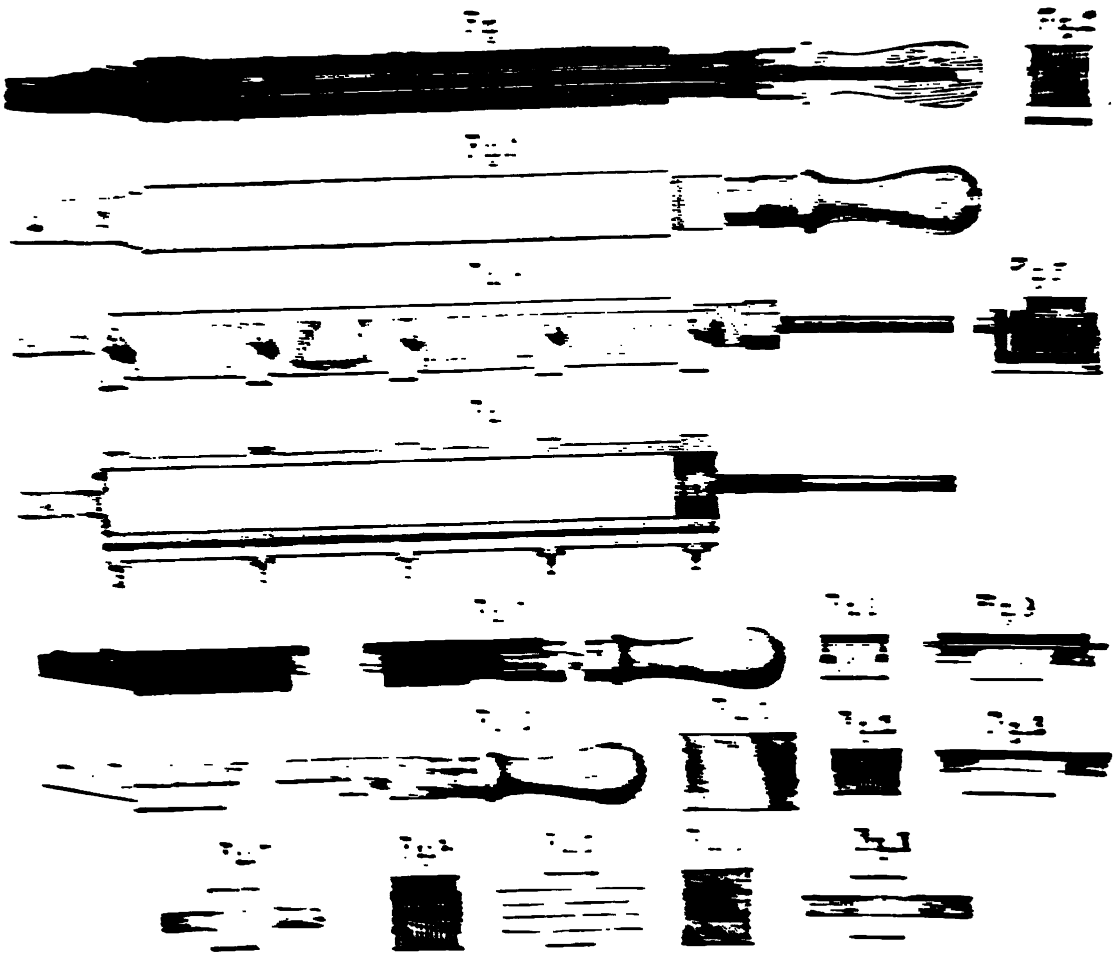

nperature used in ironing clothes. Melt
fin under the iron so as to drive it into
as much as possible, then with a cooler
t on a coat thick enough to completely
wood.

assing small articles: To one quart water
an ounce each of sulphate of copper and
oride of tin. Stir the articles in the solu-
l the desired colour is obtained. Use the
of copper alone for a copper colour.

in rust from polished steel, mix 10 parts
tty, 8 of prepared buck's horn, and 25 of
wine to a paste. Cleanse the article by
with this, and finally rub off with blotting-

l cement for celluloid is made from 1 part
lissolved in 1 part of spirit of camphor,
4 parts of 90 per cent. alcohol. The cement
e applied warm, and the broken parts
held together until the solvent has entirely
ed.

d tin alloys, after careful cleansing from
l grease, are handsomely and permanently
if brushed over with a solution of one
sulphate of copper (bluestone) and one
ulphate of iron (copperas) in 20 parts of
When this has dried, the surface should
ed with a solution of one part of acetate of
verdigris) in acetic acid. After several
ons and dryings of the last-named, the
is polished with a soft brush and blood-
vder. The raised portions are then rubbed
soft leather moistened with wax in tur-
followed by a rubbing with dry leather.

L AND SCIENTIFIC NOTES.

◆

tic Cotton - mill Engine.—Messrs.
and Grant, Dunnikier Foundry, Kirk-
ve at present in hand a compound Corliss
a very large description for a cotton mill
ay. The high-pressure cylinder of this
ine is 40in. diameter and the low-pressure
70in., each having a stroke of 6ft. The
which weighs about 110 tons, is 30ft. in
by 8ft. 6in. wide, grooved for 38 ropes, by
e power is to be transmitted to the various
hafting in the mill. The engine is to run
lutions per minute, giving a speed of ropes
erably over one mile per minute. The
ft, made of Whitworth fluid compressed
5in. in diameter in the body and 20 in
igs. The steam pressure is to be 100lb. per
., and the engines will work easily up to
se-power.

ity of Spun Glass. — A note on the
of spun glass was read at a recent meeting
Physical Society by E. Gibson and R. E.
The authors have experimented on the
of glass rods and fibres made from the
e of glass. The fibres varied from $\frac{1}{25}$ to
id the rods from about $\frac{1}{2}$ to 1mm. in
They find the tenacity per square cm.
ncreases as the diameter decreases as in
wires, whereas with fibres this is not
Experiments were shown illustrating the
of working, and the highest tenacity
was for a fibre of ·0340mm. diameter,
ve 466 × 107° per square cm.—a value
f as great as that for steel wires. The
efer to Quincke's suggestion that the in-
nacity of small wires is due to surface
and may be represented by $W = Ad +$
re W is the breaking weight and d the
but their own results with glass do not
h this formula. As, of course, every one
rrying about with him a book to enable
convert this jargon of the centimetre-
econd system, these figures are, of course,
verted into intelligible facts.

ay Lubrication.—The detailed accounts
Manchester, Sheffield, and Lincolnshire
show a result which will surprise many
ders in the fact that the saving effected
omotive department—the chief one in
—is due, in a great measure, to "oil and
That a saving of nearly £2,000 could be
n this one item alone need not be cause
shment when we consider the enormous
ion of these articles for lubricating and
ing purposes. A contemporary gives the
nsumption of oil upon the railways of the
Kingdom roughly as follows:—Engineer's
nt, £30,000. Locomotive department,
£225,000; shops, £25,000; carriage light-
00. Traffic department, £40,000; general
., £10,000. Total estimated cost, £370,000;
6d. per gallon, 14,800,000 gallons a year.
age cost per train mile of "oil, tallow, and
n the locomotive running expenses is
train mile. Oil by itself may be taken
one-fifth of a penny per train mile, which,
r aggregate mileage, would give the
above estimated as the cost in this depart-
all the lines.—*The Engineer*.

SCIENTIFIC NEWS.

◆

FROM observations made at Strasburg Kiel, Paris, and Berlin, Dr. H. Oppenheim has calculated a revised orbit for comet Brooks (B 1887), in which T = 1887, March 17·51161, Berlin M.T.; π − ☊ 159° 35′ 45·6″; ☊ 279° 58′ 40·2″, *i* 104° 12′ 49·8″; log. *q* 0·211960. The ephemeris for Berlin, midnight, on March 6, is R.A. 3h. 41m. 28s., N. Dec. 50° 43·5′.

Dun Echt Circular, No. 139, contains elements and ephemeris of Barnard's 2nd comet (D 1887), computed by Prof. Boss, of Hartford, Conn., in which T = 1887, April 6·70 G.M.T.; π − ☊ 63° 57′; ☊ 139° 16′; *i* 126° 2′; log. *q* 9·8892. The position for G. midnight on March 6, is R.A. 3h. 26m. 28s., N. Dec. 32° 48′. The comet has, however, rapidly decreased in brightness, and the position above given is doubtful.

Another minor planet (No. 265) was discovered by Dr. J. Palisa, of Vienna, on Feb. 26. No. 256, discovered by Dr. Palisa on April 3 last, has been named Walpurga; but he has still to name Nos. 262 and 263.

Father Denza, of the Moncalieri Observatory, near Turin, says that the earthquake in that region has had nearly the same extent as those of Nov. 28, 1884, and Sept. 5, 1886. In length it extended to the east along a line leaving the plains of Lombardy at Lomellina, and passing by the district of Alessandria to the Riviera di Levante, and westward over all the Western Alps, proceeding towards Switzerland as far as Geneva and beyond, and to Paris and Corsica. The telluric movement proceeded from the Lepontine Alps on the north to the Gulfs of Lyon and Genoa on the south, extending, but more feebly, through Tuscany to Rome. The greatest intensity of the movement was in the Gulf of Genoa along a line extending from Savona to Mentone; but as far as Marseilles buildings were thrown down. The movement of the soil, not so violent, but equally disastrous, spread over the mountainous country which extends from the Altare Pass to Millesimo, Mondovi, and the neighbouring regions. The shock was severe, but it did no considerable damage, in a portion of the province of Coni, as also in the provinces of Alessandria and Turin, it being very intense on Mont Cenis. It was slighter in the plains and in the valleys of the province of Novara.

What in Japan is called a severe earthquake was experienced in parts on Jan. 15 last, and is recorded as having long period and large amplitude. The seismographs in the Imperial Observatory at Tokio kept their pointers in motion for nearly ten minutes.

Reports from Honolulu state that Mauna Loa is in active eruption, all the craters in the vicinity discharging freely.

It is proposed to invite the British Association to hold its annual meeting in 1889 in Newcastle-upon-Tyne. The proposition is favourably viewed by the Mayor, Sir William Armstrong, Sir I. Lowthian Bell, and other influential gentlemen; and in due season a formal request will probably be made to the Council of the Association.

Prof. J. R. Seeley has been appointed Rede lecturer at Cambridge for the year.

At the meeting of the Royal Society of Edinburgh last week Prof. Tait read a paper on the effect of pressure on the maximum density point of water. By three sets of independent experiments it has been proved that the application of pressure heats water, and that the change of temperature on the maximum density point per ton weight of pressure per square inch is about 3°, the low mean 2·7°. Prof. Tait also read a note on the effects of explosives, in which he referred to the fact that in the dynamite outrages in the London railway tunnels persons within a certain range had the drum of one ear broken, while the other was unaffected. Prof. Tait said: "The difference between the effect of a sudden explosion in the immediate neighbourhood of the centre at which the explosion took place, and the effects of the same at a moderate distance, might be perfectly different from one another, and if they came to examine it from the physical point of view, they found it dependent upon this, that as long as the projectile matter—whether it were the air, or the materials of the explosive which were driving it from the centre of the explosion—were going at a velocity greater than sound, the effect of their motion was precisely the same sort of thing as they saw with a falling star. It produced no disturbance in front of it, but compressed and immensely heated the air immediately in front. So long as it exceeded the velocity of sound there could be nothing propagated beyond the limit to which the explosion had extended. They had, as it were, these gases going against a dead stone wall of stationary air, and the consequence was that the air was compressed and became self-luminous by the instantaneous compression. Up to the point at which the velocity became that of sound there would be an exceedingly intense impulsive pressure, and there was great danger of very considerable damage."

At the meeting of the Anthropological Institute last week, Prof. Ferrier read a paper on the "Functional Topography of the Brain," in which he discussed the question how far recent investigations could be brought into relation with craniological and anthropological researches with a view to establish the foundations of a scientific phrenology. He sketched the functional topography of the brain so far as it had been settled, and pointed out that the psychological aspects of brain functions were still far from being made out; although that correlation must be established and proved before a practical psychology, in any degree serviceable to the physician or the anthropologist, could be regarded as possible. On the question as to how far it was possible from an anatomical examination of the brain to form an estimate of the forces and capacities of the individual, he pointed out many great difficulties which had to be encountered. Not merely the size of parts had to be taken into account, but the relation of different regions to each other, actually of metastasis, structural differences, as well as other functions. *Cæteris paribus*, greater anatomical development might be considered as an index of greater functional capacity. He thought the attempt to determine the differences in functional capacity from the examination of the head involved all the difficulties connected with the examination of the brain. He indicated the cranial relations of the principal convolutions, but expressed his belief that in the present state of our knowledge the data of a scientific phrenology were still very deficient. There was reason to believe, however, that if the subject were taken up from different points of view by anatomists, physiologists, psychologists, and anthropologists, great progress might be made.

At a meeting of the Royal Society, Profs. Horsley and Schäfer communicated the results of a series of experiments upon the functions of the cerebral cortex. Prof. Horsley concluded his remarks with the statement that during the past year he had had occasion to operate upon thirteen human patients, in ten cases removing portions of the brain, and in three, portions of the skull; that he had used the same anæsthetics and antiseptics as he had employed in his experiments upon the brains of monkeys; and in no case had the patient complained of any pain being caused by the operation.

Mr. Herbert C. Saunders, Q.C., member of the Court of the Skinners' Company, has been elected Chairman of the Executive Committee of the City and Guilds of London Institute and a Vice-President of the Institute, in place of Sir F. Bramwell, resigned.

It is stated that the *Great Eastern* is at last to be employed in the trade for which she was constructed, and make voyages to Australia. Her paddles are to be removed, and she is to be fitted with triple expansion engines. A speed of twenty knots is hinted at, and as the vessel has fine lines and has accomplished fourteen knots with the altogether inadequate power supplied by the original engines and low-pressure steam, it is not impossible. Still, something like 18,000 horse-power will be required.

A large steam tug, the *Rescue*, intended for work on the Hooghly, made a trial trip last week on the Mersey. She is 200ft. long, 27ft. broad, and 15ft. deep, and is fitted with twin screws driven by compound engines. The vessel is built to a scale far beyond the requirements of Lloyds, and is fitted with every appliance which can be deemed necessary for salvage and towing work in a hot country.

The summer meeting of the Institution of Mechanical Engineers will this year be held in Edinburgh, the members having been invited to meet in the University Buildings. Sir G. Fowler and Mr. B. Baker have sent an invitation to the Institution to visit the works at the Forth Bridge, and Messrs. Barlow and Son have forwarded a similar intimation in connection with the new Tay Bridge. The meeting commences on Aug. 2.

The harbour of Trieste is now illuminated by forty-five powerful arc lights. The works at the Panama Canal are, it is said, being carried on by electric light at night, which, it is believed, will reduce the time of completion to three years.

In the bulletin of the American Geographical Society, Commander H. C. Taylor describes the various projects which have been advanced for the construction of a canal across Nicaragua, and concludes that it is the most favourable route for a canal to unite the Atlantic and the Pacific. Meantime the United States Senate has passed a Bill chartering the Nicaragua Canal Company, which is to be under American control, and have power to raise a capital of 20,000,000 sterling.

A chair of Geodesy has recently been established at the University of Berlin. The Director of the Geodetic Institute will hold the professorship in the same way as the Director of the Meteorological Institute occupies the chair of Meteorology.

Applications for space in the Melbourne Centennial Exhibition of 1888 should be made before the end of August next. Space and motive power will be found free. All particulars may be obtained from the Agent-General of Victoria in London. The exhibition will be opened on August 1, 1888, and will remain open six months.

Prof. Haeckel has left Jena for the coast of Asia Minor, where he intends to dredge and study the lower forms of animal life in the Levant.

At the meeting of the San Francisco Microscopical Society on Jan. 12th, Mr. Howard reported that the sample of supposed diatomaceous material from Arizona had proved very refractory, and had so far resisted all his efforts to separate out the contained organisms. Among the objects exhibited was a handsome mount by Thomas Clarke, Birmingham, England, of the rare and beautiful crustacean *Leptodora hyalina*. Until a few years ago it had not been found in Great Britain, and its first discovery there created considerable interest. It was found swimming among masses of a minute alga (*Clathrocystis æruginosa*). Mr. Breckenfeld stated that some three years ago a small pond or reservoir in the Presidio contained the same alga in such prodigious quantities as to give the water the appearance of thick green paint. Knowing this to be a habitat of *Leptodora*, he had specially searched for that organism, but without success. After some months the immense masses of *Clathrocystis* disappeared, and, strange to say, had not again been seen up to the present time. At the meeting of Jan. 26th, Dr. Stallard gave the report of a committee appointed to investigate into the alleged finding of Bacillus tuberculocis in milk supplied by the dairies of San Francisco. Owing to the amount of work and time necessary a complete report could not be presented; but while two members of the committee could not say they had found undoubted specimens, Dr. Ferrer asserted positively that he had found two. The subject is one of great importance; and Dr. Stallard said, the other members of the committee concurring, that the method of Ehrlich, used in the preparation of the slides of milk submitted to the committee, would have to be modified, as while it was perfectly successful when applied to slides of sputum, its results were not so satisfactory for determining bacilli in milk, owing, probably, to the fact that the oily matter in the latter interfered with the proper colour reaction of the contained organisms. There is, it appears, ground for suspicion that tubercular disease has been disseminated by milk from diseased cows.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

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⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

ALPHA URSÆ MAJORIS.

[26898.]—THE distant *comes* of α Ursæ Majoris appears, as Argelander remarked nearly 20 years ago, to form a very probable stellar system with Dubhe itself, the $\Delta\delta$ remaining practically constant at $-5' 48{\cdot}7''$, while the changes in $\Delta\alpha$ are nearly represented by the formula $\Delta\alpha = -5' 32{\cdot}2'' + 0{\cdot}097'' (t - 1836)$. Argelander assigned an annual proper motion of 0·222″ in the direction of 232·5° to the small star, while Auwers's value of the proper motion of the large one gives Dubhe an annual movement of about 0·145″ in 240°, or about two-thirds of the amount of the proper motion of the small star in nearly the same direction.

Smyth, in 1832, made the first micrometrical measures of the angle and distance between these two objects with which I am acquainted, his measures being $\theta = 203{\cdot}8^\circ$ (weight 7); $r = 380{\cdot}6''$ (weight 3), 1832·41; Piazzi's magnitudes, 1·5 and 8, being assumed in the "Cycle" determinations. Wolff's heliometric results with the instrument at Bonn in 1868 give, when reduced to 1855·0, $-5' 30{\cdot}93''$ and $5' 49{\cdot}28''$ for the differences of α and δ. I am indebted to Mr. George Hunt for the following results of one evening's observations in 1881: $\theta = 203{\cdot}48^\circ$, $r = 384{\cdot}95''$: 1881·12 (8·0in. Alvan Clark, power 99). Smyth also obtained the following "remarkably coincident results" from Piazzi's observations with Ramsden's circle (the telescope of which was of 3in. aperture and 5ft. focus) at Palermo: $\theta = 205^\circ 0'$, $r = 384{\cdot}0''$: 1800.

Smyth called both stars yellow; but Webb notes the colour of the smaller one as "violet" in 1850 with $3\frac{7}{10}$in., and "lilac" about 15 years later with his 5½in. Alvan Clark. I found B very violet with a 3in. achromatic in September, 1872 (the colour was perceptible even with a small 1¾in. telescope); but thought the colour not so marked in the next year, and "certainly not deep violet, whitish with perhaps a tinge of blue" on two occasions in 1874 with the same instrument. In March, 1875, with 6½in. reflector, I thought that the large star appeared yellow, "with a white eye," B being "decidedly bluish, but *not violet*," the colours being the same in the 3in. refractor. The altitude of the star was about the same during all my observations.

Dubhe is a suspected variable (No. 356 of Gore's Catalogue), and Klein, of Cologne, stated some years since that it was variable in colour also, his observations being "confirmed" by Weber (of intra-mercurial planet fame) at Pekeloh. The latter observer considered that the large star changed from "white" to "fiery red" with a period of a little over a month; but his statements, which excited considerable controversy at the time, have failed to obtain general credence. There are considerable discrepancies in the assigned magnitudes of the small star also, Lalande giving 7½ mag. in 1794; Piazzi 8 (both catalogues); Taylor 7 mag. in 1834; the first Radcliffe 7·2 (1845); the D.M. mag. is 6·5, and it was rated at this value in his observations with the Bonn circle in 1860; on Feb. 24, 1861, Argelander called it 8·0 mag. (a special note being attached to this determination); the mean of four determinations three years later with the same instrument gave 6·9 magnitude.

Huggins (*Proceedings* of R.S. XX. p. 391) considered, from the observed deviation of the *b* lines in its spectrum, that the large star was approaching us in 1872 with a velocity of from 47 to 62 miles a second; the Greenwich observations (with the "half-prism" spectroscope) in 1880 and 1885 give a very small approach of about 4 miles a second; but the observations were only made on one evening in each year, and the conditions were unfavourable; those made on two nights last year indicate a rate of approach of 58½ miles a second. Mr. Seabroke's one observation in 1885 gave a practically negative result, those on three nights last year are rather discordant *inter se*; but the mean value shows a rate of approach of about 16 miles a second.

It would appear from Mr. Proctor's remarkable charts of the proper motions of the stars determined by Messrs. Main and Stone from the parison of the results obtained by Bra (Bessel's), and those determined at Green nearly a century later, that Dubhe is moving direction and at a rate corresponding with which would appear if it was drifting away the apex of the solar motion in space; but it not seem that he has taken into account the sec variation of the proper motions due to the cha in direction of the meridian produced by the ing precessions. E.g., the secular proper mo of α Ursæ Maj. is now about 14·5″ in 240°; al the year 2000 B.C. the place of α Ursæ Maj. wa IVh. 27m. R.A. and + 72° 22′ Decl., the sec proper motion being then about 15″ in 181°.

Feb. 28. **H. Sadle**

SATURN'S SATELLITES.

[26899.]—IN common no doubt with m others, I have found much help from the re publication in your columns of some of the per of eastern elongation of Saturn's satellites. I suggest that the publication of each occurre whether at night or not, would be a further provement in enabling an observer to identify satellites in the position they hold at any ticular observation? **Fredk. Wrigh**

SATURN.

[26900.]—MR. WATSON'S drawing and desc tion of Saturn in your issue of Feb. 18th (le 26834, p. 541) was very interesting; but, perh I may be allowed to call attention to a poin which he alludes as hardly visible at the tim his observation, the planet then being not far f opposition. I refer to the shadow of the ball on rings; at the present time it is a most stril feature. In a 6½in. Calver reflector, last even with a low power, the rings appeared almost seve so black and incisive was the sharpness of shadow thrown upon them. **E. Brow**

AGES OF EARTH, DAYLIGHT AN SUN.

[26901.]—FULLY two centuries ago, nebulæ been sufficiently magnified to distinguish vapo ones from star-clusters, and Halley at once marked how they showed the possibility of wo having daylight without a sun. Leibnitz was originator, I believe, of the current cosmog theory, often named after Kant or Laplace, of whole solar system being evolved from the coo of rotating vaporous cloud; and this must alw if thought out, have implied the smallest planet bodies to be the earliest formed, and the sun latest. The whole nebula being at first equ hot, in whatever way it split up, how could smaller fragments escape cooling to a solid or crusted state sooner than the larger ones? this, moreover, every later discovery about t physical states has pointed. This earth, howe humble, is the largest body that we know to h any part solidified. None larger gives the l indication of resembling it in this respect, rather every sign of the contrary, of being wholly fluid. And if our globe seems intellig only as being interiorly of compressed molten within a solid skin, the sun seems quite as tainly a bubble of compressed gaseous me within a liquid skin of some of them. The ne lar cosmogenic theory has gained strength from such facts, and from the ascertained small sities of the great bodies. Yet it seems that quite recently has Faye begun to insist on great difference of age it would compel u suppose between the earth and sun. Those ge gists who may think they cannot compress crust's stratified history into the brief ten mil years that is all Sir W. Thomson will allow of sunshine, have really no call to confine it to period. The earliest formations must have b going on long before there was a sun—in the when his matter was yet only a fiery cloud, yi ing doubtless more heat, but far less light, t this present day-star. Not only the first st (deposited before there was any land), but the vegetation, and whole æons of animals, marin even terrestrial, may have thriven in pre-s days. The huge eyes of many fossil animals (c pare, for instance, those of trilobites with t nearest modern cousins, woodlice, scorpions shrimps, or those of the ichthyosauri with modern crocodile's) would seem to indicate ada tion to a world with less light. As for the Gen story, we must remember it is quite silent a extinct creatures. We must not repeat the lucky blunder by which Mr. Gladstone got Hu down upon him, as if Genesis had professe relate all divine creations, instead of only "heavens and earth, and the host of them."

Man's present "heavens and earth, and the h of them," those creatures of each past æon t were to affect us now to-day—those alone are subjects of Genesis. After creating each of t "God saw that it was good"—that is, permane good, or fit to be preserved to this present seventh æon. But of how many others, or classes of others, He may in each æon have created *pro tempore* and did not see to be permanently good (as trilobites or ichthyosuri) we have not a word. The order is given wherein extant species began, but not wherein the classes or kingdoms whereto they belong began. No species (whatever Huxley may say) can be proved younger than man. Most of the "land population" is much older; but is younger than the vast majority of extant "air-population"—the insects. Again, the whole of extant air-breathers are believed younger than the extant "sea-population," or most thereof. And all extant animate nature is far younger than the vegetables that are our coal; some of which may have extant descendants, and, at any rate, all still serve us. Whether any animal kingdom was contemporary with, or preceded them, the record is, on principle, silent. Certainly there was none that God saw to be permanently good.

From one æon, the second, this phrase, "He saw that it was good," is absent. Why? Because the only act recorded therein is commanding "an expanse" to divide fluids from fluids. A mere expanse, or separation of things already created, was not a creature, and so we do not read "He saw the sky that it was good." Nor is this said of any creatures of that æon, which, for aught that appears, may have been as innumerable as extant ones.

What "Garrison Gunner" says (p. 564) of gravitation seems perfectly sound, and I cannot but regard this force as one of the first four things mentioned. The two creatures of "the beginning" were sky-stuff and earth-stuff, and even if there were no sky-stuff, but space were truly vacuous, we must remember it would still be a creature. The vulgar notion of it as self-existent is quite false. If space has no Creator, who makes its dimensions to be neither more nor less than three?

Now, What but gravitation can be the next thing mentioned? Verses 2 and 3 may be rendered: "When the earth-stuff was shapeless and gas, and darkness was on the face of the abyss, then a breath from God stirred the face of the fluids, and God said, 'Let there be light, and there was light.'" Though Kant and Laplace held that the present system could be evolved from a mere rotating nebula, they gave no reason for its rotation. But this an American, named Jacob Ennis, has done, I think, in a book called "Origin of the Stars." He maintains that an utterly shapeless nebula—that of Orion's sword, for instance—must, if gravitating, not only fall together in time into as regular a spheroid, lens, or watch-like figure as any of the nebulæ present, but must, in so doing, be made to rotate, first, its outer or superficial parts, and ultimately its whole mass, with increasing velocity. The prominences must flow down to fill the hollows, and (unless the original figure were some perfectly regular one) the various currents thus flowing will not balance each other's reactions, but make the whole rotate like a Barker's mill, or a bit of camphor emitting currents of itself on water. Thus gravitation alone seems competent so to stir the most shapeless fluid mass as to make it acceleratingly rotate, and assume such forms as those delineated in Lord Rosse's telescope, which nobody can doubt to be rotating, even if centuries were to detect no perceptible turn. In those spirals we seem to see the stage described in the original "one day" of Genesis. A "breath from God" (namely, gravitation) stirs the face of the fluids and He has said, "Let there be light." Like Newton and "Garrison Gunner," I would regard gravitation as the first and continual unvarying Divine action—a "breath" (or silent utterance) of God continually.

The Andromeda Nebula, from the great angle it subtends, can hardly be doubted to be the nearest one; and why not nearer also than most of the stars, or even than any? Now, the sudden light that reached us therefrom the year before last, not in the brightest nebulosity, but necessarily going in some orbit round it, was just as the birth of a planet should appear if the Creator were to say, "Let the fluids under the sky be gathered into one place, and let solid matter appear." As its lava must become incrusted and dark, so in half a year its light gradually declined to invisibility. Surely, the new earth whose birth was thus witnessed may some day, by our remote posterity, be seen again, when the main central nebulous mass now ruling its motion shall have become a permanent sun, yielding it such daylight as ours. It would seem as yet to be in such pre-solar days as Genesis mentions.

About the fall of a fresh sea on our globe about 50 centuries ago, I hope to satisfy "F.R.A.S." next week.

March 1. **E. L. G.**

HINTS FOR MICROSCOPISTS.

[26902.]—AMONG the numerous readers of the ENGLISH MECHANIC there are, no doubt, many workers with the microscope, and also many beginners. Would it not be a good idea if the former would publish here some of the best "dodges" they have picked up in the course of their practice, for the benefit of their fellow-workers as well as of beginners?

It is to this end that I offer the following hints for examining, from both sides and with high powers, series of preparations of the organs of plants.

It is often necessary to view sections, &c., from both sides; but if the preparations are mounted on the ordinary glass slips, the thickness of the slips prevents us from using the higher powers on that side. To obviate this great inconvenience, I have devised the following method:—

Take two thin strips of vulcanite, wood, brass, or cardboard, 3in. by 1½in. From the centre of one cut out a square ¾in. side, and from the centre of the other strip another square slightly larger than ⅞in. side. Now glue or cement the two strips together, and you will have an aperture ¾in. square, with a ledge about 1/16in. wide all round. On this ledge the preparations are made to rest.

The specimens to be examined are mounted between two thin ⅞in. square cover glasses, in water, glycerine, balsam, &c., and they may be readily examined by putting them under the microscope (either side of the preparation turned upwards) in the frame or carrier above described. The frame is used in about the same way as the carrier for magic-lantern slides.

When the microscope is placed horizontally for drawing with the camera lucida, or for photomicrography, the slide (for we may well so designate our two square glasses holding an object) must be held in position by two thin indiarubber bands.

The preparations may also be *permanently* mounted in the square covers. If glycerine be used, put in the section with enough glycerine to completely surround it, and then fill up the remaining space with glycerine jelly just rendered liquid, but as cool as possible; when this has set, the edges of the covers may be sealed with cement. In the case of balsam or glycerine jelly mounts, it is only necessary to use enough fluid to fill the space between the glasses, and no more. For oils or liquids any of the ordinary cells may be used, and if the remaining space be completely filled with cement, the preparations will be very safe and permanent. The edge of the slide should in every case be coated with one or more layers of good cement—say, Ward's "Brown Cement." The slides will be much safer and more handy if mounted on small square frames of cardboard, all made to fit into a same carrier.

A series of preparations mounted in this way can be readily examined from either side, and the condenser can, at the same time, be brought quite close to the object. The slides can be stored away in a very small space, are easily packed for the post, and both the postage and the preparations themselves come out much cheaper than when glass slips, round covers, and a turn-table must be used. A number written on the slide, or its card mount, will serve to identify the preparation if registered on a list with full particulars. Although I have used this method of mounting only for botanical preparations, it applies equally well to any microscopical specimens, and is particularly useful when one has to prepare, for close examination, a long series of sections of any organ.

I hope these hints will induce other microscopists to give us some further practical suggestions, which, I think, would be heartily welcomed by all the microscopical readers of "Ours."

J. Guardia, F.R.M.S.

THE STRUCTURE OF ARACHNOIDISCUS EHRENBERGII.

[26903.]—I HAVE lately been observing this diatom, with the object of elucidating some new structure; and wishing to read up the latest teachings on the subject, I have turned to a paper read on May 28th, 1886, before the Quekett Club, by Mr. Henry Morland, on "Diatom Structure," and in which, amongst others, he touches at some length on this particular diatom.

He speaks of the valve as being composed "firstly, of an outer layer with large, slightly angular perforations, radiating from centre to circumference, and that this layer is strengthened by interior plates radiating from a central ring." As a matter of fact, there are two central rings and two sets of plates radiating from them; otherwise his description is correct, only it does not go far enough, and this from no fault of Mr. Morland, but simply because his glass will not carry him any further, but gave him as ultimate structure what is in reality only secondary structure. I know the lens (Zeiss's ⅛in. water-immersion) he mentions as the highest power in his possession, and an excellent lens it is; but it requires an oil-immersion to develop the structure properly, and perhaps also requires to be made with the new optical glass. With such a glass I have been looking at this diatom, and beg to lay before the microscopical readers of "Ours" the results of my investigation.

Dr. Carpenter, in his work on the microscope, gives in a separate plate the two sides of A. Japonicus, the arc side with the spider-weblike markings from which it takes its name, and the other as a supporting structure with a resemblance to a circular Gothic window. The representation is a very fine one, with this difference, that it is shown open; but, in reality, the circular Gothic window is glazed, or, in other words, the whole disc on that side is closed in with a perfectly structureless membrane. I stumbled on the fact in this way: I have a slide of A. Ehrenbergii in which the discs are mounted with opposite sides up, and was puzzled at not being able to see some fine markings on some that were perfectly clear on the others, and then found that these discs were wanted with the Gothic window side upwards, and the whole structure underneath had the appearance as if looked at through common sheet glass. It was impossible, however, to see this membrane on all the specimens except one, but on that one there were a few granules imbedded in the surface, and I was then aware of its character. On the other side are the large angular perforations Mr. Morland speaks about; but that also has a membrane closing in the whole disc, but, unlike the inner, has distinct markings which may be either perforations or raised dots, according to the theory of the observer. The large perforations diminish in size from the centre to the circumference, but inside, even the smallest are never less than four minute red dots, and inside the largest five or six.

That this must be a membrane seems to me to be certain, as it is impossible that a dot or hole can stand on a hole, and the appearance is too real to be due to an optical illusion.

Of course all this may be no new discovery; but I have seen nothing since the date of Mr. Morland's paper, either in the *Journal* of the Quekett Club or of the Royal Microscopical Society, that points to its being known. **T. F. S.**

EARTHQUAKES AND EPIDEMICS.

[26904.]—FROM long experience I am inclined to believe that seismic disturbances exercise a beneficial influence on human health. It is rational to suppose that a terrestrial upheaval of concentrated gases generated in our upper strata of animal and vegetable deposits, such as beds of marshes, cemeteries, town drainage, &c., &c., must result in an atmospheric poison, besides the pollution of water supply in wells, springs, and even in rivers. I will not fill my paper with recorded instances; I will merely mention Spain and Italy as cholera-stricken in due course, and that South Africa, just outside Milne's earthquake map of the world, is free from both calamities. Is it not possible that the continuous currents of electricity, passing through the great subterranean laboratory, are vitalising latent germs, and transforming inorganic compounds? How of the seismic effects on ozone and antozone? Observation has long ago proved that the air of Cape Colony contains A 1 of ozone.

Astro-meteorology has had another triumph. Falb and Delauney predicted the late European shock to the very hour. The annular eclipse of the sun with the two greater planets, Jupiter and Saturn, in particular position to the earth and moon were the exciting causes! I recommend Milne's "Earthquakes"; he made this branch of science his special study in Japan, as Humboldt did in South America. I think this is one of the so-called earthquake years predicted by the two foreign *savants*. There are to be others between this time and the end of the present century.

Eos.

HORIZONTAL WINDMILLS.

[26905.]—MAY I ask the "Happy Family of Horizontallers" (see p. 566 and 567) what do they hope to gain by the use of any of these arrangements for mechanically "feathering" the sails. Is it not perfectly plain to be seen that any such additions, if made strong enough to stand the year round, would absorb all, or nearly all, of the available power in turning the machine itself? I conclude that the idea of a horizontal windmill originated in the endeavour to avoid the necessity which exists in the vertical of providing means for making it face all points of the compass. Therefore if any gear is to be applied to move the sails, or to turn an eccentric, &c., in order to suit winds from various quarters, the only advantage obtainable from this form is lost. I repeat, take one sail and one sail on a vertical, and I maintain that it is contrary to mechanical principles that any form of horizontal could keep itself satisfactorily revolving with only one sail, and, of course, whatever number be added is so much additional gain for the vertical.—To "B. and G." There is no similarity between the action of a horizontal windmill and a paddle-wheel; the latter does not act as you seem to suppose. Were a paddle steamer held fast by the stern, and her engines started, she would neither go ahead, nor would the engines stop; and were she alongside of the screw, supposed to be unable to go ahead, most assuredly would she drift astern, because a screw has much more "hold of the water"; and were both vessels of the same H.P., and connected stern to stern, the screw would drag the paddle backwards with the greatest ease, in spite of any amount of splashing.

A., Liverpool.

HORIZONTAL WINDMILLS.

[26906.]—IN your impression of the 18th inst. (p. 543, 26845) "A., Liverpool," defends his previous statement that a horizontal windmill would require as powerful support as a vertical of the same power, which may be true; but as he had already laid it down that the power of the vertical mill was infinitely superior to that of the horizontal, equal power was not so much the question as a cheap, useful power, for many minor purposes, which modern science is now on the look-out to secure.

Consider the great expense and the exclusive space and situation required for the vertical mill of full power; £500 would be a small sum to lay out on it, whereas £50 would be a large amount to spend setting a horizontal wind motor to work, and any open space will do for it, or in the centre of a town provided you go just above the immediately surrounding buildings. It is not fair, therefore, to condemn it, because it cannot effect for £50 what another method requires £500 to accomplish.

Referring to the letter "J. Q. D." (26895, p. 566-7), he tells that Smeaton (a great authority, by the bye) experimented exhaustively on horizontal windmills in 1759, and "unconditionally condemned them." There is no evidence of his having done so exhaustively. This is a figure of speech by which a man is apt to excuse himself for abandoning a pursuit in which he has not yet been successful. It is a mistake to suppose that an oblique sail is more powerful than one square to the wind. 'Tis true that a ship sails faster with the wind over her quarter than dead before it; but that is because all her sails "draw," whereas with the wind right aft the head sails are becalmed by those abaft. When hauled upon a wind she will not sail so fast, though every sail may be at full stretch, and she is not running away from the wind, as when her yards are squared before it. Suppose, for instance, the horizontal mill and the vertical were suddenly stopped in a strong wind, which sail, the one standing square to the wind, or that lying obliquely to it, would have to bear the greater strain? But the vertical would have to bear the strain at every point: the horizontal chiefly on that part of its sail power which was squared to the wind at the moment.

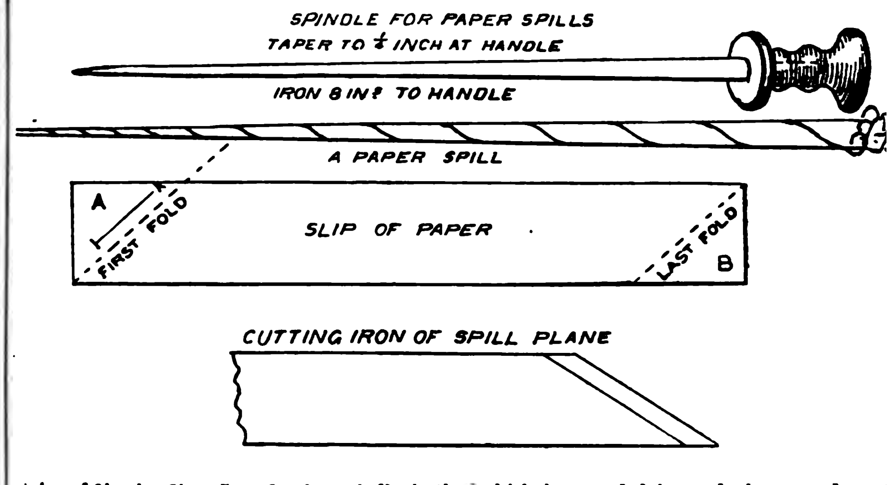
As to "B. and G." (26896), who are going to set up a horizontal wind motor, which they have begun, and hope to finish in about a month, we may expect rather a complicated affair from the long time it requires to prepare it. They are rather wide of the truth, too, in their observation about paddle-wheels and screw-propellers. Are they aware that the mighty steamers which cross the Atlantic in six or seven days, through all weathers, are driven by screws?

London, Feb. 28. **Q. E. D.**

[26907.]—IN the sketch of my horizontal windmill (Fig. 4, p. 566), the arrows ought to be from the right of the figure, not as represented, by error of the engraver, from the base.

W. I. S. Barber Starkey.

SPILL MACHINES.



[26908.]—SPILLS are of two distinct kinds of wood or rolled paper. Deal, cedar, and soft white woods are usually employed in the make of the first-named. Pine plank, ½in. thick, without knots, I use in quantity for lighting my workshop fires and my pipes. Cedar for drawing-room consumption, as it yields so fragrant a smoke. The white woods, when worked into spills, are dipped in Judson's dyes, and are made up into pretty bundles as gifts to charity bazaars; they are in great demand. The machine for cutting spills closely resembles a rabbet plane. It requires great practice and lightness of touch, or will fail in work of uniform appearance. I think my plane came from Sheffield. After trying in London and other likely places in vain, I met with this one in the workshop of a country joiner, who could not use it, and had come into possession of the tool by chance.

A wooden stock, a short cast-iron bed, and a plane iron form its component parts; a drawing of the whole put together would be unintelligible. I, therefore, only send a sketch of the last-named piece, which cannot be kept *too sharp*. In the hands of an expert the shavings fall off in closely curved taper spirals—all alike.

Enough of the wooden article. Now for the paper affair. I collect all the gay-coloured circulars, advertisements, catalogue pages, and white wastepaper, too. I fold and cut the supply into strips of 9in. by 2in. I made the spindle in the lathe from a piece of stair rod, cutting a screw at the thick end, where it enters the hard wood handle. "Practice makes perfect." A blind man could make a living by it, as it is all a matter of "fingers." Being hollow, these spills when lighted burn finely, as the least pressure blows out a flame like a tiny gas jet. I have sketched the tool and mode of use. The sharp end of spindle is put across three-parts of the corner at the dotted line; the paper is then folded *tightly* over the iron, slowly and securely wrapping in that folded piece, each successive turn of the spindle over-wrapping the edge of paper. Loosen back a little as you go on by pulling handle, and so on until you get to the end of paper B. Secure tight with left thumb and finger, while right thumb and finger twist the thin empty end at the point; then with same hand draw out the spindle firmly, keeping a firm grip on the last fold with left hand. As soon as the spindle is extracted, compress and fold about one inch of the thick end.

Note.—The plank for cutting wooden spills must be of the exact thickness to fit the groove in the cast-iron bed; said plank is secured edgeways in the clamp of joiner's bench—½in. plank is my size.

Eos.

HYGROMETER.

[26909.]—WILL some reader kindly give me some information as to the manner of using a wet and dry bulb thermometer in the matter of forecasting rain, &c.? In the early mornings, before I leave home for town, the air is often saturated with moisture, even though the day be fine afterwards. How are such readings of value? or should they be taken at mid-day? Any information bearing upon this subject, which I cannot find in print anywhere, will greatly oblige.

Al Fard.

THE LUMINIFEROUS ETHER.

[26910.]—I WAS very much pleased with "Sigma's" letter. Matter itself may have no weight; but the weight may be a measure of force charged upon it. I think that the ether may be matter itself in an invisible state—in fact, it must be matter of some kind, for without matter there can be no force. Gravity must be caused by pressure of some kind pressing everything down to the earth. There is no such thing as attraction when bodies move towards each other; it is because there is less pressure between them than on the outside, so they are pressed together, not drawn. As regards there being no electric action in space—will not a magnet act on another magnet under an air-pump receiver, as well as in air? Air is mostly manifested by its action on surrounding objects. Are comets acted upon by electricity in space? It is strange that they should move towards the sun, and then move away from it again. Hidden thoughts must be my excuse for asking two questions—namely, Does the gyroscope turn the same way under an air-pump receiver as in air? Do all bodies the same size as the sun shine by their own light? I have often thought it strange that electricity should cause the light it does by making the carbon red or white-hot without the presence of oxygen. I hope to see more on this subject.

B. R. Mills.

IMPERISHABLE PASTE.

[26911.]—I HAVE always found the (so-called) "Perpetual Paste" very susceptible to damage by damp. Whenever I opened a jar in a few days a thick, leathery fungus began to grow on the surface of the paste, which consumed and discoloured the contents. I obtained the manufacturing recipe, made a lot of paste, and the result was the same. The alum powder, resin, and cloves were not lasting preservatives, so I tried some experiments
which have ended in producing a good tenac
product of antiseptic quality; moreover, so a
sive that when I tested its power by continu
sponging with hot water some newspaper sc
fastened on printing paper, I could only get t
off *in shreds*. Here is my recipe:—Take a com
teacupful of the best white flour, stir in a
glazed saucepan with rain water until q
dissolved; not a lump must remain: it must
like cream. On a trivet, with half the saucepa
the fire, keep stiring with a glass rod (to prev
burning, which would spoil the colour and tena
alike). When about as thick as a custard, rem
from the fire, let it stand till it begins to coagul
add by drops a dessert-spoonful of chloralum
the half-pint at any chemist's), whisk the p
well with glass rod, then, while the paste is
warm and soft, pour it into a wide-mouthed g
jar, finally adding six or eight drops of the pu
carbolic acid, whisk the mass again with your g
rod, and then insert a tight stopper.

Rice paste is the one in general use through
India and China. The rice is boiled till soft
sticky, then crushed into a semi-transparent m
a pinch of sulphate of copper is added in pow
and stirred in. This is a good preservative, but sp
the colour, so I substituted corrosive sublim
This is a very suitable cement for artificial flo
makers and such like fancy workers. It can
be used in a freshly-made state. **Eo**

ROAD REFORM.

[26912.]—"NORFOLK" (letter 26852) in mal
an estimate, must not forget the provisio
proper access to the fields that would practicall
cut off if the roads were levelled. This, tho
apparently a small matter, would be an expen
one, as fields adjoining hilltops, as well as vall
would be affected, and I suppose he would
grant that the cost of removing hills would
with the kind of rock to be excavated. I do
know what may be done if he had an Imp
prerogative; but personally I believe that o
things done by Imperial prerogative are far f
being cheap. A hill 60ft. high would only
baby compared with several in the neighbour
from which I write, and 30ft. taken from the
would not raise the bottom 30ft. even with
addition of a substantial bridge, which woul
many cases be necessary. **T. R. Glanfiel**

BURNT AIR.

[26913.]—"J. Q. D." advances the theory
what is known as "burnt air" from iron stov
due to hydrogen being produced by the reduc
of the aqueous vapour in the air by the he
metallic iron; and is, further, very indignant
"A. P. S." for venturing to call his idea
question.

If "J. Q. D." were a little better acquainted
the theory of chemistry, he would know that
reduction of aqueous vapour by metallic ir
impossible in the presence of an excess of a
spheric air. **F. C.**

L. AND N.W.R. COMPOUND LOCOMOTIVES.

[26914.]—So far as the hauling of heavy l
goes, these engines seem now to be doing very
work; but they do not appear as yet capabl
attaining the highest speeds—at least that i
experience. On Sunday, Jan. 30, I travelled
Northampton by the 3.5 express, booked to
60½ miles to Willesden in 70 minutes. Thi
nearly 52 miles an hour; but, as is well kn
with the exception of the first six miles to R
(about 1 in 200 rising), and the six miles prece
Tring (about 1 in 330 rising), the road is extre
easy. The train consisted of 8 coaches, and
drawn by "City of Edinbro'," a large compo

The weather was favourable, and the road clear. The time made was as below :—

Miles.		h.	m.	s.	Speed.
	Northampton	3	6	37	
6·05	Roade, pass	3	16	46	35·7
13·36	Wolverton............	3	25	40	49·2
19·08	Bletchley	3	32	30	50·2
25·59	Leighton	3	40	20	49·8
34·16	Tring	3	51	0	48·2
48·33	Watford...............	4	6	20	55·4
54·33	Harrow	4	13	0	54·0
60·44	Willesden, arr	4	19	42	54·7

Thus it will be seen the engine lost over three minutes with a light load, and solely through deficient speed.

A few days before I travelled from Blisworth to Willesden with another large compound, "City of Glasgow." The load was 11 coaches. We were ten minutes late starting, and owing to deficient speed took 22 minutes 20 seconds to Bletchley, the booked time for the 16 miles being 21 minutes. We lost another quarter of a minute from Bletchley to Willesden. There were no slacks, and the weather was favourable. Again, on Dec. 10, 1886, I travelled from Northampton to Bletchley with "Autocrat." We took 27¼ minutes for the 19 miles, instead of 26 minutes. The load was 15 coaches, and the time was lost in running down hill, not in mounting the bank to Roade.

It is curious to notice that after running several miles down hill, as between Roade and Wolverton, the maximum speed at the bottom of the hill will not exceed 56 or 57 miles an hour. I have never exceeded 62 miles an hour with any compound, and then only for short distances.

I came from Willesden to Northampton one night in 70¼ minutes with the 6.45, drawn by "City of Manchester," and this included a signal slack outside Bletchley. This was very good running; but I fancy the compounds running the 1.30 p.m. down not infrequently lose time to Northampton, though the booked time is the same as the 6.45.

Feb. 28. **Kappa.**

ELECTRIC CAUTERY.—TO "IOTA" AND DR. STEWART.

[26915.]—SINCE writing my last letter on this subject I have made an exhaustive series of experiments as to the amount of current in ampères (as measured on one of my own instruments) required to heat platinum wires of different diameters and weights to bright redness. I may mention that I have found the platinums of commerce to vary excessively; some being quite soft and very difficult to incandesce, others being hard and, generally speaking, easier to raise to a bright, cherry-red heat. I also have found that the very fine wires require, comparatively speaking, much more current to bring them to a red heat than those of larger sectional area. For this reason I have inserted only one very fine wire as an example in the following table :—

B.W. Gauge.	Weight per Foot in Gas.	Current in Ampères required to Red-hot.
No. 40	0·833	3·0
„ 28	15·0	8·0
„ 27	18·5	10·5
„ 26	22·8	12·9
„ 24	40·0	21·0
„ 22	63·5	30·9

Disregarding the first line of figures, in which the current acquired is abnormally high, it would appear that for a given length of platinum wire the current required varies inversely with the weight; and with pure platinum, the average current needed to raise to bright redness the wire may be put down as half an ampère for each foot-grain.

S. Bottone.

AMMETERS AND VOLTMETERS.

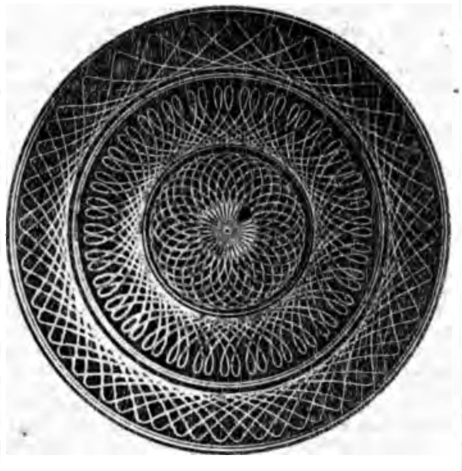
[26916.]—MY thanks are due to Messrs. "Ohm" and Dr. Dunlop Stewart for the patient and careful tests to which they have subjected the above. Their results are certainly very instructive and *concordant*, especially as regards the measurement of the *resistance* of the copper strip 1⅛in. by ⅛in., by 1/20in., which forms the conductor in all my ammeters of this price (5s.). It would greatly add to the value of the above results if Messrs. "Ohm" and Dr. Stewart would compare their own instruments—say, the resistance coils, and publish the results.

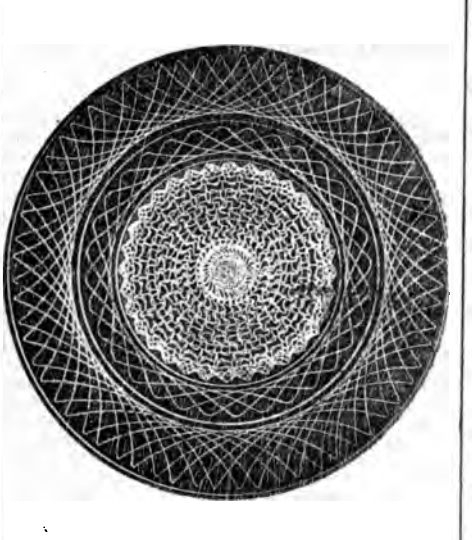
I may add that I have lately received a letter from Mr. James Murray, of 11, Dalhousie-square, Calcutta, who is employed by the Indian Government in electrical installations, in which he says (speaking of my 5s. ammeters): "Very good for the price, as far as appearance goes; but they are still better as to being correct recorders. I have had them tested at the Government offices, and they were *exact*."

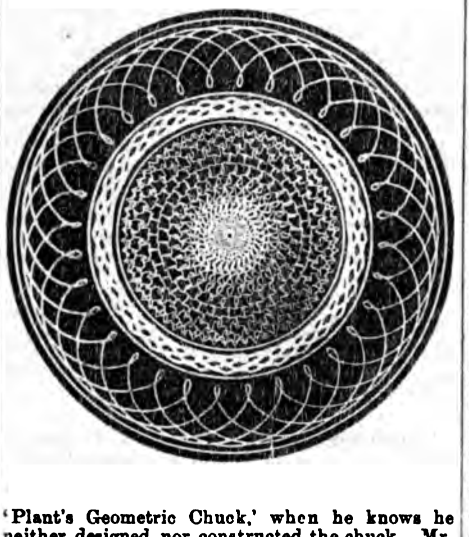
S. Bottone.

LATHE MATTERS—AMATEURS—GEOMETRIC CHUCK.

[26917.]—IN No. 98, Vol. IV., of the ENGLISH MECHANIC, dated Feb. 8, 1867, there is a letter from the late Mr. Hartley, in which he says: "I am puzzled to know why Mr. Plant should designate the turning apparatus he is possessed of as 'Plant's Geometric Chuck,' when he knows he neither designed nor constructed the chuck. Mr. Plant knows well that the chuck he bought of me," &c. Then follows a letter from Mr. Plant, in which he says: "All I claim is an entirely new method of putting the chuck in motion," &c.







Now, I headed my letter "Amateurs." Well, there are amateurs and amateurs. Some can get tools made by professional makers, and others are so impecunious as to be obliged to make their own. Now, I am one of the latter; and in 1846, 21 years before the letters above referred to, I invented the loose wheel called B on page 308, Vol. IV., "E. M.," giving "independent motion to the chuck"; so it appears I was 20 years, at least, in advance as to the "independent motion."

The old chuck is still in existence, and although it has suffered from rough usage, yet it can make a curve or two, as the inclosed blocks will show, if you think them worthy of a place. Critics will, I hope, be charitable, as I am 75 and the chuck 42 years old, so both the worse for wear.

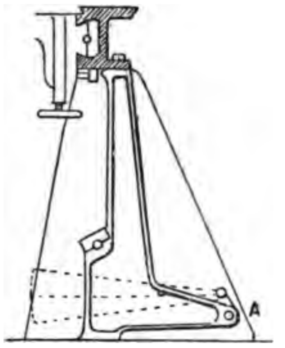
J. Allen.

LATHE MATTERS—THE "E M." LATHE.

[26918.]—"VULCAN" and I appear to be left pretty much to ourselves to make the best we can of the "E. M." lathe. I think some readers may have forgotten why it is that we seek for a new method of attaching chucks. It may be well to remind them that we want to be able to take a piece of work off the mandrel and fix it upon another chuck and yet still have it run true, that is to say, interpose another chuck between the work and the mandrel without disturbing its truth. The old screw will do this, but only if very carefully treated; but as we wish to contrive a plan which our readers can carry out for themselves at home, both "Vulcan" and myself lean to the cone fitting (or to the large flange plan) because it appears easier to insure the perfect truth of a simple surface such as a cone, than that of a complex shape—such as an Edmunds nose.

The ingenious devices of "Vulcan" interfere with the ring of the oval chuck, so does the large flange plan. I think, too, that "Vulcan's" links and dogs are too complex, and would require longer to adjust than the old screw-nose. The screw ferrule plan, illustrated on page 499 of Vol. XL., avoids all these objections, and I begin to go back to this plan, except that there must be a V-thread instead of the square one shown.

As to the sketch of the lower part of the "E. M." lathe, published a fortnight ago, I forgot to explain the use of the flywheel shown to the right of the lathe. This is intended to be taken off and put on as required, and to it would be fixed the balance weight: the idea being, that when using the lathe for light work, or when swinging the wheel half round and back, as with the traversing mandrel, one would require a light wheel of about 50lb. weight, unbalanced; whilst for ordinary metal-work one would prefer a balanced wheel of, say, 70lb. or 80lb. Here, then, comes in the second flywheel, which I propose to make of about 80lb. weight, and give it a counterweight to bring up the treadle to starting point.



"Vulcan" has pointed out to me in a private letter that the right-hand standard as I sketched it shows no provision for allowing the rack and pinion to pass. No doubt, this would have become evident in making the drawings; but I am much obliged to him for pointing it out, and hope to get more help from him, from "Glatton," or from anyone else who will kindly help us. I am anxious to provide for accessibility of the parts, and wish to arrange so that not only all the slides of the rest can be taken out or pulled off by simply unwinding their lead screws, but that the front slide itself should go on with equal ease. I think this can best be done by adopting for the right-hand standard a shape similar to the inclosed sketch. This is a single foot; it only supports and cannot twist the bed, however uneven the floor may be. This shape allows the rack and pinion to pass, also the hand-wheel of the vertical slide, and makes it easy to put in and take out the crank-shaft. It should, however, be remembered that the stay-bar at A is quite a strong one, an inch or more in diameter. By this arrangement the front slide could be racked off to the right without taking off anything. I must, however, provide a support for the leading screw inside the front slide, as none is shown in the drawing already given.

I intend to undertake complete working drawings of the whole lathe this summer, and next winter to proceed with the patterns. I propose to deposit these with Mr. Milnes, who tells me he can supply a set of planed castings for about £12 10s. I think I know of three who want a set, and perhaps others will join when the drawings are completed, and possibly some of them will undertake some of the patterns. **F. A. M.**

TO ANALYTICAL CHEMISTS OR OTHERS.

[26919.]—YEARS ago, the chemist Wach made the following curious experiments: (1) In three glasses he placed the following respective proportions of colourless anhydrous sulphuric acid and sulphur—viz.—

$$\text{Glass, No. } 1 - 3SO_3 + S = S_4O_9,$$
$$\text{,, ,, } 2 - 4SO_3 + S = S_5O_{12},$$
$$\text{,, ,, } 3 - 6SO_3 + S = S_7O_{18}.$$

(2) In three U-shaped tubes we put 40 parts of same sulphuric acid and then introduced—

$$\left.\begin{array}{l} \text{in } U \;\; - 8 \text{ parts} \\ \text{,, } U' - 6 \;\; \text{,,} \\ \text{,, } U'' - 4 \;\; \text{,,} \end{array}\right\} \text{yellow solid sulphur.}$$

In both experiments appeared curious phenomena, which neither the author nor any other chemist of the time could explain. Can modern chemists do it now?

Every chemist knows that sulphuric acid is the result of the combination of one part of yellow, solid, brittle, crystalline, tasteless sulphur, with three parts of invisible, gaseous, tasteless oxygen: but how do they explain that a solid combines with a gaseous body and forms a liquid? How can yellow sulphur become colourless, and invisible oxygen become visible? How can two tasteless bodies form a most powerful acid? Where does the acid property come from? Now, an equal proportion of solid, yellow S being added to unequal quantities of colourless liquid acid, one might have thought that either again the yellow colour of the sulphur would vanish, or the different liquids would be coloured in yellow, in proportion with the respective quantities of each. But such was not the case. In both experiments the yellow colour of the sulphur entirely vanished, and other colours appeared in its stead. What became of the yellow—from whence came the new colours? The colours produced were not the same. How can the same substances, varying only in proportions, produce different colours. Proportions are not dyes. Can these colours be foretold and explained in their constituent elements? There was no colouring matter introduced. What caused the colours? Of course they are produced according to a chemical physical law, since the colours in 1, 2, and 3 glasses were the same as those in U, U′, and U″. What is that law? The colour produced in No. 1 and U was red, that in No. 2 and U′ was green, and that in No. 3 and U″ was blue. Why was it these three colours, rather than orange, indigo, and violet? Were the colours produced by the combination of the two combined substances, or only by one of them in consequence of their arrangement, and in the latter case by which one?

If in U nine or ten parts of S be introduced instead of eight, the exceeding quantity remains unsolved. This liquid does not freeze in the greatest cold, exposed to daylight crystals of sulphur form. It boils at 38° C., and separates in two layers, the upper one being yellow-brown, the under one brown; then a part of the sulphur separates, and the liquid becomes sulphurous acid, containing but very little anhydrous acid.

In U′, in varying the mode of introduction of the sulphur, different results are obtained. In one the liquid is green, in the other it reflects the blue light, and transforms the blue in green; exposed to daylight, the acid deposits some flakes and turns brown.

In U″ if the quantity of sulphur is less, a determined quantity is dissolved, a blue liquid is formed, and there remains an excess of acid. In six weeks in the dark, and in eight hours in the sunlight, the blue liquid deposits some flakes of sulphur, and becomes yellow brown. If one of the two branches of the tube be heated up to + 56° C., and the other cooled down to − 10° C., the vapours that condense form two layers. The under one is brown, the upper one yellow. Are the laws of these curious phenomena known? What are they?

Inquisitive.

IRON SMELTING.

[26920.]—A FRENCH engineer has invented a process for extracting from its ore iron in a state of purity, in a single and continuous operation, without blast or puddling furnaces, without coal or coke, the ore supplying more combustible than necessary. The metal can be obtained at will in the state of cast or soft iron, or in that of steel, at any desired degree of carburation from 2 to 42 p.c., according to the use to which it is destined, without a converter or cementing furnace. The iron thus obtained costs 27s., and the steel 28s. per ton. I extract the above from a *mémoire* sent to me by the inventor. Is this method known and practised in England?

Morchain, Somme, France. **Ch. Rabache.**

CHEAP AMMETERS AND VOLTMETERS.

[26921.]—WE are generally cautioned, when speaking of anything cheap, that a good instrument is the cheapest in the long run, and that as Mr. Preece says about switches, "They are generally cheap and nasty." Of course, if we want to do accurate work, especially if engaged in original research, we must put our hand in our pocket, or else we are stopped at the commencement of our career by not working, as we were told last week, with "scientific accuracy—not roughly." The Bottone ammeters and voltmeters are suffering freely at the hands of the testers. When I first got mine, I compared the voltmeter with a Clark cell, set up very carefully by the potentiometer method, and found one side of the scale ·6 of a volt out; the other, or S. W. half, was quite correct on the one side, and ·25 amp. out on the other, but owing to frequent use, on recalibrating I found it about 40 per cent. wrong. Its resistance as marked is ·0031w., and actual resistance = ·0041w. at 15° C. The resistance was taken by coils graduated off standard coils from Sir W. Thomson's laboratory in Glasgow University. The current was measured by an Aryton and Perry ammeter, freshly calibrated by Dr. Fleming's potentiometer method. The great fault is friction. You need to tap the table to bring the needle to its proper deflection or to zero. Why does Mr. Bottone not double the price and quadruple the accuracy, and then we would have a fairly accurate and handy set of instruments? There is one point, I think, that may cause variations in the reading, and that is the variable value of H. The horizontal intensity is always changing in a laboratory, and as the ammeter depends on this for its deflection, it is very likely to give different readings in different parts of the same room. **Iota.**

EVOLUTION.

[26922.]—IN "Study of Sociology," 10th ed. p. 415, Mr. Herbert Spencer writes:—"Evolution, as I understand it, and creation as usually understood, are mutually exclusive; if there has been that special formation and adjustment commonly meant by creation, there has not been evolution; if there has been evolution, there has not been special creation. Similarly, unchangeable laws, as conceived by a man of science, negative the current conception of Divine government, which implies interferences or special providences," &c. But in "Scientific Obstacles to Christian Belief," p. 56, Canon Curteis writes:—"The hypothesis of evolution is nothing else than an attempt to explain *how* the heavens and the earth were created, leaving the statement quite untouched that they *were* created." Perhaps someone who understands this subject, and is familiar with the latest development of the evolution theory, will kindly explain these quotations. To me they seem contradictory; but with my limited knowledge of the subject, I may be wrong.

It may be that from an original chaotic nebulous mass the solar system has arisen, and that "an integration of matter into worlds has taken place through a decline of heat." Assume, for the sake of argument, that this is so. I take it, in such a case, Canon Curteis would mean that though the theory explains the manner in which the nebulous mass became decomposed into a system of worlds, it does not explain away the fact that that mass was itself created. I understand him to mean that carry back evolution as far as you will, you at length come to a point where creation intervenes, creation of the matter of which you trace the evolution. Assuming I am correctly interpreting the Rev. Canon's remarks, what I desire to know is whether the statement of Mr. Spencer is or is not at variance with this interpretation? If it is, what is Mr. Spencer's exact meaning?

Mr. Spencer says unchangeable laws negative the "current conception" of Divine government. Does he mean they negative all conception of Divine government, or only the present conception of it? **C.**

Repairing Cracks in Stoves.—It is stated that cracks in cast-iron stoves may be effectually closed up and cemented by the use of a mixture composed of wood ashes (passed through a sieve), finely powdered clay, and a little common salt. These ingredients are worked up with some water, and applied to the stove when cold. The cement hardens on being heated, and, it is said, will neither split nor crack. There is now ample evidence that the use of oil may be of considerable service in lessening the effect of dangerous seas. In one case the "slick" made by the oil extended 30ft. to windward, and the United States Hydrographic Office concludes that the oil is of use when the vessel is reaching ahead at the speed of eight or nine knots, with a beam wind and sea.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61092.]—**Battery.**—TO "LUMSIE."—I have received your postcard (on which by the way you do not state your address), and had not forgotten the matter, but was waiting for you to give particulars of the new machinery you were going to get—water or steam, as on the power of this will depend the dimensions, &c., of the dynamo, and to a certain extent that of the secondary battery also. As regards this last, the briefest practical directions for the construction and forming of these, such as would enable an unskilled person to make them successfully, would occupy columns of space in the "E. M.," even if I were disposed to publish such. The best advice I can give you as to the accumulators is to refer you to a paper I compiled some little time ago on the construction and formation of accumulators from plain lead pipes, and which I can furnish you with if you care to write to me, but which has not yet been published. As to the dynamo, I will send you particulars for it whenever you let me know the maximum indicated H.P. you will have at your disposal on the pulley of your turbine or steam-engine, whichever you adopt.—EDWARD CONRY.

[61124.]—**Analysis of Lime.**—In the titration with standard solution of oxalic acid to estimate the free CaO in a sample of quicklime, the cause of the return of the colour of the phenolphthaleïn which was used as an indicator is owing to "F. S." not having run in sufficient acid. Try again running in the $\frac{N}{1}$ oxalic acid solution until, on stirring, the pink colour does not return. If the difficulty of "F. S." in the use of phenolphthaleïn as an indicator had been in the other direction, it could have been better realised, as in titrating an acid solution with an alkali the pink colour disappears almost directly. This is due to the presence of carbonic acid in the atmosphere, which at once tends to neutralise the alkali. The sensitiveness of phenolphthaleïn to carbonic acid is about the only drawback to its use as an indicator in alkalimetry and acidimetry. In titrating an alkaline solution with an acid or *vice versâ*, Poierrier's orange III. is best, except in the case of organic acids. R. Engel and J. Ville have found that sulphindigotic acid and Poierrier's soluble blue (C.4.B.) are both more delicate than phenolphthaleïn or phenacetoline as indicators for use in the volumetric determination of caustic alkalies in the presence of carbonates. A full account is given in the *Comptes Rendus* des Séances de l'Académie des Sciences (1885) 100, 1074. If "F. S." would like to know more about them, I should be glad to comply with his request.—HENRY J. HARDY, F.C.S., Sheffield.

[61131.]—**Electric Cautery.**—In reply to "Iota," I may mention that the ammeter tested by Messrs. Conry and Dunlop Stewart was a very rough affair, which I have been using for the last two years as a standard whereby to test others. For my own convenience, I have graded this to $\frac{1}{10}$ for the first ampère, but do not send out my 5s. with this sub-division, unless specially ordered, as for ordinary work, such as battery and lamp testing, the eye can judge near enough to ¼ or ½ the first ampère. Regarding the question of the moment of a magnetised needle, has it ever struck "Iota" that in proportion as a needle loses magnetism, so the earth's pull on it becomes less? Hence the current will have also less difficulty in moving it, but also will affect it proportionately less? This is a most interesting question to me, and I trust to other students of electro-magnetism.—S. BOTTONE.

[61131.]—**Electric Cautery.**—I judge, from Mr. Stewart's last letter, that he has a reliable galvanometer, which he wishes to calibrate in ampères. The following information will enable him to do so. The instrument must be calibrated within a few miles of the place where it is to be used. The values in ampères of the deflections of a tangent galvanometer can be determined by calculation. The formula is—$C = \frac{5 H K}{\pi N} \tan. \theta$; where H is the horizontal intensity of the earth's magnetism, K the mean radius of the coil, n the number of turns, and θ the deflection observed. In practice galvanometers are calibrated either by comparison with a standard, or by a silver or copper voltameter. The silver voltameter is the more accurate, but is seldom employed, owing to the cost of the plates and solutions. A 15 per cent. solution of silver nitrate is employed. The copper voltameter is generally used. With care the error is less than 1 per cent. The copper plates are placed in a saturated solution of pure copper sulphate in distilled water. The density of the current should be not far from ⅓ ampère per square inch of surface exposed by the receiving plate or plates. The

' plates should be carefully washed in dis-
ter, alcohol, and ether, carefully dried and
in a delicate balance. The difference in
efore and after the experiment is taken to
nount of copper deposited. The duration
deposition should not be less than
tes. The current should, if possible, be
nstant during the deposition. If the
is not contant, frequent readings of the
eter must be taken and the proper
calculated. One ampère hour deposits
. of silver and 1·184grm. of copper.—G.
r.

]—**Heating of Platinum Wires, &c.**
last, "Iota" says, speaking of ammeters,
nent of the needle is apt to change, and
ws the graduation out." This is, I think,
as any change in the magnetic moment of
e affects not only the pull tending to de-
ere to the current passing; but also the
e to the earth's magnetism, which tends
nt a deflection—*e.g.*, an increase in the
ation of the needle would cause it to be
ongly acted upon by any current; but
force would also act more strongly just by
amount, so that keeping the ammeter in
t magnetic field, changes due to increased
sed magnetisation cannot alter the value
eflection. Of course, this only refers to
trolled by the earth's magnetic force. If
eter is controlled by gravity or springs,
ges in the needle will affect the value of
ction. The results on heating wires by
re interesting; but, if I am not in error,
nt values are much too high. This may
use by the wire not being pure platinum,
meter in use reading too high. The latter,
ly, if "Iota" used the instruments noticed
, and which I find strongly recommended
No. 1,139. I think, before he does any
ork with these, which may mislead others,
to have them checked, and if he will give
s in "Ours" it would be interesting. He
t the specific resistance of the platinum
unless it agrees with the value given in
he may depend there is something wrong
OHM.

]—**To Mr. Bottone** (**U.Q.**)—This query
y attention; if not too late I would say:
chine is series-wound, the amount of wire
lds is altogether out of proportion to the
n the armature. If the machine is shunt-
d works as a motor, you will find that on
with sufficient resistance between the
it will give current enough to light four
.p. lamps. A shunt-wound dynamo will
unless a certain resistance exists in the
uit.—S. BOTTONE.

]—**Static and Potential.**—This query
ed by "T. C., Bristol," on p. 419; but it
o me that it has not been sufficiently
for I think it has some reference to a
about the possibility of a "boy lifting
ght without machinery," an extraordinary
, which appeared some time back. One
ost respected friends answered that there
fficulty about it, and at once introduced
on of elasticity in the cords, which did
r in the original statement. It seems to
when an elastic cord is stretched and
o a weight that the energy put into that
a certain extent potential—there is, so to
tore of it, which can act at some future
when a simple cord is attached to a
rely that is static stress, and no matter
cords are attached the weight will not
There must surely be some potential
red in the cords or in the things they are
o, if they can lift the weight. How is
do not understand the latter part of
answer.—A. Y. Z.

—**Electric Bath.**—The proper connec-
induction coil for an electric bath is the
the secondary to the spine and the − to
nities of the body—e.g., the + hanging
ter and the − applied to the hands or
water, or the + applied to the back of
above water, while the − is attached to
of the bath. Care should be taken that
t goes in the direction from the spine
o the limbs, &c., otherwise the applica-
do more harm than good.—EDWARD

—**Medallions.**—I do not think you
le to restore your plaster medallions to
inal colour. The best plan will be to
either white, terracotta, or bronze. I
bronze for medallions.—APOLLO BEL-

—**Charcoal for Small Forge.**—Thanks
ay. It is charcoal from wood that is re-
—AMATEUR BLACKSMITH.

— **Colouring Statues.**—"E. X. P."
ix some "flat" colour, composed of
stone ochre, Venetian red, and driers, mixed with turps. The pigments should be well ground up, and strained through a piece of muslin folded double. The paint should be "stippled," so as not to leave the marks of brush. More particulars if necessary.—APOLLO BELVEDERE.

[61451.]—**Defective Fire-engine.**—There is not much to say in connection with this query, except to advise the querist to take off the cover of the valve-chest, and watch the motion of the valve as the engine is worked round. Then set the eccentric so that the valve will open sufficiently.—E. G. M.

[61452.]—**Electrical Apparatus.**—Thanks to "Ohm" and Mr. Conry, but I don't quite see Mr. Conry's idea about "half the cost of full-strength solution." The chemicals once used in a battery are of no further use in another set of cells. What does Mr. C. mean by "the half-spent solution is reconverted into a saturated solution by addition of fresh chemicals?" We hear such a lot about primary battery lighting; have any details been published about an installation worked by them?—ELECTRICAL STUDENT, NO. 2.

[61460.] — **Stonemason's Shellac.**—If this means "cement," take (say) 40lb. of washed river sand, 4lb. of litharge, 2lb. of quicklime, and mix into a thin paste with linseed oil. If it must be really "white," I suspect that plaster of Paris mixed with gum water or white of egg, and applied quickly, must be used.—NUN. DOR.

[61461.]—**Keeping Albumen.**—The whites of "W.'s" eggs may be converted into bookbinder's glair and preserved by the addition of a little vinegar; but if his wine is worth the trouble of fining, I would advise him to use the albumen perfectly fresh.—NUN. DOR.

[61462.]—**Legal.**—Yes, if the parish orders paving, and the querist has a corner house, it is one of the advantages of houses in such positions that you have to pave not only the front, but the side as far as the land extends.—SAML. RAY.

[61474.]—**Silver Cell.**—I see "Ohm" quotes Jamieson. I am in Prof. Jamieson's laboratory, and I know that on setting up his battery of silver cells they are short-circuited through a low resistance, about 6 to 10 ohms, for 20 minutes to half an hour, and, as the resistance of the battery is 43 ohms, the external resistance is a great deal lower than the internal. In using my silver cells, unless first short-circuited, the indicating needle deflects more and more as the cells begin to lower in resistance. The horizontal form of cell is very handy for testing purposes, and lasts some time.—IOTA.

[61475.]—**Automatic Blowpipe Apparatus.**—There are several blowpipe arrangements answering the conditions set forth by "Tal-Cato"; but he appears to refer to some special arrangement, and must give more details to enable it to be recognised. He should look in Fletcher's catalogue and Mr. Davies's work on "Plumbing" for all sorts of blowpipe arrangements.—T. P.

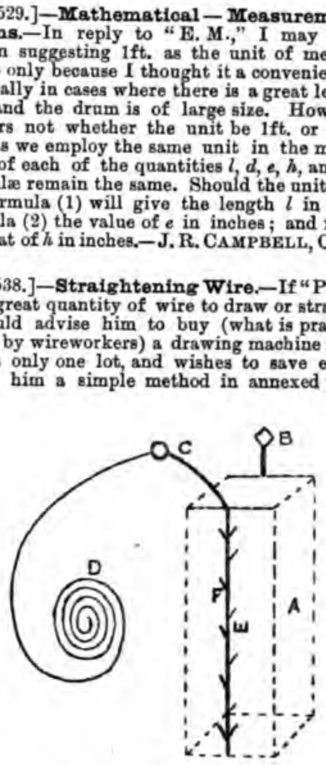
[61481.]—**Newcastle and Carlisle Railway.**—Should not "Rover" refer to existing drawings of the "Comet," say, Mr. West's interesting sheets? There is an illustration of it in last week's *Engineer*.—S. T.

[61499.]—**Storage.**—No one has yet replied to the part of my query referring to the "Thomson-Houston arc lamp." Can anyone say where I will find a description or review of it, or would "One Who Knows" give a short explanation in the columns of the "E. M."?—IOTA.

[61518.]—**Gas-Engines.**—TO "J. MCG. AND S."—There seems considerable diversity of opinion on the subject of what the proper heat is for the cylinders of these. No doubt theoretically the hotter the cylinder the better, for this would add to the expansive power of the gaseous mixture (though I have a strong idea that the power of the gas-engine does not depend even mainly on the heat of the mixture); but practical considerations restrict the heat to a certain limit, beyond which it is not economy to let the cylinder heat, having regard to the life of the engine, just as practice has fixed a certain approximate limit beyond which it is not economical to drive a large dynamo, no matter how strongly made. It is matter of opinion, but I consider myself that 60° C. at the outside is plenty hot enough for gas-engine cylinders, and that the 96° C. advocated by one correspondent is far too hot. Crossley Brothers, the makers of the "Otto," in their printed directions, say: "See that the water is properly supplied to the cylinder jacket"; and again, "Never work the engine without water in the jacket of the cylinder. The water vessel must be kept full by a ball-tap. The cylinder should not get very much hotter than the upper part of water vessel." And the necessity of this is confirmed by letters I have had from more than one private correspondent. I think all this is strong confirmation of the opinion I expressed that the cylinders are best kept cool. It is a very different case from the steam-engine, where the inside of the cylinder and the piston are continually kept wet by steam, which is in itself a lubricant. The interior of a gas-engine cylinder is dry save for the lubricant, and this is continually exposed to the strong heat of the explosion, which at the same time deposits a certain amount of products of combustion on the sides.—EDWARD CONRY.

[61529.]—**Mathematical — Measurement of Drums.**—In reply to "E. M.," I may observe that in suggesting 1ft. as the unit of measure I did so only because I thought it a convenient unit, especially in cases where there is a great length of rope and the drum is of large size. However, it matters not whether the unit be 1ft. or 1in.; so long as we employ the same unit in the measurement of each of the quantities l, d, e, h, and t, the formulæ remain the same. Should the unit be 1in. the formula (1) will give the length l in inches; formula (2) the value of e in inches; and formula (3) that of h in inches.—J. R. CAMPBELL, Charing, Kent.

[61538.]—**Straightening Wire.**—If "P. J. W." has a great quantity of wire to draw or straighten, I should advise him to buy (what is practically called by wireworkers) a drawing machine; but if he has only one lot, and wishes to save expense, I give him a simple method in annexed plan:—



A, block of hard wood, 18in. by 4 by 3; B, eye of wire, driven at bottom of block to fasten it to bench; C, guide, to guide wire from coil; D, coil; E, straight wire down centre of block to keep wire from cutting block; F, pegs of wire driven in each side of straight wire alternately. Straight wire, E, to be same gauge as you are going to draw. Put a mark on your bench the length you want to cut your wires, and draw, taking care you don't put any sharp bends in your wire by letting it off carelessly. If wire don't draw straight, open or close your pegs with hammer as required.—NO SIG.

[61560.]—**Engineering.** — I must confess to having considerable sympathy with "Disgusted," as I myself was in a somewhat similar position when a youth. I presume that "J. H." did not pay £150 premium to begin with, or he would possibly think differently; he speaks of employers, foremen, and journeymen always rendering necessary aid to those who seek it in the proper way. Do they? I don't think so. Some employers trouble themselves no further when once they have pocketed the premium; and there are foremen and leading hands who seem to have a dread lest a pupil should learn too much. On the other hand, I am glad to admit that there are employers, foremen, and workmen who will give all the assistance in their power to those willing to learn. I quite agree that some pupils will never be worth their salt whatever chances may be thrown in their way; but the fact of a heavy premium being taken from their friends gives them a right to have such chances afforded them, even though they may make no use of them. Unless employers are prepared to afford these chances, they ought to decline taking the pupils or their money. What would be thought if a man bought and paid for an article which was not afterwards supplied on the ground that it would not be utilised? For the word "article" insert "chances." In my own case, my father paid £100 as a premium, and I worked in the turning, fitting, and erecting shops for five years, and had no advantage whatever over any of the workmen's sons (of which I don't complain), or over non-workmen's sons paying £20 only, of which I *do* complain.—H. M.

[61574.]—**The Calculus.**—I am much obliged to "M.I.C.E." for the explanation in his last communication, which has wholly removed the difficulty of which I complained. I should be glad if he, or some other of your correspondents, would recommend me such books on the calculus as he thinks best fitted for a beginner. My object in studying this branch of mathematics is to be able to read the higher works on physics. Is there any book specially devoted to the application of the calculus to physics? Is there any work containing those portions only of the calculus necessary to the physicist? All the books I have been able to procure treat the calculus as a branch of pure mathematics, and I imagine contain much that has no application to physics. It cannot be that the student must master the ponderous works of De Morgan and Price (the latter consisting of four thick octavo volumes) before he can apply the calculus to the physical sciences? Life would not be long enough for this. Dr. Thomas Young, in the original edition of his "Lectures on Natural Philosophy" (two volumes, quarto), gave so much of mathematics as was necessary for the subjects he treated of. But in his time fluxions had not been superseded by the calculus. It seems to me, however, that some such selection of mathematics as he gives, brought down to modern methods, would be of great use to students of the physical sciences.—ANOTHER TYRO.

[61575.]—**Indicator Diagram.**—To "T. C., Bristol."—Through my failing to put all particulars, and the printer in placing a decimal point in the injection quantities, it makes me look in error; but I will now correct it. The hot well temperature rose from 96° with jacket on, to 106° jacket off. The injection figures in column is total in thousands of gallons, striking out the decimal point, which is the printer's error, and division by the hours, gives 3,075 gallons per hour for jacket on, and 3042·5 gallons per hour jacket off. The expansions are taken from actual measurement of cylinder, clearance included, and scaled on diagram; the valves are double beat drop, worked by cams adjustable while running. The meter is full small, and is working up to its maximum delivery, and the pressure in main is uniform, so the actual quantity per minute must be the same. Thanking you for your attention.—WATER THUMPER.

[61577.]—**Meridian Instrument.**—The mean between first and last contact is the time. Two minutes and 22 seconds in December and January and 2 minutes 8 seconds in March and August is about the interval. You must allow for the equation of time, or "sun before or after clock," which you find in any almanac, and also for your longitude E. and W. of Greenwich, at the rate of 43 miles to 1° in the longitude of London. Address —"J. K. P.," Davis's Library, King's College-road, N.W. Example:—

Feb. 6th, 1887.
First contact, 14·11
Last do. 16·25

30·36

Divide by 2 = 15·18 = mean by watch.
⊙. S. at Greenwich, 12h. 14m. 18s.
Add for W. longitude, 43

15 01

Difference, watch 17s. +. The interval for Feb. 7th as given in the table is 1m. 7s. for semi-diameter of ⊙, and, of course, double of that, or 2m. 14s., for the whole diameter.—J. K. P.

[61589.]—**Coal Economy.**—In his first letter "Nun. Dor." made by implication the sweeping assertion that sugar refiners were grossly extravagant in their consumption of coal. I requested him to indicate where an economy could be effected. Had he been at all familiar with the subject, he could at once have pointed out where this could be done—in the defecation, filtration, char-burning, and recrystallising, or in the amount of motive power used. He does not do so; but writes in a loose way about engines which consume double the amount of fuel required, uncovered pipes, coal dues, royalties, &c. This proves, to my mind at least, that he knows nothing about this particular industry, and has, therefore, no right to insinuate that the only "hampering" of the sugar refiners is brought about by their own ignorance. "Nun. Dor." does not do himself or them justice. I join with him entirely in his desire for economy in coal, but consider that this is more likely to be obtained through the careful observation and experiment of practical men, than by following the schemes of mere theorists. As he has asked me to give him some particulars, I will also ask him, if he thinks proper, to work out the weight of coal theoretically necessary to raise a ton of animal charcoal from 60° Fahr. to 800° Fahr., and to keep it thereat for 30 minutes, the charcoal to have had previously mixed with it 5cwt. of water.—SUGAR CANE.

[61617.]—**Ink Blots.**—Yes; I have many times, and shall do so again when necessity warrants it.—W. H., Newport, Mon.

[61623.]—**Legal and Revenue.**—The purchaser would probably require proof that succession duties had been paid. Application should be made to W. W. Karslake, Esq., Somerset House, who (if the purposes for which the receipt is required are set forth) would supply a certificate of payment.—B. A., Handsworth.

[61647.]—**American Organ.**—"A. C. W." will find all the information he requires in Vol. XXVI. of the "E. M." He will there find some excellent instructions in American organ construction, and if there is anything there which is not made clear I will endeavour to explain it to him, and very probably he may get further assistance from the writer of those instructions.—G. FRYER.

[61649.]—**Defective Accumulator.**—Some of "C. D. R.'s" remarks on this head are misleading. The thickness of sheet lead he recommends for the plates of Planté secondary cells (⅛in.) is far too great, and would simply mean waste of money, and an unnecessary increase of size and weight in the cells. The sheet lead recommended by Mr. Sprague, and which is about one-third of the above thickness, is quite heavy enough. Again, the process of manufacturing secondary batteries from the plain lead would, indeed, be "a costly and tedious one," if it were necessary, as he says, to continue the process of formation "until the whole of the lead in all the plates is converted into a spongy condition." Were this done, the cells would be ruined, for the plates would be dropping to pieces, and the time and expenditure of electrical energy necessary to effect this would be enormous, and would require rather years than weeks. As a practical matter, the peroxide forms fairly rapidly up to a certain stage, and when this is reached the rate of formation becomes very slow—so slow that the subsequent expenditure on the cells of an amount of forming current equal to all they had had up to that stage would only produce an increase of capacity of about seven per cent. Hence it is not profitable for anyone to continue the process of formation beyond this stage, which can be noticed when reached by the decrease in the progressive rate of formation. "C. D. R." is also hardly well advised in recommending marine glue as a good lining for either secondary or primary battery cells. The proper substances for cell lining are either the pitch I recommended or Mr. Sprague's compound.—EDWARD CONRY.

[61671.]—**Current Heating Insulated Wire.**—I am sure it would save a lot of trouble if querists would supply a proper heading to their queries. When one has to search through indices, the heading of many queries give no assistance whatever. Anyhow, when more than one question is asked, it would be well to put each as a separate query. I am sorry to have to differ with both Messrs. Conry and Bottone, as a bare wire heats more than one insulated, unless the insulation is very heavy compared with the dia. of conductor. The whole subject is discussed by Forbes in No. 52 *Journal* of Telegraphic Engineers, and is much too large to bring up here. I, however, give you one or two examples:—

Dia. of wires mm.	Current in ampères to increase temperature of a copper wire 25° C.	
	Bare wire bright C	Insulated wire Dia. of cable / Dia. of conductor =4 C
1	4·8	17·8
2	13·5	43·8
4	38·3	102
6	70·3	164

"Atoi" will be well repaid if he will obtain and peruse the above paper. It is published by Spon, price 4s. I am sorry you cannot calibrate your ammeter by electrolysis. It is much the best; but as you have Sprague, it is only wasting space attempting to give you information to be had much better and certainly more complete there.—OHM.

[61685.]—**Spring of Beam.**—To "T.C. BRISTOL."—The above question appears in Reed's book for engineers; but, as I quoted it from memory, I find I did not place it quite correctly. A beam is supported on two props, and a weight of 5 tons is placed 7ft. from one end and 12ft. from the other. Find what share of the weight each prop supports. If this beam had been firmly bedded in two walls for its support, what springing force would the same weight have brought on the walls? The first part of the query I can understand; but it is the latter portion which bothers.—E. T. GEE.

[61707.]—**Centre of Pressure.**—As "T. C., Bristol," appears to have surmised, the question was taken from an Honours paper. The papers seem to vary very much in difficulty, and the syllabus of the subject to afford very little help in preparing for the exam. "T. C., Bristol" refers to "Besant's Hydrostatics." On page 39 there is given the following general method of finding the centre of pressure of a plane area immersed in any position:—"Through the boundary line of the plane area draw vertical lines to the surface and consider the equilibrium of the liquid so inclosed; the reaction of the plane resolved vertically is equal to the weight of the liquid, which acts in the vertical line through its c.g. and the point in which this line meets the plane is the centre of pressure. How can this be applied when the plane is vertical?—S. FORD.

[61716.]—**Electric Lighting by Batteries.**—May I supplement the replies given last week by a few remarks? I would say: Wherever gas, steam, or water-power can be had at anything like a moderate price battery lighting is simply an absurdity, unless for special experiments and very short intervals. The bother of remounting the battery, the cost of material, the need of a certain amount of technical knowledge in mounting the battery, place it *hors de combat* when compared with the dynamo, with gas, or even paraffin for continuous lighting. But in cases where a few minutes light is required, such as surgical examinations of the throat, ear, &c., or seeing the time of a watch at night, showing a momentary light in the hall, the library, the study, or in a cupboard, a small battery and lamp, with elements which can be removed from the solution when not in use, compares favourably even with lucifer matches in convenience, in safety, and in price. Were I compelled to light up four 10c.p. lamps, having a resistance, say, of about 20 ohms each, regardless of cost, I should employ sixty to eighty zinc-carbon elements in quart jars, with porous inner cells, using zinc chloride solution as the depolariser. Schanshieff's arrangement is good, but is the subject of a patent.—S. BOTTONE.

[61721.]—**Quick Writing of Notes.**—I have tried upwards of six so-called abbreviated longhands, but have found them of very little practical use. If "J. R." values his time, I would advise him to set to and learn "Pitman's" shorthand. After learning this system I often regretted the time I had wasted over the systems of abbreviated longhand. "Pitman's" instruction books can be obtained through any bookseller. I would like to add that if "J. R." intends making reports or notes of scientific lectures, that he could not do better than get "Technical Reporting," by Thomas Allen Reed, price 1s. 6d.—J. SHARP.

[61727.]—**G. E. Locos.**—To "V. J. B."—The tanks in question are numbered 650-679, 790-799.—DUBLIN.

[61739.]—**Sand Figures.**—I should like to make one addition to the valuable hints given by "Reymond." Do not use a violin bow: it cannot be held firmly enough to obtain the figures to perfection. Use a double-bass bow (which may be purchased for 3s. 6d.). With this, and with dry sand sifted through muslin, and a little practice, figures may be obtained of such delicacy that the lines are in many places single rows of sand grains.—CALCULUS.

[61741.]—**Brake Trial at Ipswich.**—The brake which was being tried is the "Interchangeable Automatic Brake," invented by the late Mr. J. Cowling Welch and Mr. Parker-Smith. It is so constructed that either the Westinghouse or automatic vacuum train pipes may be used. The power is applied by means of a ram, weighing 445lb., which acting through a toggle-joint, presses the brake-blocks upon both sides of the wheels. The ram may be raised by either the compressed air of the Westinghouse system, or the atmospheric pressure of the automatic vacuum. Special provision is made for the wearing of the blocks, and the corresponding variations in the lengths of the rods of the toggle-joint.—L. B. and S. C. R.

[61742.]—**Railway Signals.**—See Mr. Stretton's letter to the Editor this issue (Feb. 25).—LIBRA.

[61748.]—**Electric Light.**—In our reply to this query on p. 573, we find a word was left out by mistake in Mr. Shippey's answer to "Selim's" question; but, in order to convey his meaning, please read, "Three groups of lamps, lamps run two in series," as the absence of the words "groups of" alters the sense of the reply altogether, and it may puzzle "Selim" and others to know how to divide the three lamps. By inserting the above in your next issue you will greatly oblige.—SHIPPEY BROTHERS.

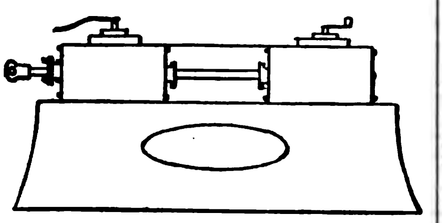
[61754.]—**Crystals in Leaf.**—Those noticed in cherry-laurel leaf by "Reymond" are in all probability crystals of calcium carbonate or calcium oxalate. Mount a section in water, and run acetic acid under the cover; if the crystals dissolve, giving off gas in doing so, they are calcium carbonate; if they don't dissolve, mount a fresh section and run in nitric acid, when, if they are calcium oxalate, they will be dissolved, but give off no gas. They are noticed in "Practical Botany," by Bower and Vines.—MOYHITT.

[61756.]—**Lame Jackdaw.**—Give your jackdaw a larger perch, and his feet will soon get better. You will notice that when at rest he sits with his feet spread out, showing that they are cramped by being closed round the small perch. He will find a flat one about 1½in. across by ½in., with the edges rounded—a great comfort occasionally. See that it fits firmly and does not shake, look to his general health, give plenty of chopped fresh raw beef and a tepid bath every other day, a cold one as often as he likes in the summer. If his claws are long, cut them a little; of course, they will not be so if he walks in the garden. Oil is very good, but keep him in a clean cage until it has dried in, as the dirt he happens to walk in will cling.—F. SEARCH.

[61759.]—**Liquefaction of Oxygen Gas.**—ERRATUM.—By a printer's error, the minus sign has been omitted before both the temperatures given in my reply on p. 573. They refer to temperatures below zero.—J. BROWN, Belfast.

[61759.]—**Oxygen Gas.**—It is absolutely impossible to liquefy oxygen gas by pressure at ordinary temperatures. No amount of pressure will alter the condition of a gas till the temperature falls below the "critical" point. I would refer "D. W. J. R." to the paper by Dr. Andrews on the "Critical Temperature" (Phil. Trans. 1869), or to Clerk-Maxwell's "Heat."—L. B. and S. C. R.

[61762.]—**G. and S.W. Ry. Locos.**—Our steam reversers are very simple and effective, and the drivers, through practice, can place the motion in any position with a slight turn of the handle. There are two cylinders, one containing water, and another into which the steam is admitted, each having a piston, with a piston-rod common to both, to one end of which is a clutch connected to the lever. The steam is admitted as in an ordinary cylinder, by turning the handle, and immediately the engine is reversed the handle is put back in its place, when the exhaust escapes by a pipe fixed to the step. There is an indicator fixed to the centre of piston-rod which slides through a slotted plate connected to the two cylinders. The water in the other cylinder acts as a cushion, and runs through the port from one end of the cylinder to the other when the piston moves, and is regulated by a valve, which is worked by a rod and lever connected to the boiler, from which the driver admits steam into the other cylinder. As I think my description rather vague, perhaps the accompanying rough sketch may avail. Concerning engines you mention, they are being broken up now, and there are very few remaining. They are pass. engines built by Mr. P. Stirling, now Supt. G.N.Ry. I am unable to obtain further particulars, as I am at present laid up ill.—G. AND S.W.RY. FITTER.



[61763.]—**Bellows.**—Use a bent needle (half-moon or crescent-shaped); you will then be able to do all the sewing without putting your hand inside.—T. C., Bristol.

[61763.]—**Bellows.**—"A Subscriber" does not say in what part of the bellows the holes are; but the best way is to take the bellows out of frame, open them to their full extent, and keep them in that position by putting a rod of iron between the broad ends. If the holes are only small ones, cut them out clean, either round or oval; then get piece of new leather, and cut same shape, ½in. larger all round. By turning the edges up all round you will be able to stitch them round with a double wax thread; but if the holes are large, and there is no seam as I have described across the bellows, you will have to begin at the small end, and take out nails, and undo all the straps; turn back the leather, cut out the bad part, cut your new rather larger; seam it across with a welt between; rub the seam down; then stretch on, and replace straps and nails as before. You will find it the best in the end.—SANDERSON.

[61766.]—**Coal and Water.**—First find the temperature of the steam due to the given pressure.

Let T = temperature, Fahr.
P = pressure in pounds per square inch including atmosphere

$$\text{then } T = \frac{2938\cdot16}{6\cdot1993544 - \log. P} - 371\cdot85$$

Where $P = 14\cdot7$ $T = 212°$
$P = 80\cdot0$ $T = 312\cdot1°$
$P = 90\cdot0$ $T = 320\cdot3°$
$P = 100\cdot0$ $T = 327\cdot7°$

The total heat required to generate 1lb. steam from water at 32° Fahr. under constant pressure $= H^t = 1091\cdot7 + \cdot305\,(T - 32°)$

Where $T = 212°$ $H^t = 1146\cdot6$ units.
$T = 312\cdot1°$ $H^t = 1177\cdot13$ „
$T = 320\cdot3°$ $H^t = 1179\cdot63$ „
$T = 327\cdot7°$ $H^t = 1181\cdot88$ „

The available heat of your coal is $10 \times 1146\cdot6 = 11{,}466$ units per pound of coal; $\therefore \frac{11466}{H^t} = x =$ amount of water evaporated at any other temperature or pressure, as H^t may be found from either—

Where $H^t = 1146\cdot6$ $x = 10\cdot0$lb.
$H^t = 1177\cdot13$ $x = 9\cdot741$lb.
$H^t = 1179\cdot63$ $x = 9\cdot720$lb.
$H^t = 1181\cdot88$ $x = 9\cdot701$lb.

—ELAG.

[61766.]—**Coal and Water.**—The sensible heat at 80lb., 90lb., and 100lb. is, say, 324°, 331°, and 338°, or a difference of 7° Fahr. approximately. Rankine gives the total heat in foot-pounds of energy required to evaporate 1lb. of water at—

212° as 885175,
324° as 911614,
331° as 914317,
338° as 914787;

consequently, as the same total quantity of heat is assumed to be used for the different pressures in your query, the quantity of water in each case would be inversely as the foot-pounds of energy, or at—

$212° = 885175 \qquad\qquad = 10$lb.
$324° = 885175 \div 911614 = 9\cdot71$lb.
$331° =\ „\ \div 914317 = 9\cdot68$lb.
$338° =\ „\ \div 914787 = 9\cdot67$lb.

—T. C., Bristol.

[61768.]—**Battery for Lamp.**—Taking Messrs. Shippey's 8-volt. 5c.p. lamp as a standard, then four cells of a single fluid chromic acid battery would light one well for about three hours right off, after which the solution must be renewed. The zinc must be amalgamated, and the strength of solution must be: Chromic acid, 3 parts, by weight; water, 20 parts, by weight; sulphuric acid, 6 parts, by weight. For particular shape, size, and arrangement of battery see p. 435 of Vol. XLIV., Jan. 14, 1887.—S. BOTTONE.

[61768.]—**Battery for Lamp.**—Five cells would be necessary, as Messrs. Shippey Bros. lamps, 9 volts on a lamp marked 8v. to light it properly. Jampots with two carbons and a zinc between would do very well, and zinc about 6in. by 2½in. The zincs and carbons would be fastened to a kind of lid, so that by raising it the battery would stop working.—ELECTRICAL STUDENT No. 2.

[61768.]—**Battery for Lamp.**—Shippey Bros. 5-candle lamps require an E.M.F. of about six volts to light them, and as a freshly-made chromic-acid cell (single-fluid) gives about two volts, theoretically three cells will do the work; but as the E.M.F. of such a cell quickly falls, you had better use four, and put in a variable resistance of some kind so as not to injure the lamp at starting. For your cells use well amalgamated zinc plates, size about 6in. by 4in. by ¼in., with a carbon plate on each side the same size as the zinc. To make your exciting fluid, dissolve 3oz. of chromic acid in 16oz. of water, then add slowly 4oz. of sulphuric acid.—E. E. V.

[61768.]—**Battery for Lamp.**—Four chromic-acid cells will light a 7-volt 5c.p. battery lamp if batteries are placed within a few yards of the lamp terminals; but more brilliant results can be obtained by using five cells so as to feed an 8-volt lamp to full incandescence up to 6c.p., and insert a little resistance in the circuit so as not to unduly strain the filament, arranged according to circumstances, which resistance can be cut out if required should the lamp fail in brightness. A good plan to obtain the best results is to have the cells as large as possible, and inclosed in a stout deal, stained box, which can be placed in any convenient place for recharging; couple your cells *p* to *n*, then to a pair of good-sized screw terminals placed outside the box, from which you can carry your main leads to the room or rooms to be lighted, using small twin branch wires to lamps, which are best suspended by flexible wire from the ceiling and placed under ornamental shades; or, better still, fixed into our electro-plated silver stars in order to obtain the best effect by diffusing the rays of light. By lamping your rooms, and using small single-light three-ampère switches, you can use the current in any room you wish by the small additional outlay for wires and lamps. You can also carry a wire up to your bedroom, and use your partly-spent liquid for lighting a small lamp as a night light, and by fixing a strong bell wire from your bedroom to your battery box, lift out the plates when not required by the aid of small lever arrangement, and thus enable you to go to sleep in comfort knowing that you are not wasting your money by useless consumption of zinc. The above is arranged for a single light installation; but by same arrangement you can increase the lights *ad lib.* by adding extra sets of cells, and coupling them in the group series arrangement according to output of current required.—SHIPPEY BROTHERS.

[61769.]—**Oxide of Copper Battery.**—Full particulars of this battery, which, by the way, seems to have fallen out of the ranks of competitors, can be found in the back volumes under the above head, or that of Lalande-Chaperon battery. Caustic soda was found to be best solution, using it about three-parts saturated. The querist will find illustrations in No. 958, and a good deal about it since—e.g., Nos. 1003, 1036.—NUN. DOR.

[61771.]—**Photo. Developers.**—Sulphurous acid the same as sulphuric? Why, you might as well say that chalk is the same as cheese. Anyhow, you will find out your mistake—possibly in another sphere—if you mix sulphuric acid with your developer. Sulphurous acid is a very weak acid; it can be got from R. Watson, Blythe-road, West Kensington Park. Citric being the strongest acid, one would suppose that its keeping properties were greater. It doesn't much matter which you use.—R. A. R. BENNETT.

[61771.]—**Photo. Developers.**—Sulphurous acid is a common article of commerce, and can be procured at any chemist's. It is quite distinct from sulphuric acid. "J. R." could not do better than use it to preserve his pyro. along with sulphite of soda. Take two ounces of pure sulphate of soda and pour on two ounces of hot distilled water. Stir till cold, then add two ounces of sulphurous acid. Stir till all is dissolved, then add half an ounce of pyro. This will keep, I believe, till it is finished. Every ten drops equal 1 grain of pyro. I do not like citric acid. It slows the development too much, owing to the formation of citrate of ammonia.—J. MCLAREN.

[61771.]—**Photo. Developers.**—A number of methods are practised for the preservation of pyrogallic acid in solution. Among others are the addition of citric, nitric, or sulphurous acid or sulphite of soda, and the application of a layer of paraffin oil to the surface of the liquid; but all these have for their object the same thing—namely, the prevention of absorption of oxygen by the solution. Sulphurous acid is not the same as sulphuric acid, but contains, as its formula (H_2SO_3) shows, 3 of oxygen only, while sulphuric (H_2SO_4) contains 4. Neither of the acids you mention has any advantage over the other, both producing about the same results. A pyro. solution containing either may keep good for a couple of months.—T. A. B. C.

[61774.]—**Bronzing Iron Copper Colour.**—Procure 1oz. blue stone, bruise fine as possible, and dissolve the same in ½-pint soft water; immerse the articles in it, or wash them until the colour is obtained as required, and thoroughly dried.—SOMERSET LAD.

[61774.]—**Bronzing Iron.**—I never got more than a sham tint of bronze out of any chemical compounds; I always employed electro-metallurgical deposit in a cupreous bath. I have done bunches of steel points, keys, rings, and such-like small articles; the coating of copper thereby is real, not artificial. The process is cheap and speedy, only this—you must understand the art. A light brushing with lacquer makes them look fine. The Germans are great in these little usefuls; no doubt you will find a man of that ubiquitous nation to do your wishes at a low cost.—EOS.

[61775.]—**Legal.**—A. would have no remedy against the lessor, B.; indeed, it is doubtful whether, even though the lessee, C., were solvent, he could recover from him the cost of excavation.—B. A., Handsworth.

[61778.]—**Transmitter.**—In J. Munro's "Electricity and Its Uses" it gives a very good cut of the Blake and its belongings. In Preece's "Telegraphy" there is a simple sketch of it; but not so complete as the other.—IOTA.

[61778.]—**Blake Transmitter.**—This instrument is in extensive use, and, of course, has been illustrated and described in your pages. All the details are shown in No. 781, p. 14; but if that No. is not procurable, and I suspect it is "out of print," the querist might find what he requires in No. 894.—NUN. DOR.

[61784.]—**Phonograph.**—To operate this machine, first neatly coat the cylinder with a sheet of tinfoil, made to adhere by gumming the corners, then bring the pointer to bear against the foil, so that on turning the cylinder it makes a depressed line or furrow. The mouth is now placed close to the opening in the vulcanite disc, and the metal plate is talked to, while the cylinder and foil are revolved with a uniform motion. The plate vibrates to the voice, and the pointer indents the foil, impressing it with the varying numbers, amplitudes, and durations of these vibrations.—J. Q. D.

[61786.]—**Organ at Albert Hall.**—The concert organ by H. Willis is blown by steam-power. There are two engines, one of 8 and one of 12H.P. This great power is needed owing to the organ working with pressures as high as 28in.—N. H. S.

[61786.]—**Organ at Albert Hall.**—Mr. Edwards, in his book on "Organ Building," says in reference to this instrument: "In the base-

;ard to the pedal notes, you can arrange
a separate soundboard. The following is
specification for a two-manual American
Lower manual—bourdon, 16ft.; diapason,
incipal, 4ft.; clarinet, 16ft.; diapason
ift.; flute, 4ft.; bass coupler and treble
great forte. Upper manual—bassoon, 8ft.;
.; oboe, 8ft.; piccolo, 2ft.; voix celeste,
humana, forte. I have mentioned some
rincipal stops required. A manual coupler
lso be added; also a pedal coupler to keys.
YER, Gorse-lane, Swansea.

.]—**Lawn Tennis Tournament.**—I
he principle of the Bagnall-Wylde system
ie number of units in the second round
.ways be 4, 8, 16, 32, or one of the numbers
ries. The effect of this is that there are
fter the first round. Thus, if there were
the first 12 would play in six pairs, and
4 would be byes, and the second round
nsist of the six winners and 13 and 14.
were 22 units, the first 12 would play in
thus the second round would consist of
inners and the 10 byes. If there were 21
e first ten would play in pairs, and there
11 byes, so that the second round would
f 16. I do not understand the difficulty
ubles and singles, as for purposes of
ient two players may be considered a unit.
W.

.] — **Watch Pivoting, &c.** — "Work-
ll find plenty of information on pivoting
XXXV.; but the most important part
is, plenty of practice and patience.—

.]—**Electro-Plating.**— A plated article
mes out bright from the plating bath
little bisulphide of carbon is added to the
You are most likely overdoing the
le: a drop or two drops to the pint is
iny more only spoils the solution. By far
way is to plate the articles without the
le, and then scratch-brush them. A single
cell exposing 120 to 150sq.in. of copper
makes the best plating battery, using
th the zinc.—IOTA.

NSWERED QUERIES.

◆◆◆

*nbers and titles of queries which remain unan-
five weeks are inserted in this list, and if still
d are repeated four weeks afterwards. We trust
s will look over the list, and send what information
r the benefit of their fellow contributors.*

ir last, S. Bottone has replied to 61135.

ie Brown-Allan Relay, 376.
icroscopical, 376.
Tell the Age of Eggs, 376
cccharine Matter in Mortar, 376.
rought-iron Castings — Aluminium added to
Wrought Iron, 376.
and Planers, 377.
il, 377.

ullition, p. 464.
ad Waste, 464.
lphocyanide of Barium, 464.
cquers and Dips, 465.
sat's Apparatus, 465.
intern Slides, 465.
tallic Hone, 465.
Tubes, 465.
ooden Tubes, 456.
ttery, 466.
ns, 466.
ttery Plates, 466.
lding Solution, 466.

ing Journal Oil.—The oil which drops
irnals is collected in many mills and
to be cleaned and used again. A little
s has been constructed for this purpose,
y be described as follows: The apparatus
-like concern, of several "stories," the
ither lined with, or else consisting entirely
Above, it has a shoulder like a funnel,
h is poured the oil to be cleaned. The
il passes off through an escape pipe in the
The different shelves, or "stories," are
d and covered to a height of about 2in.
loose cotton, through which the oil must
. The cotton serves as filter, and retains
of contaminations. After the oil has in
ier passed through the several shelves, it
nd clean, and drops into a vessel under-
The dirty cotton is occasionally replaced
It is necessary to add that the apparatus
d in a warm place. The cleaning of oil
nicals is both a tedious and a doubtful
because even after thorough washing it
retain traces of acids, rendering it unfit
cating purposes.

QUERIES.

◆◆◆

[61812.]—**Tricycle Enamel.**—Will someone kindly inform me if there is any way to prevent the ordinary enamel sold for "doing up" tricycles from coming off? How would a coat of varnish applied afterwards do?—TANDEM.

[61813.]—**Mechanical Support.**—A young woman having much writing to do the latter half of the day stoops forward very badly. A spinal instrument maker advised the putting in of a perfectly rigid wood busk in the stays. Truly it did prevent stooping to pick anything up, but not the stooping of the body. I then looked through back vols., and found a suggestion: "A strong tape was to be passed round the throat and fastened at the back to the top of the stays." This would have done, I think, but for the tendency to lift the stays up bodily towards the head, causing much discomfort (unless exceedingly tightly laced), although the skirts were looped over an inverted hook at the bottom of the front of the stay busk purposely to throw all the weight possible on the stays—in fact, the instructions given were followed most exactly. The tape at the back was next fastened to the bottom of the stays; but the slightest forward motion of the neck forcing the bottom of the busk into the body, it had to be abandoned. The next plan adopted was suggested by "A. P. S.," of Leamington, in last vol., that is of putting a steel busk under the wooden one, extending upwards towards the throat beyond the stays some 6in. It was made of ½in. best steel, 3in. wide, heated and shaped to the body, then fastened in a wash-leather pocket underneath the other busk. Of course, it was nicely padded, top and bottom. This did not do, because, on leaning forward, the bottom of the busk was forced into the body at a still greater pressure than before. After this, it was determined to lengthen the busk downwards, so that when the wearer sat down it would just touch the seat, keeping the other position extended upwards, making it 25in. long in all. This would answer perfectly (because any forward movement causes it to act as a spring or lever, the lower portion being the fulcrum) if I could tell exactly the right temper for the steel. It breaks through the centre of the waist. Having done this twice in five days, will someone please tell me the best way to harden and temper it to prevent this? Being next the body, a breakage is most dangerous.—WILLING TO ASSIST.

[61814.]—**Watch Dials.**—How can I clean gilt and silvered watch dials without losing the painted figures? What has become of our friend "Alfojoe"? Has he left us and gone to the better land? Some more articles from his pen would, I am certain, be much appreciated by many besides one who wishes to be—GETTING ON.

[61815.]—**Plate Secondary Cell.**—"C. D. R.," in reply 61649, shows how to make a plate secondary cell. I will take it as a very great favour if he will give me a little more information, as he seems to understand all about them. I should like to use 30 volt lamps. I have a shunt-wound machine gives 8 ampères and 50 volts. He says to arrange the plates in pairs—is that only one pair in each cell? or can I put the number of plates in the cells I want to form the accumulators when complete—that is to say, can I fit up, say, 15 or 16 cells and commence charging them? Mine is a gas-engine, and at present the light is not steady, and I would like them as regulators, and to light 3 or 4 lamps when the engine is stopped. If "C. D. R.," Edward Conry, or any others will assist me, I will take it as a favour, and say what size the plates should be and the number in each jar, and if the dynamo should be driven at its full power, giving the 8 ampères after the plates are completely formed and ready for use. Do they require to be reversed as in the forming of them?—THOMAS MILLER.

[61816.]—**Plain Horizontal Drilling Spindle.**—Would "T. C., Bristol," or any other kind contributor, give particulars, with drawings, of one, and the various shaped tools, suitable for 5½ centre lathe that an amateur may be able to make for himself?—SOMERSET LAD.

[61817.]—**Battery.** — One of my batteries has gone wrong. Have tried several things, but cannot manage cure. The troublesome battery is a Leclanché, and every three weeks or month the wires that connect zinc and carbon get covered with a green deposit and then break. I have covered the wire with varnish and Brunswick black, but to no purpose. Will someone help me out of this difficulty?—BELL WIRE.

[61818.]—**Bunsen Battery.**—Will someone kindly inform me as to what size the zinc plate should be when the carbon is 8in. by 4in. by ½in.? I am using plates, not cylinders. Should the nitric acid be the strongest, or diluted? Would the zinc in a sulphate of zinc solution give as good a result as diluted sulphuric acid? If so, would the plates waste if always left in solution? I wish to construct as powerful a battery as possible for the size using six cells.—E. J. C.

[61819.]—**Painting on Polish.**—I oil painted and then varnished with picture copal my initials on a French polished T square, but after two months use it has nearly all rubbed off. What should be mixed with the paint, or how should the surface be prepared in order to make the paint stick well to the polish?—G. M. S.

[61820.]—**Umbrella.**—How are the small eye sockets and ferrules fixed on to the ribs of umbrellas?—G. M. S.

[61821.]—**Fixing Emery.**—I should be obliged if any of your subscribers could inform me how to fix emery without recourse to pressure, or to make artificial stone. I wish to line a drum internally about ⅛in. thick.—CHARKAFF.

[61822.]—**Force Pump.** —To a horizontal pair of engines that I am driving a force pump is now fitted for the purpose of feeding the boilers. It is to be connected to the back rod of the piston. The stroke of the pump will be that of the engine—viz., 4ft., working 20 strokes a minute; dia. of plunger, 4in. forcing the water through 3in. dia. pipes to the boilers against a pressure of 40lb. per square inch. What additional power from the engine is required to work it, or, in other words, what number of horse-power is necessary to work that pump? This question worked out in a simple way by any kind reader will greatly oblige—ITHEL.

[61823.]—**Quick-drying Paste.**—Can any reader tell me how to make a good paste that will adhere firmly as soon as used?—G. H. A.

[61824.]—**Lining for Wooden Cell.**—Could any reader tell me if there is any substance with which to paint a wooden cell, so that the bichromate solution will not eat it away?—S. N. C.

[61825.]—**Dynamo, 30-Light.**—I have procured the back numbers referred to in reply to 61673, and carefully read the articles. Thanks to Mr. Eaves for what he has done and the large amount of useful information given. I don't like to try the pattern given. I very much prefer a modification of the Gramme, wound in the way Mr. Eaves sketched in reply 57813, Vol. XLII. p. 207. Mr. Eaves' pattern would be entirely new to me; the Gramme is not. Now if Mr. Eaves, or some other contributor, would kindly give the dimensions it would oblige me very much I would have end pieces of cast iron, F.M.'s rectangular, and of wrought iron. There would be a hollow in the centre for the armature. Armature of punchings of sheet iron, with or without cogs, as Mr. Eaves may advise. It will be wanted to light up to thirty 20c.p. lamps, and not less than ten at any time. If series-wound is as good for this, I will follow his advice. The amount and size of wire for armature and F.M.'s will also be required, and carefully studied by—WEE SANDY.

[61826.]—**Tyer's Block Signalling Apparatus.**—Some of the block circuits which are under my charge have been recently fitted up with Tyer's block instruments, and as it is essential that I should be fully conversant with the apparatus in every detail, I shall be very glad if any of "ours" can tell me if there has been a work published on the above.—TELEGRAPH LINEMAN, Royal Engineers.

[61827.] —**Wheatstone's Bridge (Post-office Pattern).** — Having had considerable electrical experience, I am anxious to make one of the above for my own use. Will our old friend (Mr. Bottone) kindly assist by giving rough sketch, together with necessary details and sizes of various parts?—TELEGRAPH LINEMAN, Royal Engineers.

[61828.]—**Ammeter.**—Will any of our kind readers give sketch and full particulars for making an ammeter from, say, 1 to 10 ampères?—TELEGRAPH LINEMAN, Royal Engineers.

[61829.]—**Resistance Coils.**—I wish to make a set of resistance coils, from 1 to 4,000 ohms. Will Mr. Bottone, or some other friend, kindly give the number of coils required and the most suitable size wire to use for each coil, together with approximate length per coil? I suggest the following group of coils; will this be correct?—1, 2, 3, 4; 10, 20, 30, 40; 100, 200, 300, 400; 1,000, 2,000, 3,000, and 4,000 ohms each for my purpose? Also, how are the coils grouped for use with the Wheatstone's bridge? In winding resistance coils, is it not usual to bring both ends of the wire together and wind as a double wire?—TELEGRAPH LINEMAN, R E.

[61830.]—**Galvanometer Coils.**—What is the best size wire and quantity of same to use for winding quantity coils of a detector galvanometer?—TELEGRAPH LINEMAN, Royal Engineers.

[61831.]—**Telescope Eyepiece.**—I have a 3in. glass, and wish to purchase an astronomical eyepiece. Will some kind reader tell me what power will be most useful for observations on the planets?—AN AMATEUR.

[61832.]—**Violin Strings.** — Four strings of same length and material, but of different thicknesses, are stretched on a violin and tuned so as to give successive fifths. If the tension be the same, compare the different thicknesses of the strings. What must be the tension on the several strings that they may all give the same note?—SOUND.

[61833.]—**3in. O.G.**—The writer has been grinding a 3in. o.g., and has finished it except the polishing. Would any of our kind correspondents advise him as to the best means of producing the beautiful polish that is generally put upon these objects by opticians?—AMATEUR.

[61834.]—**Plumbago Crucibles.**—Will the writer of the series of excellent articles which have appeared in the "E. M." under the title of "The Amateur Workshop" kindly say how the plumbago crucibles, to which he refers in article 31, are made? Also, what vessels are used for holding the iron, which he says can be melted in small quantities in a brass-furnace?—H. A. C.

[61835.]—**Eclipse of Sun, Aug. 19.**—Will some astronomical friend kindly inform me from what places on the earth the total eclipse of the sun on Aug. 19th (this year) will be visible as a total eclipse, and the times of commencement, totality, and end of the eclipse?—SOL.

[61836.]—**Flash Point of Mineral Oil.**—I have been using for some time a lubricating oil for my gas-engine, which cost me 4s. per gallon; but have just tried another oil, which only cost 8d., and appears to answer as well as the former oil. My man, however, is afraid of the oil taking fire. How can I ascertain the flash point of the oil?—N. M. M.

[61837.]—**Photographic.**— I have a 7 by 5 rapid rectilinear "Optimus" lens, with a set of seven stops, the largest aperture of which is, as near as I can measure ·93in. in dia., and is numbered 1. That of the smallest is ·11in., and is numbered 7. What is the focal length of this lens, and how can I number the stops so as to correspond with the standards of the Photographic Society, tables of which sizes are given by Burton in his "Modern Photography"? The sizes of my stops seem to correspond with sizes given by Burton for 7½in. focal length from standard Nos. 4 to 256, but are numbered differently. The size of aperture of lens mount is about 1·7in. Is this the "full aperture"? I want to know what exposures to give for different size stops. Any information will oblige—BEGINNER.

[61838.]—**Photographic.**—Is the following a good developer for "Ilford" dry plates, both ordinary and rapid? No. 1 solution: Liq. ammoniæ, 1½oz.; bromide potassium, 8drm.; water, 6½oz. No. 2 solution: Water, 8oz.; citric acid, 2drm.; pyrogallic acid, 1oz. 1oz. of each solution is placed in two 16oz. bottles, and each filled with water. For developing, equal quantities of each of the latter are taken. Will this developer keep for any length of time, and can it be used as above for both ordinary and rapid plates? Any information will be received with thanks.—BEGINNER.

[61839.]—**Twist Drill Apparatus.**—Will any kind reader inform me whether there is a lathe attachment in [illegible] —**Arc Lamps.**—I want to make [illegible] I have no mea[illegible] I want to use the lan[illegible] shall burn very fine [illegible]

[illegible] —**American Organ.**—Thanks t[illegible] for replies to my query. I [illegible] Mr. Fryer advises to have th[illegible] set voiced to imitate the clarionet. Will [illegible] better than having them voiced to imitate the [illegible] as recommended by him some time back? [illegible] do not intend voicing the reeds myself. Wi[illegible] describe the method of producing the celeste [illegible] out putting one set out of tune with the othe[illegible] I can have the half-set of 8ft. voiced to imita[illegible] and if it would be suitable, providing the [illegible] voiced to imitate the violoncello? If so, I sh[illegible] half-row three instead of two and a half octa[illegible] make bellows, &c., the sizes he gave me, as t[illegible] the space I have for them very well. [illegible] the arrangement a nondescript. I am afrai[illegible]

[illegible] —***Whistles.*** [illegible] If so, sketch will [illegible]

[illegible] **Sawing Logs.** I am about to construct a [illegible] exceeding 3ft. [illegible] inform me the length of saw [illegible] length of stroke, revs per minute, power [illegible] wood work and [illegible] should be glad of full [illegible] A WORKING MECHANIC.

[illegible] **Opals.** I should be glad to know how to make [illegible] please give me the necessary hat has to be put in. The two full rows will -row tube-board placed at the front of the the half-rows at the back of the soundboard underneath, and fitted with the double-touch . I shall make the tube-board for the half- as there will be three octaves of English con- s (steel) placed on the top and blown by pendent of the other bellows belonging to the I am thinking of putting the pedal reeds on undboard, fixed above the main soundboard, d to it by four posts, through which the wind Vill "Organon" say what he thinks of this ? Will Mr. Fryer or "Organon" please de- st method of fixing the vox humana fan?—

Backlash in Slide-Rest Screws and m much annoyed by this in the top slide car- carriage of a 10in. sliding surfacing and g lathe, especially when screw-cutting. Is medy short of a new screw and nut? And is ource of annoyance to the expert workman? s the common practice in engineers' shops for r remedying it?—VERDANT.

Screw-Cutting (Books on).—Do any of rgely with the shaping of the tool, clearance, e, rake, &c.? I want one such, being well up etic of screw-cutting. I don't want to pay , compilation of tables of change wheels.—

Electric Lighting.—Can any reader tell incandescent lamp which consists of a tube arbonic-acid gas? A wire is run into each ube, which is sealed, and when a battery is wires, a light proceeds from the gas. I also w about a battery with a block of carbon and —in fact, Bunsen's elements—only, instead of d nitric acids. I am told chloride of sodium or was used. Please say if porous pot is used, ry is any good, as I would like to use it instead r my own use. 2. Can anyone say what thermopiles are made of which were described rical Review a week or so ago? They were ittle for gas and to be powerful for size, but said of composition.—CAPTAIN NEMO.

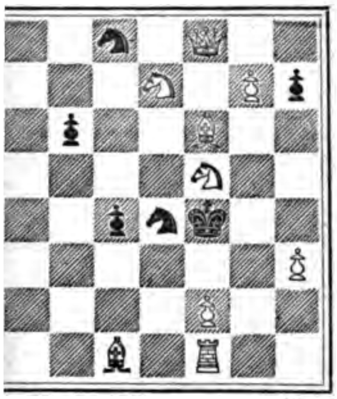
Stability of Ships.—Given the tonnage, n of hold, beam, &c., &c., of a ship; required and draw the curve of stability. Is the ship eeled over to different angles by the concen- eight on one side of the deck, and the righting rresponding to those angles thus arrived at? ighting moments for given angles of heel be om the dimensions and weight of the ship?—

CHESS.

munications for this department must be J. PIERCE, Langley House, Dorking.

BLEM MXXXIII.—BY BLACK PAWN.

Black.



White. [11 + 6

hite to play and mate in two moves.

SOLUTION TO 1,031.

.	*Black.*
.	1. Anything.

, Kt, or B mates,
P discs. mate.
(Thirteen variations.)

IOTICES TO CORRESPONDENTS.

solutions to 1,031, by W. J. Carpenter, V. Hewson-Kilbee, V. S. Pochin, Black Pawn, A Beginner, Country Boy, Link, A. Dean, is cleverly avoided), J. Mackenzie, G. A. A. 1,030, by T. H. Billington, Link, and F.

'AWN.—Thanks for problems. They shall be

WALKER.—Obliged for slip, and for good

HIN.—Marks are taken off for wrong solutions, r second attempt at 1,029.

, in three-mover's, White's second move need en after Black's defence.

TICE TO SUBSCRIBERS.

receiving their copies direct from the office are re- serve that the last number of the term for which tion is paid will be forwarded to them in a PINK n intimation that a fresh remittance is necessary, if continue the Subscription.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

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1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,025.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: Nos. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 2, and unacknowledged elsewhere:—

A. M. TAYLOR.—H. Watson.—G. F. Riddiford.—A. Henry. —R. E. Quinn.—Chas. Rabache.—A. J. Adams.—F. R. Davis.—J. B. Shipley.—R. H. Harrison.—Sir R. M. Stephenson.—G. D. Neil.—K. B. Williams.—C. S. Stock.—D. H. Littlejohn.—J. Boggis.—W. C. Roberts.—J. T. N. —F. Hunt.—W. G. Jackson.—H. L. Whitaker.—S. R. C. —Beginner.—Cambridge.—Capture.—Zirconium.—H. Green.—Furnace.—Leumas Lerref.—H. P., Leicester.—Queen.—One Deeply Interested.—Dublin.—Tor.—F. G. Lloyd.—A Fellow of the Royal Astronomical Society.—Machinist.—Fog.—Brickey.—Arthur Mee.—Eos.—A. F. Shakespear.—J. Q. D.—Aerial.

EBBO. (You were answered last week on p. 575. Correspondents should take the trouble to look through the paper before repeating their queries.)—BEGINNER. (Similar query inserted on p. 553.)—CHAR. (You would, no doubt, find all the works on sizing at any large booksellers in Manchester; but perhaps Webb's "Warp Sizing" will suit you. Its price is 7s. 6d.; but we forget the publisher.)—JASPER. (We do not know a work with that title by Cameron Knight. His "Mechanician and Constructor for Engineers" is published at 18s. See the catalogue issued by Mr. Calvert, Great Jackson-street, Manchester.)—G. CALVER. (If the choice is limited to books at a moderate price, we should suggest the following:—Shirley Hibberd's "Field Flowers," 3s. 6d., Groombridge, or his "Handy Book for the Rambling Botanist," 6s. 6d.; Moore's "British Wild Flowers," 16s., Reeve; Plues's "Rambles in Search of Wild Flowers," 7s. 6d., Bell; and Pratt's "Wild Flowers," 12s., Society for Promoting Christian Knowledge.)—R. F. TAYLOR. (There are at least four works for choice, according to what you want. Martin's "Screw-cutting Tables," 1s.; Sheddon's "Screw-cutting, Boring, and Turning," 1s. 6d.; Greenwood's "Screw-cutting," 1s. 6d.; and Holden's "Guide to the Manipulation of the Screw." We forget the price of the last, and do not know publisher of any; but no doubt they can be had of any large bookseller.)—MICRO. (As to the instrument, it would be invidious to recommend one maker in preference to others; but at any rate procure a good stand. You can always add objectives. As to a book, try Jabez Hogg's "The Microscope," 7s. 6d., Routledge; Dr. Lankester's "Half-hours with the Microscope," 2s. 6d., Allen; and Dr. Carpenter's "Microscope and its Revelations," 16s., J. and A. Churchill.)—LU. (Pepper's "Playbook of Science," 5s., Routledge.)—N. E. (If the engine is worth special notice, you will, no doubt, find it on the sheets issued by Mr. West, of Darlington.)—WANTS TO KNOW. (The fat is cut up small and placed in a copper or brass vessel over an open fire, or preferably it is heated by steam. It is gently stirred, and after a time the liquid portion is drawn off through a tap, and alum is added in the proportion of four or five parts per thousand. After standing for six or seven hours in the melted state, the clarified fat is run into the vessels in which it is sold, and allowed to cool. The refuse in the copper is put into a press to express the fat, and the remainder is sold as greaves.)—A WORKING MECHANIC. (Brine, or a solution of chloride of calcium is used because it does not boil until a much higher temperature than that of boiling water is reached. Consequently the tins completely immersed in such a bath have steam generated within them, and that drives out the air when the vent is pierced. The steam is allowed to escape freely for some little time, and then the tins are hermetically sealed. See No. 816, p. 238, for full details, as the process varies with the nature of the articles to be preserved, and whether cooked at the time or previously.)—STUDENT. (No indication is given as to your whereabouts; but surely you can attend some evening classes. The books you have are good ones. All scientific dictionaries are necessarily expensive, and you must specify what branches of science before anyone can advise.)—OLD SUBSCRIBER. (Certainly not. Such acids and chemicals are sold by the boy at almost any oilshop.)—B. W. M. (No. A will may be written by any one; but those who are to witness the signature must not be legatees. That is, witnesses must be persons who derive no benefit whatever by the will.)—APOLLO BELVEDERE. (You might get a colony of ants, and utilise them for the purpose, keeping them as nearly as possible in their natural conditions; but they are of doubtful use. See p. 419, No. 1059. and the indices.)—L. W. (They can be hardened and tempered in the manner usual with other articles of steel; but perhaps the cementation process is the safest for such pieces. See indices for many references to suitable processes.)—R. B. (Nothing wonderful in such stones. They are used like plates of glass or brass in the harmonicon. 2. There is no doubt that the campanile at Pisa, better known as the leaning tower, is an example of subsidence in the foundation, because there are obvious indications of attempts on the part of the builders to bring the tower back to the vertical. You will find an account of that and the tower at Bologna in most of the encyclopædias. 3. No, they are not electricity; but minute particles of steel combining with oxygen owing to the heat produced by friction. 4. See many articles on enlarging in back numbers.)—CONSTANT READER. (See the indices of back volumes. If you want something to be sung at "our place of worship" why not procure some of the many excellent pieces you can find in the list published by Novello, say? 2. You will find the mechanical operations for tuning organ-pipes in back volumes; but the "ear" is the principal requisite. There is no ready answer to either of your questions. The first would involve the writing of a small treatise; the second is answered in the back volumes so far as it can be, as it is simply a matter of practice.)—MINERVA BOILER. (Only for the same reason as liquid fuel is hurtful—that the intense or concentrated heat damages the plates; but so far as coke is concerned, it is used. 2. Rain-water ought not to be hard, though, if stored in a galvanised tank it will no doubt take up some of the zinc.)—LES DENTS. (One of Bailey and Co.'s (Salford) Pyrometers would answer, no doubt; but look at pp. 444, 466, 532, Vol. XLIII.)—EIN RASTLOSE URSACHENTHIER. (The kind of attraction referred to belongs to the phenomena of capillarity, for an account of which see Ganot's "Physics," or almost any of the textbooks dealing with such subjects.)—W. CARTER. (The only phenomenon about it is that it can do so only when the wind is strong enough to overcome the effect of the current or tide. You are not, of course, referring to the effects witnessed in the case of eddies. In the case of a broad, strongly-running stream the water at the side is generally comparatively stationary, but sometimes has a contrary movement to the water in the centre.)—A. S. (Have we not already given ample directions for making batteries for electric bells? There is nothing better than the Leclanché for bell work.)—BEGINNER. (You have only to melt the zinc and pour it into the moulds; but unless you have a furnace and suitable appliances it is cheaper to buy. Cylinders for Bunsens are usually cut out of sheet, made hot and bent round a mandrel. Always use the strongest nitric acid in the inner cell of a Bunsen.)—AJAX. (A patentee is a person who has obtained a patent. There is no such thing as a provisional patent. When an application for a patent is accepted the applicant can sell his rights in it—if he can find a purchaser.)—G. C. (Such an invention would be valuable; but air is not pumped out of the tins referred to; it is driven out by steam. See answer above to "A Working Mechanic.")—J. BARFORD. (See several "Answers" last week.)—ITHEL. (Better find out the cause by consulting a medical man. Discharge from the ear is sometimes a serious symptom.)—YOUNG SUBSCRIBER. (There is a good deal about harmonium construction in back volumes, but we know of no practical work on the subject. Probably if you put definite questions you would receive full answers from some of our readers.)—ASCALON. (For old-fashioned weather-guides see p. 42, No. 1016, p. 546, No. 1012. They depend for their action on the effect of atmospheric moisture upon a piece of gut—such as a fiddle-string.)—C. S. (You can obtain such a work at Pitman's. One is mentioned in Reviews, p. 2.)—A NOVICE. (Campin's "Hand-Turning in Wood, Ivory, &c.," of any bookseller; but most works of the kind deal with something more than wood. 2. Yes, a dozen Bunsen cells will enable you to have the electric light; but before you fit them up read back numbers, and even the present.)—J. L. (A short coil of rather thick wire is passed from end to end of the magnet while a current is flowing through the coil; but you do not mention shape of magnet. It is usual to draw the coil nearly off the ends of magnet. The coil should be large enough to pass easily over the bar, and a strong current should be sent through it.)—CANTAB. (It is impossible for anyone to say what is the matter with your injector. Personal examination would be necessary. You do not even say whose make it is. Read up the principle of its action in one of the textbooks.)—INQUIRER. (It means exactly what is stated—1ft. in 6ft., or 1in. in 100in., or whatever it is. Thus, a roadway may be said to fall 1 in 200, which would mean 1ft. in 200ft., or 1in. in 200in.)—UN-SCIENTIFIC. (A ball is certainly not influenced by any movement of the thrower made subsequent to the ball leaving his hand. What is referred to is possibly "bias" given to a ball by which it takes a different direction to that expected by everyone but the thrower. In cricket, for instance, the aim of the bowler is to puzzle the batsman, and he puts a bias or twist on the ball, by which, while apparently clear of the wicket, it "breaks in" behind the bat; but that twist must be imparted to the ball as it leaves the bowler's hand—he cannot affect it afterwards. Never mind about the absurdity of the question; others much more absurd are put.)—H. NEWTON. (You will find much about it in back volumes; but few if any books. There are articles in the cyclopædias giving all the information necessary.) 3 YEARS' SUBSCRIBER. (Impossible to answer such a question. Compensation cases depend on the reports of valuers who must inspect the place and examine into asserted profits before they can form an idea of the proper compensation to be awarded for compulsory removal.)—C. W. CADE. (We believe we answered you recently. You will find plenty of polishing pastes in back volumes. Perhaps what you refer to is rouge mixed with some fat.)—PLUMBER. (You can obtain all the information necessary in connection with the plum bers' certificates from the clerk of the Plumbers' Company, Guildhall, London, E.C.)—POOR WOODWORKER. (If you cannot refer to the back volumes, hire an instrument and examine that. If you will ask a definite question, it shall be answered or inserted. There is not much "effect" to be obtained from so small an affair.) P. Q. (If the water is hard, a lead cistern is as good as anything else. In London, cisterns are mostly lined with zinc, but slate and lead are frequently used. Enamelled iron would perhaps be best of all.)—CHARCOAL. (If you mean vulcanite or ebonite, it is not enamel, but the polished surface. See p. 422, No. 1111, and the indices of back volumes.)—ENQUIRER. (See p. 224, Vol. XXXV. The former is made up of pieces of wood, the exterior being of the expanded shape of the bellows. When the latter is finished, the centre pieces are pushed out and the former is taken apart and removed. No book on so simple a matter.)—WATER THUMPER. (See p. 456, Vol. XXXIV., and the indices of back volumes. The method has been frequently described.)—EDWARD CONRY. (You must use your own discretion. It is useless to occupy space a week later with replies sent in at the last moment, which are already answered in the following issue; and as far as fault-finding with replies goes, we think you have done your share. This week we have again left out or modified several replies.)—H. I. (Mathieson's "Vade Mecum for Inventors," published by Mathieson and Co., Bartholomew House, E.C., is the book you want; but you *must* employ a broker, unless it is a very small sum, when it can be done through the Post Office Savings Bank.)—J. S. (No; we saw nothing very novel at the Stanley show this year.)—A VICTIM. (You have no remedy but the County Court. There is nothing criminal in your debtor's conduct.)—VULCAN, E. E. M., W. HABGOOD. (In type.)

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I will exchange my 52in. **Bicycle** (by Bayliss and Thomas, Coventry), in perfect condition, cost £17 10s., for a useful Lathe, about 4in. centre, with gap bed, value about £6.—T. MASTERS, Tenterden, Kent.

Will exchange 56in. Matchless **Bicycle**, good condition, balls both wheels, for Lathe, with slide-rest, &c.—PENNEY, Highcroft, Dyke-road, Brighton.

2½ **Lathe**, gunmetal headstock and poppet head, dog chuck, and foot motor for same, in good condition. Offers requested.—DOVER, 6, Clifton-street, S.W.

Air Bell Indicator 4 holes, in working order. Exchange.—Apply JOHN H. HINDLE, Edenfield, near Bury, Lanc.

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Youth's new **Tricycle**, Grindstone and Frame, 4 new perambulator wheels. axles, plated case. Offers. Seen by appointments.—W. SMITH, Bilston-road, Wolverhampton. Stamp.

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Wanted, "**Sprague's Electricity**," and Bottone's Book on Dynamo. Exchange Gem Air Pistol, in case; 4½lb. Chromic Acid, Tennis Racquet.—SANDELL, 15, Vallis Way, Frome

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Scientific Books.—Offers. "Mechanics, cal" (Twisden), published 4s. 6d. "Mechanics" (Wors lished 3s. 6d. "Steam Engine" (Evers), published 2s. 6d. Tables and Rules for Steam Engine" (Haldicke), publis

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Cornet, cost 30s. Will exchange for good or take one guinea in cash. 4 shanks and plated mout FULLER, Westerham, Kent.

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Wanted, for lecture purpose, thoroughly well m HORIZONTAL or BEAM ENGINE, no boiler. about ¾ bore for good Scientific Exchange or offers.—Mr. HOW, 75, land-street. W.

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Complete set of 2H.P. **Engine Casting** cylinders, turned and bored. What offers? Stamp for 24, Alexandra-road, Ford, Devonport.

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Set of 2 H.P. Vertical **Engine Patterns** make, costs £2 at sale. What offers?—H., 24, Alex Ford, Devonport.

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Orguinette, very powerful tone. What off SAUNDERS, Dickleburgh, Scole.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 11, 1887.

NIBLETT'S NEW SCREW-CUTTING APPARATUS.

FOR many years past attention has been drawn to the difficulty of tracing screws by hand with the ordinary chasing tool, and from time to time the inventive faculty has been exercised in devising expedients to facilitate this work. Success has been but partial hitherto; for, although at first sight it may appear a simple matter to arrange a mechanical apparatus in connection with the mandrel to drive the tool at a given rate, nothing is more difficult than to do this with accuracy without considerable alterations of the lathe, or considerable additions to it. Screw-cutting, moreover, is of two kinds—viz., for metal screws of various sizes, for which nothing can beat the ordinary self-acting lathe, and the special machines for making bolts, nuts, and small screws; and, secondly, such screw-cutting as embraces the work usually done in the lathe with traversing mandrel screws of short length in wood, ivory, and occasionally brass, for which the self-acting lathe is comparatively useless. I make this distinction here very emphatically, because amateurs are sometimes induced to buy self-acting lathes under the impression that they will be enabled, by this means, to cut screws upon boxes and similar articles, and are disappointed to find that the lathe is not at all suitable, and is very unfit for ordinary turning in wood, the saddle and irremovable rest being continually in the way. For such work as most amateurs engage in, the traversing mandrel is alone suitable; or some such substitute as I am about to lay before the reader, and which I am glad to say originated with a paper of my own some time ago, entitled "Screw Mania." I there endeavoured to point out *what* was needed, and *why* it was needed, and the inventor was stirred up thereby to a series of experiments by which the present apparatus was ultimately developed. The ingenuity displayed will, I think, hardly be called in question, even by the most captious critic. Let it be at once understood that it is only for that kind of screw-cutting of which I have just spoken that this contrivance is introduced. It is, therefore, for the amateur and instrument maker that it is peculiarly suitable. It may, however, be added to a back-geared or self-acting lathe to increase its capabilities. Its advantages over a traversing mandrel may be thus stated:—1. It is infinitely less costly. 2. It will cut screws upon a long article held between centres as easily as upon chucked work. 3. It can be added to any lathe without difficulty. 4. Instead of copying, it will originate any thread from about 6 to the inch down to the very finest. It is always ready for action; and when by its aid the desired screw has been cut, the only part that is in the way is unhooked and set aside in an instant. There is nether cogwheel nor cord required, and the actual working part remains upon the mandrel always ready for use. The price may at once be stated as under £3. Such are the claims of this apparatus; and if they are duly met, I think a great boon will have been conferred upon the little world of amateur turners.

FIG. 2.

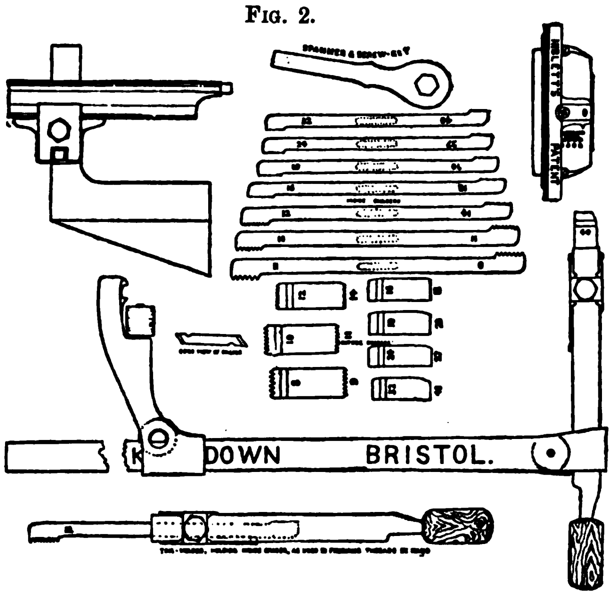
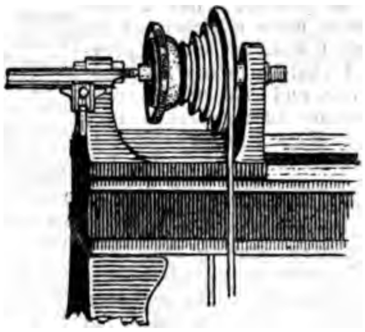


FIG. 1.



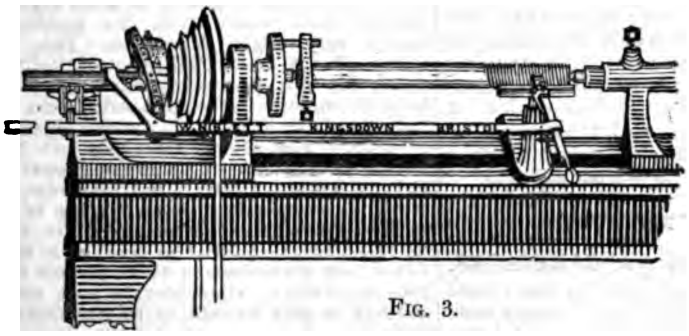


FIG. 3.

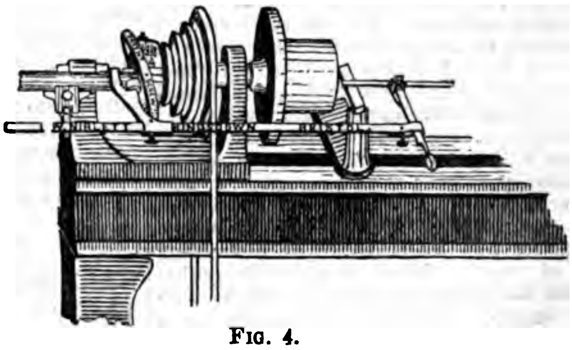


FIG. 4.

It is somewhat difficult to describe so that it shall be thoroughly understood that part of the arrangement by which the slow motion is attained; but it will be recognised as a modification of Jewsbury's internal gearing patented about 20 years ago. This is adopted in order to impart a very slow but even motion to a revolving disc or swash-plate, the rotation of which by means of a roller in contact with its face gives movement to a horizontal bar carrying the chasing tool, the pitch of screw depending upon the angle at which the swash-plate is set. I myself suggested some years back the possible use of such swash-plate in this manner, but am free to confess that the difficulties attendant upon its practical adaptation appeared so insurmountable that I gave up the idea as an impracticable arrangement. Mr. Niblett's mechanical knowledge and ingenuity enabled him to master these difficulties by giving to the disc one revolution only to 24 revolutions of the mandrel. This is the secret of the practicability of a swash-plate for the purpose in question, because if it makes turn and turn with the mandrel, only half a thread of any given pitch can be obtained by its means; but another difficulty has to be battled with. If a bar is in contact with a swash-plate, the latter will not give uniform motion to it; it becomes necessary, therefore, to substitute for the flat surface of the disc a certain definite curve to equalise the traverse. This has been effected by the maker, who ascertained the curve by experiment; but it is one that a mathematician could easily decide and plot for the purpose. It is, I am told, a spiral. Another desideratum, and a very important one, is this: The traverse should, if possible, be made and arrested at a given point without stopping the lathe, which should throughout preserve its usual rate of speed; this also has been most cleverly effected by the form given to the disc. *The lathe is driven as usual—the tool travels along its appointed path, stops a few seconds, and returns to the starting point, from which it again starts automatically to return as before.*

So far as I know this is the only screw cutter that will do this, and this alone serves to stamp the invention as one of very special interest and value. The screw may be right-handed or left, at pleasure, as the

VOL. XLV.—No. 1,146.

raverse is equally uniform in either direction. Everyone knows the care needed with traversing mandrel, and the necessity of nly allowing the flywheel to take a half urn to and fro; and also with any apparatus onnected with the overhead the nuisance of djusting the cords. But here there is othing to be done but to keep the lathe teadily running as usual, and to move back he tool slightly on its return journey to revent it from crossing the thread with a eft-hand one.

I have thought it better to lay before the eader these particulars that he may be able nore thoroughly to grasp the details of the nstrument. I do not say that the rate is o perfectly uniform as to cut a thread with nathematical precision; but that it will do what a traversing mandrel will without the rawbacks of that costly affair, I am very appy to testify, for I have the arrangement itted to my own lathe, and have practically ested it, and I could desire nothing better. have cut wood and brass with equal success, nd I have no reason to think that it would ail upon iron, upon which metal I suppose ew would be inclined to test the strength nd capability of a costly traversing mandrel.

I will answer any questions put to me in he pages of the English Mechanic as airly and fully as possible; but I have othing to do with mere criticism of an nvention in which I have no sort of pecuiary interest. I shall give my own fair pinion of its merits, and leave the inventor o defend it, where such defence may ppear necessary. Fig. 1 shows the apparatus attached to the mandrel of a athe with one cone and back centre. ig. 2 shows it as sent out by the maker, the everal male and female chasers being, however, extras. Ordinary chasing tools will nswer if the handles are removed; but those hown are very convenient. The part seen n the upper left-hand corner is called the rest-bar." It is a smooth rounded bar, which an be slid forward in its bracket until its educed extremity enters a hole in the backlate of the driving apparatus, as will be ereafter explained. The bracket is secured y a bolt to the headstock. It is shown in lace in Figs. 1, 3, and 4. Upon the upper urface of this slides the hooked or hollowed art of the attachment with roller, and hrough a mortise in the bottom part of this asses a flat steel bar, adjustable as regards s length by means of a clamping-screw. The ther end of this bar has a spring clip and ghtening-screw, in which is secured the hank of the tool-holder. The latter has a it of wood attached as a handle, so that hen the thread is secured, it can be used s a hand-tool, and detached from the bar to omplete the screw. The little chasing ols are clamped, as shown, in this shank. he bar, with all that is attached to it, is fted off and set aside in a moment, and thing but what is seen in Fig. 1 remains. Ve now come to the appliance by which the te of traverse is obtained. This consists of ring or disc of iron pivoted on the outside the brass case in which the gearing is conained which imparts the slow motion [illegible] this case and disc, the rate being [illegible] one turn of the disc to 24 turns [illegible] the mandrel. The small steel roller attached to the hooked arm sliding [illegible] the tool bar is held in contact with the [illegible] of the disc or swash plate, and the angle [illegible] which the latter is fixed determines the [illegible] of traverse, in other words, the pitch of [illegible] screw. The disc has attached to it a [illegible] plate of steel filed to act as a [illegible] and on the brass upon which it rests [illegible] a series of lines numbered with [illegible] is needed is to [illegible] required, adjust [illegible] tool bar, select and clamp [illegible] chaser, and set to work to [illegible] thread. I have given the general description and view of apparatus first, to prepare the reader for details to follow; but enough has been said to substantiate the absolute novelty of the plan as also its simplicity. Many a time have I worked at the swash-plate idea, which seemed to me the one thing needful; but I could not devise a slow motion which would enable the swash-plate to remain on the mandrel, and yet not partake of its rate of speed. Now it is done it looks simple enough, but every inventor knows how difficult it is to work out a simple design so as to make it practically efficient. The manipulation of the tool and tool bar presents no great difficulty, absolutely none at all after a few trials have given the requisite confidence. The right hand grasps the tool-holder, and the left lays hold of the roller arm, keeping the same roller in easy contact with the face of the swash-plate. The arm and the tool-holder both lie horizontally, the latter being supported by the tee of the ordinary hand-rest, or a special tee, which will be supplied, if desired, made with a flat surface, and with the end turned down at right angles, and filed up to enter the hole to be screwed in the case of a female screw. It is convenient, but by no means essential, and an ordinary rest will answer very well.

I can foresee an objection likely to be made—viz., that a mere bar held in the hands will prove too unstable, and that it should be made to slide in bearings. Directly you begin that sort of thing you begin to add complications, and to depart from the simplicity of the apparatus. At the same time I consider that the actual invention is the application of the swash-plate to screw-cutting. This, as well as the details, is patented. But the simple hand manipulation of the bar and its adjuncts will be found, on trial, to constitute a valuable and perhaps necessary feature of this plan. The tool needs just that power of adjustment thus obtained. It is slightly drawn back after each cut, and replaced as soon as the traverse movement recommences. There is always time for this, because the traverse in either direction ceases (the lathe still running), and the tool remains quite still a few moments before the backward traverse begins again; and there is no fear of the tool not falling into the cut, for it cannot do otherwise, there being no back-lash or loss of time, because the motion of the swash-plate is continuous, although its action is to give a to and fro movement to the bar and tool.

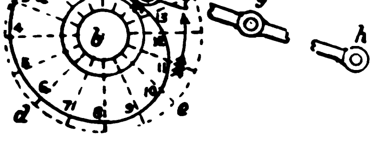
O. J. L.

WARMING RAILWAY CARRIAGES.

Recent railway accidents in the United States have produced a loud outcry there against the use of stoves and petroleum lamps for the warming and lighting of the cars, and the subject has been debated with much energy by the various societies of master mechanics and railway managers' associations. Fires caused by the stoves used for heating cars are of not unfrequent occurrence on American railways, and occasionally when a train is derailed or disabled by a collision the result is great loss of life, as in two recent accidents which happened on the Baltimore and Ohio and on the Boston and Albany roads. In this country we put up with the foot-warmers, because our railway journeys are comparatively short, and the weather is rarely so severe for any long time as it is in America. There, however, not only are journeys of thousands of miles common, but the winter in many States lasts for months at a freezing temperature and below. Again, it is often the case that cars wait for hours at stations, and, in short, it is imperatively necessary that some means should be provided for warming them when occasion requires. That has generally been done by means of stoves within the car, or attached on the outside; but it has been abundantly proved that both are dangerous methods. In the case of stoves fitted beneath the floors of the cars it is usually necessary for the attendants to go outside of the train to regulate and replenish them; and as that is objected to, the majority of cars are still heated by stoves placed inside. Stoves can, however, be so fitted to cars that, while the burning fuel is really beneath the floor of the vehicle, the fire can be regulated and fed from the inside, the heated air coming in through the casing both warming and ventilating the car. The real danger from burning up in accidents arises from the fact that in the majority of accidents the passengers are unable to get out of the cars. Some experts say that they would rather have the stoves inside, because then they could reach the red-hot cinders and extinguish them; while others assert that with the stoves outside, and the exterior of the floor properly plated, there ought to be no danger at all. In view of these arguments it is not surprising that the tendency is to try at least experiments in utilising the boiler steam; and it is pointed out that the quantity of steam required to heat a train is only a small fraction of that which can be generated in a locomotive boiler. Thus, in Mr. Forney's *Railroad and Engineering Journal*, it is said that one of the speakers at a recent meeting gave the heating surface in a Baker heater at 5·6sq.ft., so that a train of twelve cars would have a total surface in its heaters of 5·6 × 12 = 67·2sq.ft. An engine capable of hauling such a train would have about 12,000sq.ft. of heating surface in its boiler. But owing to the forced draught and other causes, probably a much greater amount of heat is transmitted through a square foot of heating surface in a locomotive boiler than is conducted through the same area in a Baker heater, so that locomotive boiler heating surface has a much greater value than that in a car heater, from which it follows that only a small fraction of the capacity of the locomotive boiler—probably less than half of one per cent.—is required to heat a train of twelve cars. This fact is important, because it is generally believed, and is often asserted, by master mechanics and those who should know, that locomotives cannot make steam enough to draw a heavy train and heat a train of cars too. If the steam required to warm the cars is so small a proportion of that which a locomotive boiler can generate, then the difference between good firing and bad would compensate for the drain on the boiler for heating purposes. If these are the facts in the case, then the objection so often urged to heating with steam from the locomotive has a very slight foundation. The president of the New York Central Railroad points out that it is not always possible to have an engine attached to a waiting car or a train simply to give heat. Another objection to steam is that after a train has left New York, for example, it will pick up additional cars at Poughkeepsie, Albany, Utica, Syracuse, and so on. These cars have been waiting in the station in advance of the coming of the train to accommodate passengers and save time. Often they are sleepers in which persons have gone to bed early. They must be kept warm, and how is that warmth to be had from an engine drawing a train miles away? It has been proposed to have a special boiler attached to the baggage car, with a special attendant. This would give heat to the complete train; but as it is doubtful whether the plan has ever been put into any kind of successful operation, it is considered that what must be devised is a source of heat for each car, without the use of fire.

In this country experiments have recently been made in warming the coaches with steam or hot-water pipes from the engine, but those have been made only on local trains which are rarely broken, and which run only comparatively short distances at slow speed, whereas the real want is a method of efficiently warming the express trains which make long runs. In this case it is doubtful whether the steam can be spared from the engine. Another method has been tried where Pintsch's gas is available. A jet of that is placed in the roof—to give light when necessary—and utilised in heating a vessel of water exposing a large surface to the air, which is accordingly warmed and forced down tubes to be discharged near the floor level. It is stated that in the experiments already made no difficulty was found in maintaining the current of fresh air at 54° Fahr., which is sufficient, and which the cam acts, *h* being its working end. *b c* is the greatest radius of the cam, and *b*. 15 the least, the differences between these being the travel of the roller *f*. To set this cam out, the radii *b c* and *b*. 15 being given, describe the circle *c d e*, and divide its circumference into any convenient number of parts, say, 16, divide (*b c*—*b* 15) into 15 parts, and on each radius from *c* to the left set down, 1, 2, 3, &c., of these parts, and through the points 1, 2, 3, 4, &c., thus found, describe the contour of the cam. When the cam is caused to revolve in the direction of the arrow, the end *f* of the rocking beam will be slowly and steadily raised until the point *c* of the cam has passed under it, when it will speedily return to its lowest point, only about one-sixteenth of the revolution being occupied by the return stroke.

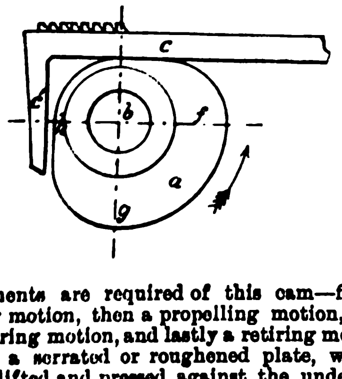
FIG. 17.



To ascertain the mean pressure upon *f* during the working stroke, a method similar to that used in the previous case will apply. Let F = the mean moment of force in foot-pounds acting about the centre of the shaft *b* during the working stroke of *f*, that will be through fifteen-sixteenths of the circumference. Let R = radius *b c* and *r* = radius *b*. 15, then if S = the stroke of *f*, S = R − *r*, and P being = mean pressure on *f*; $P = F \times 3{\cdot}1416 \times \frac{15}{16} \times \frac{1}{S}$. Let S = 1·25ft., and F = 2,000lb.; the $P = 2{,}000 \times 3{\cdot}1416 \times \frac{15}{16} \times \frac{1}{1{\cdot}25} = 4712{\cdot}4$lb. The return stroke is effected by a counter-weight.

There is a movement in sewing machines for carrying the work along between the stitches being taken, which is called the feed motion, and is commonly effected by two cams acting together, but one is sufficient for the purpose if made of the contour shown in Fig. 18. Four movements are required of this cam—first a lifting motion, then a propelling motion, next a lowering motion, and lastly a retiring motion.

FIG. 18.



d is a serrated or roughened plate, which, being lifted and pressed against the underside of the work (resisted above by the *smooth* surface of the spring presser foot), holds it while it is pushed forward the length of one stitch. It then drops away, and is retired to again seize and move the work forward. The lifting and propelling is done by the cam, the lowering and retiring movement by a spring controlled by the cam, and by an adjustable stop, by which the length of the stitch is regulated. This latter is a very simple arrangement, which limits the return of the feed after the cam has pushed it forward to its full extent. In the Figure, the feed bar, *c c*′, is shown as low down and as far back as the construction will allow; but, by means of the stop alluded to, the end *c* may be arrested on its return, the cam leaving it until it again comes up to it in the following revolution. The presser-foot, when not upheld by the feed-bar, rests on the plate of the machine, the serrated plate being beneath it, clear of the work.

a is the cam, fixed upon a driving shaft, *b*. The amount of lift, and also the distance of movement forward, will be equal to the difference between the radii *b f* and *b e*. Let the cam revolve through a quarter of a circle in the direction of the arrow, then will the point *f* be directly under the bar *c*, which will have been lifted, the point *e* having passed to *h*, in the next quarter revolution the point *f* will be against *c*′, and the forward movement of the feed completed, its height being maintained by the arc *f g*, *g* then having passed to the top position. The revolution being continued, the feed-bar will then be allowed to fall away from the work, and to retire to its former position.

THE AMATEUR WORKSHOP.—XXXV.

Miscellaneous.

IN this article I will try to pass in rapid review those minor tools which could not be included under previous heads, but which are required more or less in all shops.

The importance of correct measurement in the workshop cannot be over-estimated, more especially since parts are frequently not put or even tried together until they are finished. Thanks to the perfection of modern tools, it is now quite easy to obtain such correctness of results as this.

We know that for all rough and ordinary measurements the rule is the proper instrument to employ; but I am now speaking of the more exact work of the machinist. Everything is deduced from the rule in the first instance; but the actual measurements are taken by means of gauges of various kinds, so that work prepared at different times and in different departments of the same factory will be mutually fitting and interchangeable.

Direct rule measurement is the roughest and most unreliable of all, and end measurement, when the rule becomes worn, is positively incorrect. When, therefore, the rule is used, the divisions on the body should alone be taken, starting, say, from 1in. or 2in. The ordinary engineers' rules are of steel, 1ft. long, and answer at the same time the purpose of small straight-edges. They are to be bought from one shilling upwards. The one which is most convenient is that having divisions of the inch on one side, and of the mètre on the other, or one having millimètres on one edge and inches on the other, but both on the same face that they may be directly compared with each other. I have at different times had to work a good deal to drawings with French dimensions, and have used a boxwood rule 1 mètre long, divided into centimètres and millimètres, and a steel rule thirty centimètres long, divided into millimètres. One cannot help remarking how the use of these decimal divisions facilitates measurement and calculation. No reducing of decimals to vulgar fractions, no vulgar fractions of various denominators, no such thing as "full" and "bare," since half a millimètre is small enough for anything not actual gauge measurement. Those time-honoured terms "full" and "bare" can never be expelled from the workshop vocabulary under the present system of measurement. How vague they are, too! How much full?—how much bare? So we get "just full," "very full"; "just bare," or "just under, or very bare"; or perhaps we say $\frac{1}{64}$th bare or full, or between $\frac{1}{64}$th and $\frac{1}{32}$nd. Then also we get such queer dimensions as $1\frac{5}{16}$ $\frac{1}{32}$ full, or $2\frac{1}{8}$ $\frac{1}{64}$ bare; or perhaps $1\frac{11}{32}$ full, or $2\frac{3}{64}$ bare, and then when some of these have to be added, subtracted, and divided, mistakes are apt to occur when putting down different denominators, as, take $1\frac{1}{32}$ from $2\frac{7}{16}$, or take $\frac{5}{32}$ from $3\frac{9}{16}$ $\frac{1}{32}$, &c., &c. Yet this is perpetuated in the workshops in England year by year, when the simple adoption of the metrical system would sweep it all away. We can scarcely understand how our fathers tolerated the heterogeneous screw threads of forty years ago. Yet the Whitworth threads are to the older systems what the metrical divisions are to those which are founded on the inch, and probably our children will by-and-by marvel at our long retention of the latter. Perhaps we are passing through a state of transition as regards methods of measurement. We are very conservative of old use and practice, and must not expect that the good old English inch, with its $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$, &c., will be readily discarded in favour of the mètre with its $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$ths. But it is significant that the manufacturers find it pays them now to make most measuring instruments in metric divisions as well as in those of the inch, and that in many modern scientific books the metric units, millimètres, kiles, &c., are employed in preference to the inches and pounds. In all books of reference also, tables of equivalent values of English and French units are given. Hence we are getting sensibly nearer to the employment of some uniform and consistently proportional method of estimating dimensions and weight.

Since no one depends on any rule for very accurate measurement, the sense of touch or contact is employed in preference, hence the use of gauges. The ordinary male and female Whitworth gauges are those most commonly used therefore, not for turned work alone, but also in combination with calipers for flat work, the caliper measurement being transferred to the gauge rather than to a rule. These gauges are turned and ground to fit with marvellous accuracy, cast iron in the larger sizes, and steel in the smaller being the materials employed. They are expensive, and ought to be used with care, for forcing them into and over roughly-bored and turned work soon damages their fine surfaces, and impairs their fit.

The cylindrical-stepped gauge, or corrective gauge, is a combination of several short internal gauges. These are of somewhat limited application, being used as tests or standards of reference rather than for direct measurement of work. The B. W. G., or the new standard wire gauge, are used for wire and sheet metal. For obtaining and transferring measurements, the calipers are used in four forms—external, internal, combination, internal one side, external on the side opposite to a central point or pivot, and a special form in which the turned round ends point in the same direction instead of being opposed to each other. Even in so simple a matter as the taking of caliper measurements it is easy to go wrong, the precise dimension being that at which contact of the caliper can be just detected. A large pair, especially if they have thin, springy legs, will, if a very slight force is exerted, give sufficiently to make the resulting dimension unreliable, hence caliper legs should be rigid in proportion to their size. Micrometer gauges are seldom wanted in ordinary workshop practice; but for very delicate and precise adjustment of size it is well to possess one. These little gems are not so very costly, and are admirable examples of perfection of workmanship. A screw-thread gauge, for telling the pitch of any screw in an instant, is very useful. It simply consists of a thin sheet, or of several sheets or laminæ of metal, notched at the edges to fit over the vees of screw threads of different pitches. The common scribing block or surface gauge is quite essential. This tool and the steel squares are usually made by fitters themselves. Three or four squares are wanted ranging from about 2½in. to 9in. in the blade. They are formed by fitting a thin strip of steel—the blade—into a hack saw kerf in the end of the stock, and riveting through the two, final adjustment and correction being given to the blade by filing. At least one surface plate is necessary for fitting level faces. Two plain forms are shown (Figs. 427), either of which can be made by careful scraping if the use of a true block is available to fit them to. If not, it is necessary to make three similar plates in the manner originated by Sir Joseph Whitworth and frequently described in the text books. The same method applies to iron straightedges also. These tools are all used for purposes of direct measurement.

The cutting and abrasive tools necessary for the equipment of a workshop, even of small size, embrace a considerable number. There are the various lathe and machine tools whose weight can be diminished by the employment of tool holders, the cold chisels, screwing tools, files, shears, &c. With a little practice a machinist can render himself independent of the tool smith, and forge and temper his own tools. One great advantage, however, of the use of tool holders is that the temper of the cutters, once got right, does not require to be renewed, while with solid tools re-forging means re-tempering. The slightest change of shade in colour, unnoticed save by a practised eye, is sufficient to make the difference between a soft and a brittle, crumbling tool. The less tools are brought into contact with the fire the better. They may be made of a low red heat for hardening in the clear of the fire; but the spanners are best, but those made in cast steel are also usually reliable. The straight spanner is not a convenient form, having to be turned through a larger angle than one whose handle is cranked. One whose handle is cranked at an angle of 15deg. will turn a six-sided nut in 30deg., one whose handle is cranked at 22½deg. will turn a square-sided nut in 45deg. Screw wrenches are handy as saving a multitude of single spanners of different sizes.

Stud blocks are tools essential for screwing studs into work. When a stud is screwed in by means of a nut threaded over it, the slackening back of the nut often causes the stud to slacken back simultaneously. With a stud block there is no such trouble. The block, (Fig. 437) is screwed to the size the thread, and the top screw presses down on the head of the stud while the latter is being screwed in. As soon as the stud is at its depth, the top screw is slackened back, and the block is run off, leaving the stud in place. There should be one of these blocks to each standard size of thread.

It is astonishing how soon the small tools accumulate, what a quantity of drills, chisels, drifts, &c., one requires who does much work at home. Many of these will be properly kept in drawers under the bench, while some will be placed on shelves, and others again hung on pegs. Tools not carefully looked after are often missing or damaged just when required, and time is lost in searching for them, and putting them in trim.

For lubricating purposes one of the numerous light compound oils now manufactured by firms of repute, is more suitable and cheaper than pure oils. The compounding of oils to suit any class of machinery has become a speciality in trade, and their superiority is beyond question. Sponge cloths, or cotton waste, are used for cleaning bright and other work of oil and dirt, and should be used freely.

There are two dangers from fire in a shop, and I have seen fires caused by each. One is the spontaneous combustion of waste, due to the heating of an oil having a low flashing point, the dirty waste being allowed to accumulate on a wooden bench. The other is due to the sparks from the emery-wheels flying up and lodging on a beam overhead, smouldering there, and finally setting it alight. The remedy for the first is not to allow the waste to accumulate; the remedy for the second is to put a protective covering of sheet iron over the emery wheels, leaving room only for the belt to move freely.

TOBACCO-GROWING IN ENGLAND.

AT an ordinary meeting of the Society of Arts last week Mr. E. J. Beale read an interesting paper on this subject, in which he gave an account of the experiments carried out by Messrs. Carter, to which we referred on p. 124 of the last volume. Commencing with a brief notice of the origin of the present movement, Mr. Beale made a few remarks about other experimental crops which were grown last year, one of which—that raised by Mr. Bateman in Essex—was unfortunately lost by fire in the process of curing, a fact it is advisable to note. Mr. Beale traced the history of tobacco-cultivation in this country, and gave a summary of the laws which finally ended in its prohibition, although from the time of Charles II. to the reign of George III. they were often evaded. In Belgium and other parts of the Continent of Europe a handsome profit is made by the cultivation of tobacco, and it would seem that in parts at least of this country tobacco might be cultivated with advantage by a judicious selection of suitable seed. As may be remembered, the object of Messrs. Carter's experiment was to determine, if possible, whether any varieties of the plant were better adapted than others to this climate, and in order that their operations might be readily inspected they hired a field near London, which was, however, scarcely adapted for the purpose, though it offered advantages in the fact that within its limits were to be found three kinds of land—viz., a black vegetable deposit (retaining moisture tenaciously), a rich, sandy loam, and a light gravelly soil; but owing to parts being almost under water, want of time, and other circumstances, it was found impossible to obtain the fine tilth considered desirable. The tobacco seeds were sown on hotbeds on April 7 (very late), and made such slow growth, owing to the prevalence of unusually cold east winds, that it was June 16 before the plants were set out 3ft. apart, on ridges. Mr. Beale says that in an ordinary spring the planting-out may be safely conducted about the middle of May, when the harvest would be proportionately early, and there would be a better chance of rendering the after-curing more simple and certain. In the case in question, the cutting of the crop was commenced on September 18—some varieties being riper than others—and the cutting and housing was finished on September 27. The harvesting was performed in the following manner: Men went round with shoemakers' knives and severed the stems of the plants just above the ground, the plants being left until the next day, in order that the leaves, which in their growing state are brittle, might become limp and wilted. A slit was then made in the lower end of the stems, and the plants were threaded upon hazel rods, which were carried to a barn—the best place Messrs. Carter could procure. There the rods were suspended from the rafters, care being taken that the plants did not touch one another. The curing progressed satisfactorily, although the environments were not exactly those adapted to the purpose, and the first stages of the "curing" had to be accomplished by the cold air—that is, by the admission of dry easterly winds, and the careful exclusion of foggy or humid atmosphere. This treatment was continued for about five weeks, when "firing" was commenced—not too soon, in the opinion of some, but quite soon enough in that of others, who regard the excellent quality of the tobacco produced as largely due to the slow process of curing which was perforce adopted. Mr. Beale, however, says that, except in cases where bright golden colour in the leaf is aimed at rather than smoking quality, it is desirable to dry the leaves for a fortnight or three weeks by cold air; but if the air is moist, then slow firing should be commenced at once—that is, sufficient heat should be used to dry up the moisture entering the building in the air, and also some of that exuding from the leaves and stems of the plants. In Messrs. Carter's case a moderate firing was continued for about a mouth, and then the plants, which had already shrunk about 50 per cent. in bulk, were packed as close as possible, and canvas walls being erected, the average day temperature ranged from 80° to 90° for four or five days. The tobacco was then considered sufficiently cured; but as it has a tendency to crumble into dust, the external air is again admitted for a day or two to soften the leaves and render them pliable and easily handled. Then comes the stripping and sorting, in which the leaves are divided into three qualities—"lugs," those which have grown nearest the ground, usually more or less damaged; "firsts," the brightest and best coloured leaves; and "seconds," the medium quality. The leaves are then "handed"—that is, they are arranged with their butt ends together in bundles of from ten to twenty, and bound round with another leaf, the end being secured by inserting it between the leaves. The bundles are compressed by passing through the hands of the workers, and the "hands," as they are then called, are piled by the packer into a solid block, the "butts" coming to the outside of the pile while the tips of the leaves are in the centre. These piles are usually 6ft. long by 3ft. in depth, the leaves being trodden firm in the centre by the packer. In this condition the tobacco rapidly ferments, and it is necessary to prevent overheating by careful examination—pulling the pile to pieces and rebuilding if necessary—attention in this stage of the preparation being amply repaid by the superior condition of the product. The tobacco is now saleable, but it undergoes an after fermentation known in America as the "May sweat," and is then packed into hogsheads for the market. It is usual, however, on the Continent, to sell before the second fermentation, which is looked after by the manufacturer, and consequently the final results of Messrs. Carter's experiments will not be known until the report of the manufacturers has been received. Mr. Beale summed up by saying that the successful culture of tobacco depends on the attentive observation of rules laid down by English experimentalists rather than by following the customs of other nations, frequently impossible or undesirable; and by the exercise of daily observation which will often suggest some improved system of procedure. Mr. Beale gives the approximate cost of cultivating an acre of tobacco at £25 7s. 8d., which, if the produce yields 4d. a pound, will show a net profit of from £10 to £24 per acre; but the items of the account, with other useful matter, will be set out in a book, which will be shortly published, on tobacco culture in England.

In the course of the discussion, the chairman, Sir Edward Birkbeck, Bart., M.P., expressed the opinion that a man who smoked 2oz. of tobacco a week, and contributed 10s. per annum to the revenue, should be able to smoke that which he grew in his own garden; but, at the outset, there is at present a tax of £1,600 per acre on tobacco, which was imposed by 15 Chas. II. c. 7. For experimental purposes, this tax can be avoided by making a statutory declaration, and producing the tobacco grown, at any time, to the revenue officer. Between July 7 and Sept. 8, the excise officer paid Messrs. Carter's experimental plot six visits; but, doubtless, he was interested in the experiment. Mr. Kains-Jackson asserted that tobacco could be grown here which English people would be glad to smoke. Both Mr. Beale and Mr. de Laune distinctly stated that they had no desire to induce tenant farmers to take up the cultivation of tobacco as a crop, the latter expressing the hope that if Government made any concessions they would be made only to experimentalists; while the former hoped that many would try a rod, or half a rod, watch it carefully, and not even try to sell it, for sixpennyworth of seed would be sufficient for such an experiment, and with the experiences of many a better idea could be formed of the possibility of growing tobacco as a paying crop.

MINIMA VISIBILIA AND SENSORY CIRCLES.—I.*

HARRIS found that a black square on a white card, the side measuring $\frac{1}{10}$in., is distinguishable as a mere speck at the distance of 40ft. from an emmetropic eye, whilst the square is not perfectly defined in colour at a further distance than 7ft.; he found also that these distances corresponded to visual angles of 44″ and 4′ 5″ respectively. Ernst Weber's experiments on the skin elaborate a result that a circular metallic tube, the diameter measuring ⅛in., is felt as a single point when pressed against the palm of the hand, whilst its shape may be perceived with its diameter exceeding ⅛in. (sensory circle of the palm). Hence two varieties of minimal perception may be recognised—viz., points and areas (minimum visibile vel tactile et punctorum et extensionum vel formarum). Our present subject will deal with the proposition that all minima are of a secondary nature, defining and being defined by a limitation in the acuity of muscle perception. That there is such a limitation in the apperception of visual angles is exemplified in the judgment of apparent distance being liable to error in the retina of actual objective distance, as well as in apparent relievo being less marked in a like ratio (minimum motorium). One strong argument consists in bracketing together the nonexistence of minima auditoria vel objectoria with the absence of suitable motorial appendages to these senses; so by analogy physiology would probably supply no basis for dogmas on the present subject were there wanting the groundwork of a visual or tactile muscular diagnosis. Then, again, the phenomena of minima visibilia and sensory circles are so harmonious in two very diverse sensations that nothing short of a common causation can adequately solve the harmony; neither are discrepancies in these phenomena, where any exist, explicable on terms other than those of the proposition. Finally, by coupling the facts that visual angles are of muscular origin, whilst the minima of vision have been resolved into such angles by Harris ("Treatise on Vision"), the proposition as regards vision seems to be adequately verified.

Let us examine a series of ascertained data, so as to institute a comparison between their solution by the hitherto prevalent and the present doctrine, simply premising that the former tenet has been constructed on the view that all sentient points exercise their directional and positional powers by an inherent faculty of primary sense—thus: "The skin is the criterion of locality" (Tod and Bowman). . . . "The simple sense-impressions of the optic nerve are colour, intensity, and direction" (Le Conte). As regards the skin, there is no cutaneous point that we can prick without producing pain; as regards the retina, a star is distinctly visible and without apparent magnitude, even though it be magnified 5,000 diameters. From these data we are committed, by the former dogma, to a conclusion that each minimum punctorum corresponds with the brain by a distinct and duly insulated nerve-fibril. Dr. Young has calculated that 10,000,000 of nerve-fibrillæ pass through the contracted orifice of the sclerotic tissue, and as many are possibly transmitted by each sensory nerve. Now, such a minute subdivision into nervelets is entirely superfluous, according to our proposition. To all intents and purposes, both skin and retina may be regarded as sentient expansions or superficies, whose every minimal point is subject to a muscular surveillance. This conclusion seems to be warranted by any limit to the minuteness of visibility, with sufficient luminous intensity, having been disputed by some metaphysicians; and, additionally, by stars of the smallest magnitude being seen under the comparatively greater visual angle of 44″, whilst the smallest tactile impression is referred to the entire area of its correspondent sensory circle, equalling in apparent size the impact of numerous sentient impressions on the same area. It has been surmised, with a view of covering these peculiarities, that each visual minimum of 44″ corresponds to a single cone of the bacillar layer, so that an identical excitation is effected by the incidence of purer or more luminous raylets; but a serious objection consists in the surmise being inapplicable to the case of sensory circles — namely, that their numerous ultimate fibrils coalesce into a single sensory fibre. For, granting this to be so, two cutaneous points in adjacent sensory circles of ½in. diameter would be apparently duplicate with an interval between them of only ⅛in., which is not the case. Sensory circles, therefore, are mere metaphysical abstractions in the above respect, and the inextricable blending or interlacement of their impressions points only to a common muscular influence.

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* By the late Brigade-Surgeon T. OUGHTON Army Medical Department in the *Lancet*.

Then, each retinal cone must be subdivided into at least three terminal fibrils in order to explain intelligibly the perception of colours (Young, Helmholtz, &c.); there must be a blue, yellow, and red, or a red, green, and violet fibril (primary colours), whilst the function of the entire cone naturally combines these minimal colours for a sensation of minimal whiteness. I must protest against the coinage of a minute anatomy in this perfunctory manner; both matter and organisation are pliable commodities, but I think hypothesis must be stretched here. Quite sufficient difference exists in the intrinsic nature of coloured lights to explain adequately a variety of correspondent coloured perceptions without resorting to variations in nervous mechanism; neither should it be forgotten that the province of nerve organisation is to interpret rather than to modify nature, for of a truth (others notwithstanding) there is a latency in the cerebral constitution of every natural imponderable that may be transmitted thereto by natural channels. Far be it from me, nevertheless, to deny that the minimum visibile of 44″ is much concerned in the several phenomena of colouration, colour-blindness, &c. And, apart from colouration, transparencies teach us thus much about their construction—that their molecular particles fall extremely short of the minimum visibile.

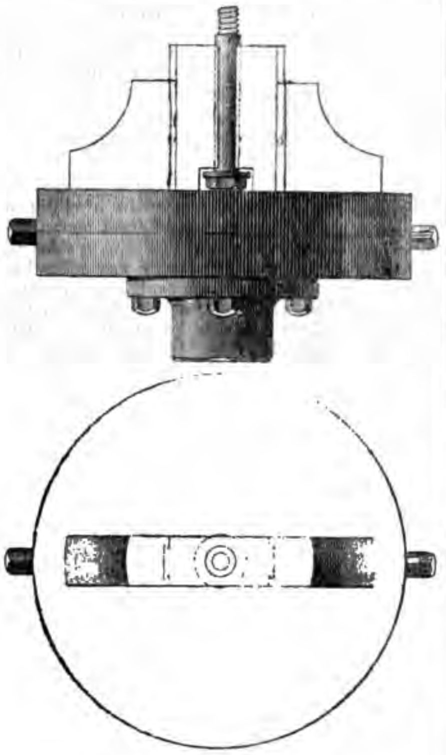
Based on the evidence of apparent extension (minimum formarum) is the doctrine of the cerebral realisation of sensational points, indicating a similar mechanical deportment of nervous structures. Impressions on two adjoining minimal areas, retinal or cutaneous, give rise to the mental impression of contact, and the excitation of several contiguous areas affects an idea of coherence or extension; such experiences could not obtain, according to the above dogma, excepting on the inference that the termination of afferent fibrillæ in the brain is a precise facsimile of their origin. Bernstein says, "The representation of the surface of the body is imprinted upon our brain," so that by experience or practice (which may signify a constant repetition of primary perceptions) the brain is capable of determining any points of the skin's surface that may be touched. Professor R. S. Wyld writes: "In vision there is mapped out in the sensorium a true representation, though on a different scale, of the forms, motions, and relative sizes of external objects as they exist on the retina"; and he has submitted a diagram, explanatory of single and double vision, in which each retinal image is actually reproduced in the corpus quadrigeminum. But, on the contrary, the idea (perception) of space or extension is as different from that of body (the sense of contact) as it is from that of a scarlet colour; it is true that a scarlet colour, like body, must have extension, but the two ideas are distinct (Locke). Moreover, since the idea of solid form (relievo) is contained by surfaces, and has been proved to be a secondary perception elsewhere, the idea of superficial extension must also be of a secondary nature. Wherefore the present proposition renders the anatomical identity of relation between the proximal and distal extremities of an afferent nerve another redundant additamentum to minute anatomy.

Nevertheless, in further elucidation of the subject, the contiguity of sentient impressions on peripheral nervous expansions is clearly a *sine quâ non* in the constitution of an idea of extension; retinal images or sensory impressions must be arranged *in ordine* for the generation of the mental idea of coherence, although we deny their reception *in ordine* by the brain through the channels of primary perception. This will be obvious on reflection that the directional influence of a voluntary muscle upon neighbouring impressional areas varies by a regulated increment, according to their regular positional relation to the dynamic centre of secondary perception. It is maintained that all ideas of extension, whether definite or infinite, may be ultimately resolved into the appreciated movements occurring in exarthrodial and diarthrodial articulations in the tactile sense, or into unfettered ocular rotations in the case of vision; and, further, the coherence of extension is comprehended ultimately by a duly perceived aggregation of what we may designate a minima motoria.

(*To be continued.*)

SPECIAL TOOLS IN THE MACHINE SHOP.*

IN going through Birdsall's shop some time ago I noticed a rig for threading the ends of brass bolts which had to be turned and cut to a shoulder. These bolts used to be centred and countersunk on both ends, faced and turned down to size, then the thread was cut with an ordinary thread tool in the lathe. As can be seen, these operations took five distinct handlings. They were used right along, and were made up in lots of seventy-five or a hundred every other week; there was no gauge to fit them to, and the chances were that even if the bolts of one lot were of a like size they would differ with the preceding or else the next lot. Birdsall had just hired a man who was used to special tools; he was a good tool-maker and knew all about jigs and gauges. One of the first tools he made was a receiver, or screw gauge, for the brass bolts. He didn't take a lathe tool and drill a hole in the end and tap it out the size of the bolt; nor did he make it out of a piece of cast iron he picked up in the scrap heap. He cut off a piece of good tool steel and had the blacksmith anneal it for him; after roughing out this piece he had it annealed again—the first annealing was to soften it, the second was to make it lie still when he should come to harden it. The blank was drilled and tapped, slightly under size, turned, knurled on edge, then was hardened. Care was taken in he ing not to get the gauge quite as hot as was annealed, and after plunging it was have opened only a very little at the mou ground it to size with a cast-iron plug and The cost of this gauge was a little more th had been made of scrap iron, but it was investment; every person who used it did so with great care, being particular to keep dust and dirt out of the threads, lest, by constant use, they would grind the hole out larger. The life of many a tool is lengthened by being well made in the first place; men will always take better care of a good-looking tool than of one which looks botchy, and the well-made tool will last longer, do better work, and be the cheaper in the end. The gauge being finished he turned his attention to getting out bolts more expeditiously than by the old methods, which would be uniform and fit the gauge. A turret head to put on his lathe would have done the work nicely, but the shop did not have one. He found a two-jawed chuck and dovetailed pieces into the jaws as shown in the figure. These dovetailed pieces or removable jaws were pinned in position and bored out to fit the body of bolt, the bottom being planed out to receive the head. He afterwards fitted up several pairs of jaws for as many different jobs for this same chuck, and when one job was finished the jaws were taken out and the chuck was ready for some other work.



An extra tool block was fitted on the lathe carriage, and was so placed that its tool was behind the work; this tool was a square nose, like a cutting-off tool, and was used by reversing the lathe, to face up the end of bolt and to square the shoulder after it had been turned. In the other or front tool-post was a round-nose tool that turned the bolts ready for threading; this was set to a stop which brought all the bolts to a uniform size. The thread was cut with a die rigged up in the tail-stock, which was allowed to ride free on the shears. The die was fitted to a holder which was turned tapering in the shank to fit tail-stock spindle. In cutting the thread the tail-stock, sliding freely on the ways, was pushed up against the end of bolt, and the thread cut up as far as required; when the lathe was reversed the die backed off itself and the bolt was finished to gauge with one handling. Birdsall told me that last time he had put through a lot of three thousand bolts, and said he: "The difference in cost over the old way almost paid for the tools! And this isn't all —every bolt in the lot is the same size; and every bolt in the lot we are now making is the same size as those we made last."

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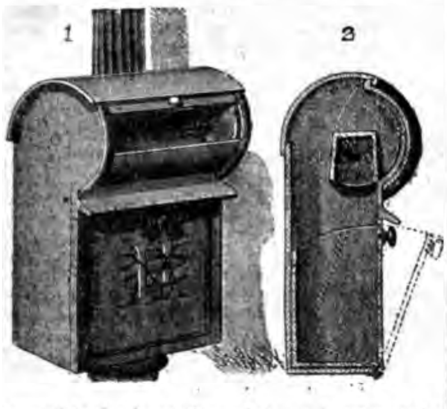
* By J. J. FLATHER, in the *American Machinis*

SIMPLE FORM OF WATER BATTERY.

PROF. ROWLAND describes in *Silliman's Journal* for February a most simple, convenient, and cheap form of water battery, whose design has been in one of his note-books for at least fifteen years. He says: "It has proved so useful that I give below a description for the use of other physicists. Strips of zinc and copper, each 2in. wide, are soldered together along their edges so as to make a combined strip of a little less than 4in. wide, allowing for the overlapping. It is then cut by shears into pieces about one-fourth of an inch wide, each composed of half zinc and half copper. A plate of glass, very thick and a foot or less square, is heated and coated with shellac about an eighth of an inch thick. The strips of copper and zinc are bent into the shape of the letter U, with the branches about one-fourth of an inch apart, and are heated and stuck to the shellac in rows, the soldered portion being fixed in the shellac, and the two branches standing up in the air, so that the zinc of one piece comes within one-sixteenth of an inch of the copper of the next one. A row of 10in. long will thus contain about 30 elements. The rows can be about one-eighth of an inch apart, and therefore in a space 10in. square nearly 800 elements can be placed. The plate is then warmed carefully so as not to crack, and a mixture of beeswax and resin, which melts more easily than shellac, is then poured on the plate to a depth of ½in. to hold the elements in place. A frame of wood is made around the back of the plate with a ring screwed to the centre, so that the whole can be hung up with the zinc and copper elements below. When required for use, lower so as to dip the tips of the elements into a pan of water and hang up again. The space between the elements being one-sixteenth of an inch, will hold a drop of water which will not evaporate for possibly an hour. Thus the battery is in operation in a minute, and is perfectly insulated by the glass and cement. This is the form I have used; but the strips might better be soldered face to face along one edge, cut up, and then frame, which is pivoted in the dome, and is so overweighted in front of the pivots that it will swing of its own accord to a closed, inverted position for dropping any mail it may contain into the main receptacle, as shown in the sectional view Fig. 2



Secured to the front edges of the end plates of the shifting frame is a curved plate, provided with a knob, by means of which the frame may be turned so that its mouth will coincide with the opening in the dome, when mail matter may be deposited. When the frame is in this position, its lower back piece, together with a stationary curved plate held at its ends to the main frame, closes the main lower part of the box, so that no mail already in the box can be extracted. Properly arranged flanges on the movable curved plate and across the upper edge of the dome opening, the side edges of which are covered by curved and grooved heads, prevent the entrance of rain and snow. In the lower part of the main frame is a box so hinged that it may be swung outward, to facilitate the emptying of the mail matter directly into the mail collector's bag. This letter box, the invention of Mr. A. V. B. Bush, of No. 2, Fulton-street, New York City, is adapted to receive either large or small mail matter; and when opened for the deposit of mail, the main part of the box is securely closed, and, as the shifting frame automatically closes itself, there is no danger of the box ever being left open.—*Scientific American.*

Sanitary Science.—In a lecture on "Sanitary Science" with which Dr. Edward Seaton recently inaugurated his lectures on "Public Health" at St. Thomas's Hospital, the point was insisted on that the advocacy of cleanliness was not the sole object of sanitary workers. The enforcement of cleanliness has undoubtedly done much to improve the public health, but there is too much tendency at the present time to forget that for the prevention of the disease much more is necessary. Our knowledge of its causes is still in its infancy, and until these causes are fully understood it is impossible to define the means by which it shall be prevented. To rely upon cleanliness alone is, therefore, to neglect other conditions which are often far more potent for evil. Dr. Seaton's protest is certainly timely. We freely join with him in the desire to see the doctrine of cleanliness generally accepted, but we none the less accept his views that this is not a panacea for all human ills. Every year emphasises this opinion, and teaches us that many maladies, and especially some of those which are of a communicable character, have less to do with filth as a cause that was formerly supposed. The recent investigations of Mr. W. H. Power have shown this forcibly, and lead us to hope that sanitary science has before it much greater triumphs than those which have already been attained. It is not many years ago that the public were taught that all that could be known was already discovered, and that the use of a 2ft. rule was now all that was required for the purpose of sanitary administration. It is this view which the public is but too willing to accept; its teachers are not always those who are workers, and it is well that it should be reminded from time to time that sanitary science must necessarily be progressive. We trust Dr. Seaton's protest will be heard outside his class.—*Lancet.*

Berly's Universal Electrical Directory.—The sixth annual edition of this useful directory of the industries directly or indirectly connected with electricity and magnetism has been recently published by Messrs. W. Dawson and Sons. It contains the names and addresses of manufacturers in this country, America, the Continent, &c.; brief accounts of the telegraph, telephone, and electric light companies having offices in this country; a list of books and publications connected with electricity; some useful tables, and a quantity of information rendering it valuable to all engaged in the trades interested in the progress of electricity.

SCIENTIFIC NEWS.

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THE Dun Echt Circular No. 141 contains elements and ephemeris of Barnard's Second Comet of 1887, calculated from observations made at Paris, Strassburg, and Hamburg. Dr. Oppenheim gives T = 1887, March 28·4918, Berlin M.T.; π − ☊ 36° 33′ 51″; ☊ 135° 27′ 11″; i 139° 46′ 41″; log. q 0·00272. Position at Berlin, midnight, March 13, R.A. 3h. 37m. 5s.; N. Dec. 32° 9·5′. The brightness is only about one-tenth of what it was at time of discovery.

The *Journal* of the Liverpool Astronomical Society for March contains, as usual, a number of interesting papers on various matters connected with astronomy, including a note by Miss E. Brown on the way to look for Vulcan.

The death is announced of Prof. Arlt, the famous oculist, of Vienna. He had a worldwide reputation as an operator in affections of the eye, and is said to have had no fewer than 5,000 cases of cataract alone.

The death is reported of Dr. Grothe, professor at the Polytechnic, Delft.

The Burgomaster of Hamburg, Herr Kirchenpauer, a well-known geographer and naturalist, died the other day at the age of eighty.

The report of the Meteorological Council to the Royal Society for the year ending March 31, 1886, was issued on Monday, and is full of matter interesting to meteorologists. During the year the office received 189 logs of observations made at sea, of which 138 are classed as excellent. Out of a total of 591 warnings issued, 327 were justified by gales that followed, 142 were partially justified by strong winds, and 115 were failures; but there were only eight gales of which the office failed to issue a warning. During the harvest season thirty special forecasts were forwarded daily to subscribers, and of these eighty-two proved more or less correct.

The report of the committee appointed in December, 1885, to inquire into the working of the Patents Act of 1883 has at last been published, and, as was expected, the system of examination as carried out by the office has been condemned almost in toto. The committee recommend that the practice introduced by the Act of 1883 of warning applicants of the existence of unpublished applications likely to conflict with their own should be dropped. In the unanimous opinion of the witnesses this practice had entirely failed, and it was calculated that the repeal of the provision would result in a considerable saving. The present system of examining applications appears to the committee to be too elaborate, and they consider that it might be simplified by diminishing the excessive amount of supervision exercised. The alterations suggested, it is believed, would set free some of the staff, who might then be employed in working up the heavy arrears in the publications of the office. The committee further recommend that any amendment of a specification required by the Patent Office should be supplied within a month, or that the patent should date from the time when it was so supplied, instead of from the time of the original application. They further advise that steps should be taken with a view of fixing a standard of qualification for the title of patent agent. If the proposed alterations are adopted, the committee suggest the appointment of another committee after a sufficient time has elapsed to test the working of the office. Properly carried out, subsections 5 and 6 of section 7 of the 1883 Act would be of advantage to intending patentees; but it appears that the examiners have not unfrequently made mistakes, and concluded that inventions which were in some respects similar were identical. It is not always easy to say what a provisional specification means: hence, to avoid injustice, the committee recommend that the practice of examining for novelty be dropped.

Oxford University has agreed, in answer to the representations of the Royal Geographical Society, to found a readership in geography, bearing all the expense thereof. Cambridge University has determined to take a similar step, the Geographical Society paying half the stipend of the lecturer.

A map showing the distribution of fog over different parts of the earth has been published by Admiral Teisserenc de Bort. It is based upon observations made at 1,600 land and 112,000 marine stations.

The guarantee fund for the meeting of the British Association in Manchester this year now exceeds £8,000; but much more will be required. Arrangements are being made for a number of excursions in the district, and amongst the vice-presidents are the mayors of Manchester and Salford, the Duke of Devonshire, the Earl of Derby, and the bishops of Manchester and Salford.

In the latest issue of the *Mineralogical Magazine* there are several papers of interest, notably one by Prof. Judd entitled "A Contribution to the Theory of Schillerisation," the submetallic lustre or "sheen" which crystals exhibit in certain positions, and which is produced by inclosures developed along definite planes which reflect the light incident upon them at certain angles. Prof. Macadam gives the analysis of a sample of talc used in papermaking. This mineral is obtained from New Jersey. It is very largely employed for papermaking in place of China clay (kaolin), and gives, amongst other advantages, a much more pure effluent, fully 90 per cent. being retained in the paper. From its fibrous nature it appears to attach itself to the smaller paper particles, and retain these also. The very high and beautifully smooth glaze of the American papers is largely due to the use of this substance.

On Friday last, at the meeting of the Liverpool Microscopical Society, Mr. J. Mayall, jun., read a paper on "Recent Improvements of the Microscope: a Visit to Jena," the substance of which we gave on p. 473 last volume.

At a recent meeting of the Liverpool Engineering Society, Prof. Hele-Shaw read a paper on the "Theory of the Steam-Engine," in which he remarked that one result of all the elaborate researches and investigations upon the theory of the steam-engine had been to reveal the complex nature of the problem. It was true that the main features of the theory of this the most important of all prime movers had long ago been stated by Rankine and Clausius, but in spite of many new and interesting facts which further experience has revealed, there were a number of important points concerning which, at the present moment, great differences of opinion existed. To the careful testing of steam-engines, and the systematic way in which these tests had been carried out in recent years, were due the clearer views now held on many points of steam-engine economy, and it was by continual work of this kind that the still doubtful points could alone be decided. It was now recognised that the efficiency of the steam user or engine must be separately examined, and also that when possible the useful effect of the steam must be determined, apart from the loss of friction in the mechanism of the engine. There were thus really three sets of separate efficiencies, the product of which represented that of the steam-engine as a whole.

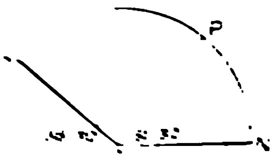
The *Etruria* having made the fastest trip out to New York has now also made the fastest return—viz., from New York to Queenstown in six days, five hours, eighteen minutes. The voyage out and home has thus been accomplished in remarkable time, and shows that the average speed through the ocean must have been 19 knots (22 miles) an hour.

A recent invention of an explosive engine, for which a patent has been granted to Herr von Ruckteschall, of St. Petersburg, relates to the employment of nitro-cellulose and similar preparations as the explosive, converted without combustion into a gaseous state by electricity or any other means, thus producing a strong and sudden expansion, whereby, besides the powerful expansion resulting from the formation of the gases, heat is rendered latent, and the machine is protected from over-heating, whilst the expanded gases may be expelled unburnt, and thus be utilised.

A patented compound for preventing incrustation in boilers, as well as removing scale, consists of caustic potash, esparto, valonia, nutgalls, carbonate and chloride of potash, silicate of soda, and chestnut flour! A mechanical method of preventing incrustation also

[illegible]

[illegible] A figure [illegible]



[illegible] supposed to be [illegible] and the [illegible] and quite [illegible] of 51° 30' [illegible] and N. the [illegible] of course, [illegible] A star with [illegible] appear above N. [illegible] meridian [illegible]

[illegible] Royal Astronomical Society.

OCCULTATION OF ALDEBARAN, MARCH [illegible] 1887.

[illegible] under very [illegible] was clear and [illegible] was being [illegible] occultation [illegible] which was not [illegible] The [illegible] of that [illegible]

A N S

[illegible]

If the star grazes the south limb of the moon, as seen at Greenwich, how can the occultation be visible as far south as the Equator, and so short a distance north?

Evidently the star grazes the north limb of the moon. This will give the point of disappearance [illegible] As seen in an inverting [illegible] makes no difference, for the lowest point of an object in the south is then its N. [illegible]

F. B. A.

[illegible] the limb it was well observed here. The instantaneous character of the star's disappearance at the moon's dark edge contrasted remarkably with the lingering, almost gradual, nature of its reappearance.

The star seemed for two or three seconds to be attached as a bright point to the moon's illuminated limb. The phenomenon was strikingly similar to the exit of a transit of one of Jupiter's moons when the satellite passes off the planet's disc. In [illegible] the light of Aldebaran [illegible] was evidently [illegible] in a marked degree than the moon's illuminated edge, with which the star appeared to be [illegible] in contact.

[illegible] Bramber.

[illegible]—EXPECTING, as usual, in the [illegible] I prepared to [illegible] what should have been an interesting [illegible] the evening of March 1. My first [illegible] of the moon and star about [illegible] p.m. showed me that no occultation would take place—and so it proved. The "nearest approach," as seen here was about [illegible] p.m., some five minutes after the star had passed the line of the moon's terminator, and the distance at that time between Aldebaran and the moon's limb 4' [illegible], as roughly measured with a suitable eyepiece.

My approximate latitude is [illegible], and the northern limit for this occultation, as given by the N. A., [illegible]; therefore, the star ought not to have escaped the moon's limb. A correspondent at Cirencester, lat. [illegible], informs me that the occultation did not take place, as viewed from that station, which is only some 14' north of the latitude of Greenwich; so that it is scarcely possible such phenomenon was even "visible at Greenwich," in N. A. parlance.

To those persons who are, like myself, apt to regard with implicit confidence any data given on the authority of our national Ephemeris, such a discrepancy is not a little startling, and is calculated to shake that perfect faith in its supposed infallibility.

If the authorities at Verulam Buildings were a little less conservative in their ideas, and a little more alive to the exigencies of the times, they might also make their annual publication much more useful than it now is to the astronomer. I would commend the American *Nautical Almanac* to their notice, from which they might gather a few new ideas.

Leicester. **W. G. Franks.**

[26928.]—BEING from home and unable to use my excellent 6¼in. Calver to observe this phenomenon, it struck me that probably it might be witnessed with an opera-glass, and to my satisfaction, with this simple instrument, the *disappearance* proved successful. About a quarter of an hour prior to the event, Aldebaran stood out a perfect little point of light in close proximity to the moon, and continued so until lost behind the dark limb. The impression on the mind is widely different between the telescopic observation of this phenomenon and as witnessed with an opera-glass. In the former case, the star is blotted out in a moment with startling effect; in the latter, the star continues shining until insensibly lost to view. Aldebaran was not apparent at the immediate *reappearance*, as the bright limb of the moon overpowered its tiny light; but very shortly after the star was quite conspicuous. My object in communicating this is merely to show that much can be done by those who feel interested in watching celestial phenomena, although not in possession of telescopes. The day was singularly fine.

Southampton. **S. S.**

CONSERVATION OF SUN'S ENERGY.

[26929.]—TWO correspondents in "Ours" of 25th Feb.—viz., "E. T." (26873, "Life of Sun,") and "F. W. H." (26833, "Luminiferous Ether,") bring to recollection some notes made by me a few years ago on the above subject, which, if in their crude state will interest our readers, and assist "E. T.'s" wish to raise an argument thereon, I herewith transcribe.

Gravity is reciprocal; there must be an *object* to be attracted; the force is not dissipated into empty space.

Motion of a single body can only be conceived through a change of position of that body with relation to some other body or *object.*

Electricity is not manifest until circuit be completed, or opposite poles joined, therefore electric vibrations exist only when there is an *object.*

By analogy, light and heat must have an *object*, and cannot be manifest without one, hence cannot be lost in empty space.

Luminiferous ether is hypothetical, invented (like Phlogiston of old) to explain a preconceived theory.

Air or gas, sufficient to explain transmission of light and heat through space.

Gaseous matter is subject to laws of gravity, and its limit of tenuity unknown, therefore there may be a continuity of gaseous (or Crookes's "radiant matter") between sun, planets, and stars, more or less condensed on their masses by gravity; but streaming with diminished tenuity along the lines of gravity joining the masses, and through which light and heat vibrations can pass.

Interstellar space, except on these lines, will be void of such gaseous matter; hence no loss of energy, except to some *object*. Therefore, assuming that our Solar system of sun and planets were "in the beginning" all of the same temperature, then the smaller bodies would give up heat to the larger, in proportion to their recipient surfaces. Consequently, the sun would gain heat at the expense of the planets, and the latter would cool down until an equilibrium resulted, after which they would continue to be of a temperature proportionate to their respective radiating surfaces.

If the above reasoning be correct, the sun *fully conserves its own energy.* **F. G. Ll.**

PLANETARY CONFIGURATIONS.

[26930.]—THE following passage occurs in a work entitled "The Gallery of Nature," by Rev. T. Milner (1846, p. 69):—"A conjunction of the five great planets took place between the Wheat-ear of the constellation Virgo and Libra, September 15, 1186. It will be ages before they collect again in that part of the heavens."

The subject of planetary configurations is very interesting. Is anything known about the above-mentioned conjunction, as to where it was observed? Mercury being included, it would probably have been seen from some country nearer the Equator than ours, and with a clearer sky; moreover it could not have taken place at a very remote distance from the sun, and would therefore have been soon after sunset or before sunrise. Chambers, in his "Astronomy," does not allude to the conjunction, although he refers to one of Mars, Jupiter, Saturn, and Mercury recorded in the Chinese annals, which according to one authority took place Feb. 28, 2446 B.C., or to another, Feb. 9, 2441 B.C. Other conjunctions of four planets are given by Chambers—viz., Nov. 11, 1524, Venus, Jupiter, Mars, and Saturn very close, and Mercury only 16° distant; Nov. 11, 1544, Venus, Jupiter, Mercury, and Saturn were inclosed in space of 10°; March 17, 1725, Venus, Jupiter, Mars, and Mercury appeared together in same field of telescope. This must have been a very interesting and brilliant spectacle. Various other combinations of a smaller number of planets are alluded to.

When we consider that there are five planets moving in different apparent paths among the fixed stars, it is evident (taking into account only naked-eye observations) that the number of possible configurations or conjunctions of *some* of them must be practically infinite; while, on the other hand, the chance of their all being seen close together in any part of the sky must be exceedingly remote.

In parts of the Cape Colony and South Africa generally, where the atmosphere is for months in succession of great transparency and free from clouds, these morning or evening configurations become very fascinating, for Mercury is an important factor in them, shining brighter than a first mag. star when favourably placed; and if Venus happens to be near at the time, and some bright star also, the various changes of relative position seen day by day are most marked. It is then, perhaps, they tend to utterly confuse one who has not studied the principles of their motion.

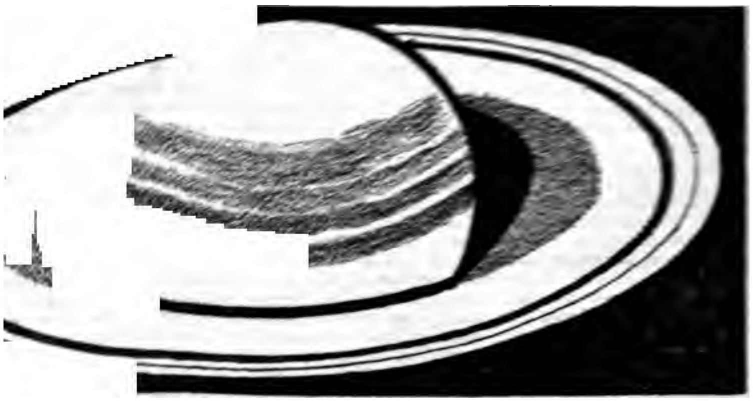
In 1880, from 10th Oct. to 13th Nov., there was a series of most beautiful configurations of Mercury and Venus, in the evenings, firstly with Spica, and afterwards with Antares and other stars of the Scorpion.

1881, Feb. 23.—A very clear evening; Saturn, Venus, and Jupiter all close together in the west, forming a triangle, of which Saturn is the apex; this configuration was very noticeable on account of the brightness of these planets. On the 25th these same three planets formed the points of a very nearly equilateral triangle. May 18, before sunrise, the same planets again formed almost an exact equilateral triangle. June 22, before sunrise, there was a beautiful effect of the old moon and several planets forming a fine combination; these were Mars, Saturn, Venus, Jupiter.

1882, Sept. 20.—A pretty combination of Spica, Mercury, and Mars. The two first were in the field of the telescope, and presented a beautiful contrast, Spica being a steady blue, and Mercury a [illegible] the Astronomical [illegible]

EEN THROUGH AN [illegible] UATOREAL.

[illegible] with Mr. Watson's [illegible], I made a careful [illegible] by a power of [illegible] year the [illegible] never seen the [illegible] done. The [illegible] that it was [illegible]



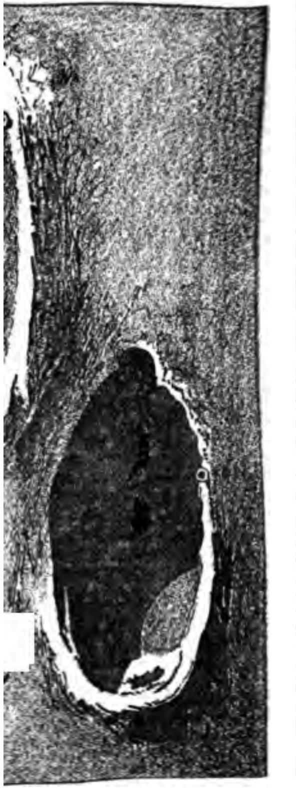
ith even the lowest power. On oke's division in the outer ring ot as I have seen it on former e that Mr. Watson has not shown sketch of the planet.

A. Percy Smith.

tory, Rugby.

AND HERCULES.

ISE on this pair of walled plain Feb. 27 was a beautiful sight, o ying sketch gives an altogether



Am I deceived in figuring a the north-east border of both rtion of the interior of Hercules, reat shadow, was prettily seen; powers 60 and 200 on 8½in.

Arthur Mee.

FORNACIS—PLATO.

much obliged to Mr. Sadler for nal determinations of the magnitude of the [illegible] page [illegible]. The [illegible] with the [illegible] of [illegible] Mr. [illegible]

The [illegible] drawing of Plato given by Mr. Eger on page [illegible] shows a [illegible] and interesting feature. It has been frequently noticed that the floor of this object [illegible] about the middle and [illegible] of spots Nos. 1, 3, 4, 5, and 17; but so far as I am aware no object exactly resembling the definite low mound drawn by Mr. Eger has been delineated or described before. This mound occupies exactly that part of the floor on which are situate the three crater-cones Nos. 3, 30, and 31. It is somewhat singular that neither these nor any of the other crater-cones should have been seen by Mr. Eger. Possibly there may be some connection between the absence of crater-cones on this occasion and the "ill-defined, smudgy outline" of the interior shadows. I have watched the progress of sunrise upon Plato on several occasions, but without ever noticing any similar want of distinctness in the shadow outlines.

A. Stanley Williams.

MR. HIGG'S COIL.

[26940.]—A DESCRIPTION of an induction coil of moderate dimensions, giving such splendid results as a 10in. spark in air, with a single bichromate cell, appeared in the "E. M." of January 7th (26676) and since (February 11th, 26831). Mr. Higg has very kindly given details of its construction.

Such an instrument would be invaluable to spectroscopists, and it might advantageously supply the place of a Bunsen burner upon a chemical laboratory table available at any moment during an analysis. With the instruments hitherto employed, all the nuisance of having to keep a four or five cell Grove or other large battery in order had to be considered, and consequently the spectroscope has been less consulted than it should be.

As I imagine very few have the necessary mechanical skill to enable them to construct such an instrument for themselves, perhaps Mr. Higg will kindly inform us if the time has yet come when such a coil can be purchased of the philosophical instrument maker, and its probable cost?

R. G. P.

CHEAP AMMETERS AND VOLTMETERS.

[26941.]—THERE must be something radically wrong about "Iota's" ammeter (letter 26921) if he need "tap it to bring it to zero." The pivot must be injured. If "Iota" will kindly return it to me, I will readjust it with pleasure, as I make it a point to turn out ammeters which turn to the $\frac{1}{10}$ of an ampère. I am now about patenting an ammeter without magnets, which I hope to be able to sell at 5s., and which will surpass even "Iota's" idea of accuracy.

Carshalton. **S. Bottone.**

RAW HIDES.

[26942.]—THROUGHOUT Asia and Africa green hide is used generally in preference to tanned leather for thongs, cords, bindings, and fastenings; the sinews also of deer and the larger animals are utilised for all purposes requiring tightness and strength. The skins, after being deprived of their hair, are hard rubbed and treated with various greasy substances while stretched in cool, shady places. The required strips are then measured and cut out while wet, a stick is inserted at each end for two men to pull and twist the thong, according to the purpose needed. While at full [illegible] with a rag, and then hung up with a heavy weight at the lower end, and never allowed to become very dry. The native blacksmith, carpenter, farmer, and many other artisans use it largely—the native agriculturist, and cattle-[illegible] in fact. I have no room on paper to describe its multiplicity of uses. Before railways intersected the great arid regions of India we European travellers of experience had ascertained that ordinary wheeled carriages might drop to pieces [illegible] for the [illegible] and contraction of raw hide: accordingly we had to prepare for such long journeys of weeks and even of months, duration [illegible] being a frequent feature of the [illegible].

In those [illegible] there was a great and sudden demand for skinners. An unpleasant odour pervaded the air, by which the eye was guided to [illegible] busily engaged in transforming [illegible] bundles of whip-like [illegible]. Every kind of English vehicle was being [illegible]. Soon the springs would disappear in a neatly plaited covering like wicker-work. Straps and thongs intersected all iron-work, taking off the possible strain and leverage consequent on [illegible] upsets. The huge camel-panniers, consisting of square wooden framework, their sides and bottoms woven of the same basket-like skin material, were examined and strengthened to contain [illegible], stores, and servants' baggage. In these queer receptacles the Afghans carry their women, children, and Persian cats).

Catgut has been known for centuries in India. The larger sorts are inferior to the European kinds; but the smaller, made for musical instruments, no thicker than linen thread, is the most perfect product in the world. I always carried some to mend the joints of fishing-rods, applying it wet; but the natives use sinews of animals for all breakages of bows, spear shafts, &c. These adhere with glue-like tenacity. Arrow heads are secured by the same durable method. I found a wandering tribe in N. India who only hunt with looped snares set across particular spaces, on ground prepared by clearing away bushes, thorns being placed thickly on the outskirts of the approaches. These loops, I ascertained, can only be made of hyena hide, twisted while green: they are so wiry and stiff that they stand upright from the ground, to which they are pegged in an irregular row, sufficiently circular to admit the fore part of a wild boar or antelope going at speed. Men, women, and children, with their dogs, pursue a herd, making fearful noises. The animals, hard pressed, rush into the unseen springs, and are soon despatched with spears and swords. I have stowed the best pieces of new rhinoceros hide, taking care to keep them flat between heavy planks for some time; when nearly dry, my backwoods carpenter used to saw them into lengths, then plane them into taper form. They were next tied very tightly round a pole, and allowed to dry thoroughly; again, after a time, planed, scraped, polished, and mounted as riding whips—terribly severe they were. All those who have suffered by a boot of badly-cured leather, worn in a warm room, can imagine the torture of ancient barbarism—a man, sewn up in a fresh hide, was placed in the sunshine, and slowly squeezed to death!

The handles of great chisels used by house-carpenters and boat-builders in the East are all neatly secured by wet plaited thong, which dries hard, and saves the handle from being split by mallet blows.

Eos.

BURNT AIR.—VALEDICTORY.

[26943.]—I BEG to remind "F. C. S." that I did not evolve the theory set forth in my letter out of my inner consciousness, but from the authority which I stated in letter 26865. Doubtless this work is somewhat antiquated; but I have yet to learn that any discoveries since its date affect the point of chemical science to which this discussion refers. The work is considered reliable, and it should be in all conscience, for it was published at no less than sixty guineas in unbound parts. I make no pretence of being a chemical specialist; but if "F. C. S." does, will he say if the theory will account for the boiler defects to which I alluded, or whether that also is "impossible"? In conclusion, I can't help thinking that some correspondents display an unnecessary amount of dog-in-the-mangerism.

J. Q. D.

MÜLLER'S PATENT FILE.

[26944.]—SOME time ago I wrote a query, *re* Müller's patent file, but no one seemed able to give any information on the subject. Since then, however, the tool has come more under my notice, and I am able to give sketches and descriptions. Fig. 1 is the section; Fig. 2, face view; Fig. 3, file in grinding frame; Fig. 4, front of cutting plate of double sided file; Fig. 5, ditto of four-sided file.

lights, as they have a spectacle glass in front which diffuses the light.

There are many cases in the kingdom where one company runs over another's lines. Perhaps each line has different signal lights. How confusing this must be! Perhaps Mr. Stretton will say what is being done to remedy this dangerous state of things. It seems to me that the attempts of many companies at signalling their lines are about as crude as their ideas of braking their trains. **P.**

ELECTRIC LOCKING FOR RAILWAY SIGNALS.

[26950.]—I have read with much attention Mr. C. E. Spagnoletti's system of electric locking for railway signals; but I am sorry to say he is far behindhand with his system, as to the merits of which I say nothing; but we have now had in use for a long time on this line Sykes' system of electric locking, which is far simpler than the kind Mr. Spagnoletti advocates, although very much the same in some points; but Sykes' is an electrical lock instead of a mechanical one, and it gives the signalman absolute control of his section, either up or down, and is worked in connection with the one wire double arm bell instrument, thus making it the best and safest system of working extant. In saying the best, it is the simplest; and what is the simplest for the signalmen in connection with the safety of the public must be the best, as signalmen are not all necessarily either electrical or mechanical engineers; but still they must have some knowledge of both, and in Sykes' system the mechanical lock is not forgotten and is worked in connection with the electric lock on the starting signal, the mechanical lock being placed on the home signal, which when pulled off once for a train to enter the section in advance and replaced to danger, cannot be pulled off again until the train has passed the starting signal; the action of putting on the starting signal with electric lock attached releasing the mechanical lock on the home signal so that the signalman can allow another train to draw in under protection of the home signal, the starting signal being controlled by the electric lock by the signalman in advance.

L.C.D.R. Signalman.

ACCIDENT AT CARLISLE—BRAKES ON THE LONDON AND NORTH-WESTERN RAILWAY.

[26951.]—General Hutchinson's report upon the collision which occurred at Carlisle on the 21st of December has just been issued, and contains some valuable information upon the subject of continuous brakes.

The North-Western Railway Company's down limited mail, drawn by the "City of Liverpool," No. 410, and consisting of 14 vehicles, came into collision with a Midland engine, No. 1,580, on the crossings at a point 300 yards beyond the usual stopping place, and after knocking the bogie and trailing wheels of the Midland engine off the rails, continued its journey for another 180 or 190 yards, every vehicle being damaged by coming in contact with the Midland engine. The four driving-wheels of the compound engine, No. 410, and the six wheels of its tender were fitted with a steam brake, 11 vehicles with the simple vacuum brake, and three vans with the North-Western automatic brake arrangement. The uselessness of the continuous brake is clearly shown by the following facts.

The steam-brake was tested when about two miles from the station; the vacuum brake was applied more than 1½ mile from the point of collision when the speed was between 45 and 50 miles an hour, and the ejector was kept open for nearly half a mile; but without producing any effect upon the speed, though the gauge showed 20in. of vacuum. Ultimately the steam brake, assisted by reversing the engine, and two guards' hand brakes, reduced the speed to 12 miles an hour at the time of the collision.

After the accident, the vacuum brake pipes between the engine and the tender were found to be completely blocked with ice, extending about a foot on each side of the junction of the pipes. The gauge on the engine, as before mentioned, showed 20in., and in the vans 15 or 16in. of vacuum, yet the brake was absolutely useless. This is the dangerous brake to which the North-Western Company trusts its passengers and servants, and which was adopted with such a flourish of trumpets after the so-called conference at Euston in April, 1881, and it is one of the various "best brakes" which, according to Mr. Moon, are always in turn in use on his railway.

General Hutchinson reports: "The collision was undoubtedly caused by the action of the vacuum brake having been stopped. . . . The advantage of the automatic brake arrangement advocated by the Board of Trade over that now in use on the London and North-Western Railway is also made manifest, for had the automatic arrangement applied to the whole of the mail train instead of only to the three brake vans, and had it been applicable by either one of the three guards, the train might easily have been stopped at the proper place when the driver, finding that the vacuum brake would not work, gave the brake whistles."

The readers of the English Mechanic will well remember that the serious accident at Dalston Junction, Feb., 1881, gave the *coup de grâce* to the emergency chain brake on the North-Western, and apparently the accident at Carlisle has performed a similar service for the Webb simple vacuum brake on that line, for, at the half-yearly meeting held at Euston on the 15th Feb. last, Mr. Moon stated that, having spent £110,000 on changing from the chain to the vacuum, and fitting more than half their stock with it, in deference to the wishes of some of the neighbouring companies, they had also agreed to instruct their officers to make the brake automatic at a cost of £45,000. He would not, however, like them to run away with the idea that the brake was to do away with all danger. "On the contrary, it had its own special dangers." He was not in favour of it.

It would, I think, have been interesting both to railway men and also to passengers, if Mr. Moon had gone a little further into the subject, and told the shareholders what are the "special dangers" which the brake will have on the North-Western when made automatic.

For ten years that company has placed the Board of Trade conditions at defiance; in February, 1879, Mr. Moon told his shareholders that "no man in his senses would risk their trains to an automatic brake." It is, therefore, satisfactory that at last this company has, "in deference to the general desire of the community," admitted the necessity of employing an automatic brake. It is not at present made known what the new brake is to be; but it is sincerely to be hoped that the North-Western Company will now adopt the best and safest appliances, and thus avoid further delay, accidents, and waste of money.

Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.
306, City-road, London, E.C., March 7.

HEAT, FORCE, AND GRAVITATION.

[26952.]—Will "F. W. H." (letter 26883) excuse me for saying that his ideas of heat, whether derived from Buchner or not, seem somewhat loose? It is true that energy in the form of heat is expended in tearing the molecules of a body asunder, the same amount of heat being given out upon their reunion, but that certainly does not prove that heat is a separation, cold is an approximation of the material atoms.

It is not quite so easy to define heat save that it is a form of energy. With regard to force, it is, perhaps, safest to adopt the conclusion of Prof. Huxley, that all that can be said about is that is the cause of motion. Until, however, we get new laws of motion, matter must be regarded as inert, incapable of changing its state except from external influences, and this is no doubt equally true of invisible as well as visible motion. Sir Wm. Thomson has lately suggested that what seems repulsion may be due to inertia. It has no doubt been pointed out to "Garrison Gunner" (26879) before this time that several attempts have been made to explain gravitatien by pressure or impact of attenuated matter. What I suspect the astronomer requires for his motions is practically empty space. **J. A.**

Earthquakes and Epidemics: Erratum.—In 3rd line of letter on p. 11, for "beneficial" read "pernicious."—Eos.

Electric Cautery: Erratum.—Letter 26915: For "weight per foot in *gas*," read "weight per foot in grains."—S. Bottone.

At a recent meeting of the Berlin Physical Society, Dr. Richarz, speaking on the formation of peroxide of hydrogen by electrolysis, said if a current were conducted through diluted sulphuric acid, then there was formed at the positive electrode a strongly oxidising substance, formerly taken for peroxide of hydrogen, but demonstrated by M. Berthelot to be per-sulphuric acid, S_2O_7. In experiments on the electrolysis of concentrated solutions of sulphuric acid with wire-shaped platinum electrodes, the speaker had obtained in the solution, beside per-sulphuric acid, ozone and peroxide of hydrogen, and assumed that all three bodies made their appearance at the positive electrode. The following experiment served as a proof:—A 40 per cent. sulphuric acid solution was subjected to electrolysis, and thereby, on account of too great attenuation, no peroxide of hydrogen, but only per-sulphuric acid, came to view. If, now, into the 40 per cent. sulphuric acid 60 per cent. acid were poured, after the electrolysis was finished, then did peroxide of hydrogen show itself in the fluid.

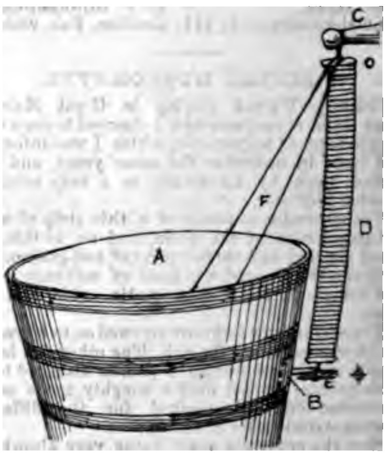
REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61386.]—**Flash-Point of Mineral Oil.**—Get a tin or copper can, about 5in. by 3½in., fill it with fine dry sand, place in the sand a glass beaker about 3in. by 1½in.; leave the top of beaker just projecting out of the sand; fill the beaker to within a half-inch of the top; the oil will expand; place can and contents over a Bunsen burner or gas jet, and suspend in the oil a glass thermometer, graduated up to 600° or 700°. The bulb must not touch bottom of beaker by ¾in. As the sand becomes heated the temperature of the oil will be shown in the thermometer. Do not raise the heat more than 8° or 9° per minute. When the vapour begins to come off, say, at about 330°, get a piece of hard, twisted cord, and light one end; the light should not be larger than a pea, or you will heat the oil on the top. Pass this small light over the surface of the oil; continue this until a small, blue flame passes over the surface; a small pop will often proclaim the flash point before it can be seen. Note the temperature; keep on passing the light until the flashing becomes one continuous blaze; this is the igniting point. There is no danger, so you need not hurry; remove the thermometer, turn off your gas, bring a piece of paper down over the burning oil and can, and the light will be extinguished. If you blow out the light you will blow some of the oil in the sand, and get the fumes next time you use it. The flash point of your oil should not be less than 375°, and should not ignite under 410°. When the flashing and igniting points are close together, or when there is some peculiarity in the blazing of the oil, suspect doctoring. If I have not made this clear write again, and, as far as I can, I will give you the desired information.—Oils.

[61401.]—**Oval Chuck.**—In reply to "C. L." I beg to say that the sketches of above I found in Vol. XXI, No. 522, page 40; also in No. 581, page 280. I believe I have followed the sketches given in above numbers pretty closely, and the chuck seems to run very well; but I cannot finish the ends of bradawl handles, &c., without having "rings" of a twisted nature on the work when finished. I should feel greatly obliged to "C. L." or any other reader, for a few hints.—Church-Hill.

[61402.]—**Electric Bath.**—This is a very simple affair. It may not be generally known that sea-water is the best excitant for dipping the Pulvermacher's chain, and also for the bath itself. I was once on board a large steamer when I heard a paralytic passenger complaining that he had forgotten a supply of acid, and could not use his chain. I got a fishing line, and let down Pulvermacher into the ocean, and very much gratified the invalid by an unexpected shock. Get the half of a very sound beer hogshead, scald it, and let it dry. Get a piece of sheet copper about 2in. square, ¼in. thick, drill a hole in the centre, and tap it with a screw; take a piece of stout copper wire 3in. long, tap one end with a screw to fit the hole in the above plate, at the other end of the wire make an eye or ring. With copper tacks fasten the plate on the inner side of the cask, about a foot from the bottom; with a gimlet bore a hole straight from the outside to the screw hole in the copper sheet; then pass the end of the wire through the wood;



A, the bath tub; B, copper plate; C, wall peg; D, Pulvermacher's chain; E, copper pin with eye; F, wire leaders; O, negative pole; +, positive pole.

and screw it in very tight. Put up a wooden peg in the wall of your bath-room at such height as a 60, or, maybe, a 120 element Pulvermacher can hang at full length, so as just to meet the eye of the wire. Draw the tub to within 6in. of the wall, and hook on to it with a small bit of wire the *positive* (or zinc) pole; pour water till the tub is three-fourths full; hang the *yellow* or negative pole by a piece of string to the peg in the wall; attach two long insulated conducting wires to that end of the chain—sufficiently long to allow 2ft. of the same to enter the water. The points of the wires should have electrical conductors. The patient, having stripped, should put on an elastic tape under his arms mounted with a copper hook and eye buckle, which can thus be easily shifted to any part of the body requiring galvanic treatment. I made everything, except the chain, myself; but all such small appliances can be bought. On entering the water the bather will take one wire in either hand and fasten the other wire to the buckle. Though in perfect health, I always enjoyed these baths; but it is possible they might be injurious in some cases of organic disease. For torpid liver, piles, rheumatic affections, defective circulation, paralytic symptoms, and disorders of debility they are undoubtedly beneficial. The German medical electricians use medicated baths, and assert they can extract mineral poisons from the system by this treatment. Note.—The body must be kept quite clear of the inside plate: by sitting face towards the chain this can be insured. An oval bath is preferable to a round one for a grown person. Any bath of metal can be used, but it must be lined with thick sheeting.—EOS.

[61426.]—**Charcoal-making.**—When it is required to carbonise a large quantity of wood, it is necessary to drain away the tar which accumulates, and the mound is consequently built on a saucer-shaped piece of ground, with a drain leading to a pit. Your correspondent will probably "coal" only small quantities at a time. Let him make up in brushwood a long pillar like a bolster, and stick it up on end, with a cord projecting from the top. Arrange around this "bolster" the pieces of wood to be converted into charcoal, either flat or at angles, but so that there can be a free circulation of air, except towards the outside of the heap. Flues must be left leading up to the bottom of the bolster. When the stack of wood is complete, cover with brushwood, turf, or even clay, and pull out the bolster. Then light a fire in the "chimney" thus left, with peat or any combustible, and lead it through the heap by means of the flues, studying the wind. When the heap is well alight block all holes with turf or clay, and watch to see that the wood does not burn too fast. It takes some days, and is better done in large quantities.—SAML. RAY.

[61452.]—**Electrical Apparatus.**—TO "ELECTRICAL STUDENT No. 2."—The sort of action I mean is well exemplified by the Daniell cell where partly-exhausted solution is recuperated from the reservoir of crystals of sulphate of copper.—EDWARD CONRY.

[61452.] — **Electrical Apparatus.** — I am sorry that the formulæ I gave for charging secondary batteries with primaries should have caused such a difference of opinion; but I still assert there is an advantage in using secondary batteries in conjunction with primary for lighting, as in the case where the number of lights required is small (say, five lights of 10c.p.), and therefore a dynamo and engine would be out of the question. I cannot agree with Mr. Conry that it requires a week's charging of accumulators with primary batteries to get two or three hours lighting out of them, seeing by the formulæ I gave that six ampères for 20 hours will light three 5c.p. (nominal) lamps four hours. I have been given to understand that the important improvements he mentioned in the numbers of "Ours" for Jan. 28, that Messrs. Woodhouse and Rawson were making with the Upward battery, are in this direction, and that their exhaustive experiments having proved so successful, that they intend putting the plant in the market in a short time. I, too, have made experiments with this system (with another primary) which has proved satisfactory, and intend fitting a small installation at my residence in a short time, when I shall be pleased to show it to any readers of "Ours" who may like to give me a call, and will also report to the "E. M." for publication of results and cost of maintenance. I agree with "Ohm" that lamps now usually made require 3·7 watts per candle-power; but the lamps I allude to are the standard 5c.p. nominal, which we know are about 20 per cent. above their actual candle-power. But there are some specially made that require less than 3 watts per candle-power nominal, and I have been informed there are some being made by the Edison Swan Company of 13c.p. 36 volts, requiring 2·75 watts per candle-power. Referring to the efficiency of accumulators, "Ohm" must have made some mistake, or the ones we have had experience with are of a very obsolete type. The efficiency of the later type of E.P.S. and Elwell Parker accumulators is far higher than 60 per cent., and if he has none of these to test I should advise him to read the latest papers and articles on accumulators by the first electricians we have. He will find the following very instructive:—Messrs. Drake and Gorham's paper and discussion that followed at the last meeting of the British Association; the article now appearing in the *Electrical Review*, by Mr. A. Reckenzaun; Mr. Preece's paper on "Domestic Electric Lighting," read by him before the Society of Arts, March 26, 1886, and several others I could mention.—W. HARGOOD.

[61499.]—**Storage.**—"Iota" will find a description of the Thomson-Houston arc lamp in the *Electrical Review* for Nov. 22nd, 1884.—P. A. C.

[61525.]—**Racing Canoe.**—If "Shamrock" will refer to pp. 54, 93, and 160 of Vol. XXVII., he will find a good deal of practical instruction about canoes, and there has been much since. His dimension 11ft. long is rather small, and I doubt whether there is a safe sailing canoe of so short a length. It is rather remarkable, too, that "Shamrock" expects to have two masts.—SOUTHAMPTON WATER.

[61532.] — **Varnish for Transparencies.**—This query is incomprehensible. A varnish is generally used to cover work and protect it from atmospheric influences. Surely the querist is not stopped by the simple difficulty of getting water colours on to a photographic print. If that is so, and he will promise not to tell, I don't mind informing him that professional colourers lick the print with the tongue. If he does not like to do that, no doubt a little prepared ox-gall will enable him to get the colours to flow as he desires.—I. H. J.

[61534.]—**Lathe Tools.**—Yes, it is very annoying, as the querist says, to find the tools crack in hardening after they have been shaped at considerable expense of time. Nevertheless, let him take courage from the fact that others have similar experience occasionally. I have heard a late relative use very choice language whilst engaged in the attempt to manufacture or, rather, temper tools, and his was daily experience from boyhood. Sometimes, do what you will, everything seems to go wrong; at others they harden and temper beautifully. So, good Mr. "Tool Steel," try, try again; but don't do more than heat to a cherry-red (in the dark).—NUN. DOR.

[61535.]—**Fret-Saw.**—If this querist cannot find out what is the matter with his fret-saw, how can any one who has not seen it? Perhaps the two arms do not move an equal distance, and so the saw becomes slack. It is, however, only a mere guess.—T. J.

[61536.]—**Organ-Blower.**—It is quite practicable to employ a steam-engine to blow an American organ; but as to the advisability of doing it, there may be a difference of opinion; but I would rather be without it. A boy's time can be had for about 2d. or 3d. an hour, and he would be much cheaper than the steam-engine. —ORGANON.

[61553.]—**Etching Ground.**—If the "ground" referred to by W. Holden is perfectly satisfactory why his query, p. 487? If he wants to find out how it is made, why not experiment? He will find plenty of hints in back volumes. Will he say exactly what he means by a "transparent dark etching ground"? If he does, I will endeavour to help him, though I have no doubt he will find all the information he can need in Lalaune's "Treatise on Etching," published by Sampson Low.—NUN. DOR.

[61555.]—**Muriatic Acid.**—According to this query, a lot of iron was left in strong muriatic acid, the result being a collection of blue crystals. Question is, Will the acid do for soldering purposes? Answer is, Don't think it will, and doubt very much whether the statements are correct? Would like to see some blue crystals produced by leaving iron in muriatic acid—rather a novelty. No joke, of course.—NUN. DOR.

[61557.]—**Vapour.**—What chemical change, if any, is afforded by a substance vaporised? Suppose "No. Sig." proceeds to explain his query: he may then get a reply; at present it is a mystery.—NUN. DOR.

[61558.]—**Metallic Paint.**—As no one else has answered this query, I would say that there is no difficulty in making a copper or tin paint that will stand handling. Simply mix "natural copper" (trade name) or "silver" (trade name) with copal varnish, abundantly thinned with turps, and you have a paint which will not readily rub off; but it is not to be compared to the galvano-plastic coat of either copper or tin.—SAML. RAY.

[61559.]—**Gold Paint.**—The only way, I think, is to coat the dry "paint" with "paper" varnish. Perhaps it may be necessary to size first; but it depends on the nature of the ground and over-varnishes. Gold paint, put on with an oil varnish, such as copal, thinned with turpentine, will not work up when a spirit varnish is applied carefully; but a coat of size makes all safe.—NUN. DOR.

[61560.] — **Engineering.** — As a matter of course, parents and friends looking out for firms wherein to article pupils should take care to inform themselves as to the reputation of the firms before coming to a final decision. To say that employers who fail in their duty should decline taking the pupils or their money is to expect them to pass a self-denying ordinance of too disinterested and sublime a character for the world as at present constituted. The remedy is obvious. Select a firm of good repute, just as one would go to the best shop to make a purchase of any kind.—J. H.

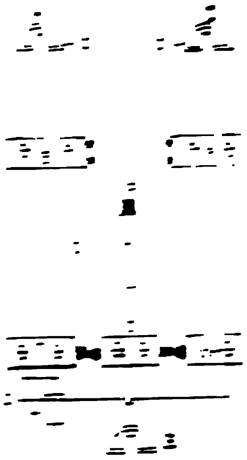
[61574.]—**The Calculus.**—For a student who wishes to acquire a fairly complete knowledge of the differential and integral calculus, without the help of a tutor, there is no better work than Todhunter's (in 2 vols., published by Macmillan and Co.); but for one who merely desires to obtain such a general knowledge of the subject as shall enable him to read the simpler class of books on physical science Woolhouse's "Differential" and Cox's "Integral Calculus," both excellent little books belonging to Weale's series, will probably suffice. Gregory's "Examples," a book containing the best exercises published, may be used in connection with any of the above-mentioned treatises. It is as well to observe, however, that no one is qualified to enter on the study of the calculus who is not already well grounded in the elements, at least, of algebra, trigonometry, and plane analytical geometry. Had your correspondents bestowed sufficient attention on these subjects, the difficulties which seem to have met them at the very commencement of the differential calculus would never have occurred. The application of the calculus to any physical science—e.g., dynamics—can only be learnt from a book on that science; and to read many books of this class, you must not only understand the processes of differentiation and integration, and the application of the calculus to geometry, &c., but must also have some knowledge of differential equations—a subject rarely included in modern works on the (so-called) calculus. Two of the best treatises on differential equations are those of Boole and Forsyth. The latter was published in 1885.—J. R. C., Charing.

[61574.]—**The Calculus.**—I have again to thank "M.I.C.E." for his suggestion on successive differentiation, and I have also to thank "Vladimir" for his suggestions on the same subject. Can "M.I.C.E." indicate any work in which I shall find such a geometrical illustration of successive differentiation as that to which he refers? I am glad to be assured by "Vladimir" that if I understand the differentiation of a function I ought to have no difficulty in understanding the differentiation of its differential coefficient. That I do understand the former I am as sure as that I understand the multiplication table. I therefore hope I am not far from understanding successive differentiation. Thus, let $u = ax^3 - bx^2 + cx + e$, then $du = 3ax^2dx - 2bxdx + cdx$. I am quite sure that I understand this, but the third differential coefficient, $6a$ (which is a constant), I do not understand. What is the meaning of $6a$ with respect to the original function or to the first differential coefficient? I will adopt "Vladimir's" suggestion with respect to Lagrange. I have his book in French, but so far as I am aware it has not been translated into English; and although I should not shrink from any book on chemistry or physics in French, I dread the effort of reading mathematics in French. Dr. Thomson, in the second edition of his work on the Calculus, adopts the method of limits, but says in his preface that the first edition was based on Lagrange's method of derived functions. I will try to procure the first edition. Dr. Thomson is a very clear writer, and I do not doubt that I shall understand his exposition of Lagrange's method. I believe that Lagrange's attempt to give a purely algebraic origin to the calculus has been abandoned even in France; still, if it enables me, as "Vladimir" suggests, to form a clear conception of successive differentiation, I shall think the labour of applying myself to the study of derived functions well bestowed.—TYRO.

[61589.]—**Coal Economy.**—Your correspondent, "Sugar Cane," after misrepresenting (probably misunderstanding) what I have written, asks me to do a *sum* which, when complete, will interest about ·001 of a reader of the "E. M.," although it will take some time merely to put down the figures. I trust he will excuse me if I decline—though I cannot excuse him, for I am still waiting for an explanation of what he meant by "400 tons weekly" and "130 horse." If he does not know, why does he not say so? There is no need for "Sugar Cane" to feel crushed because he has made a mistake.—NUN. DOR.

[61581.] — **Telephone Switch.**—Perhaps the accompanying sketch will assist "Enswitched" out of his difficulty: A is a disc or cylinder of

[illegible]



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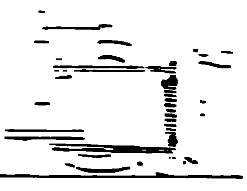

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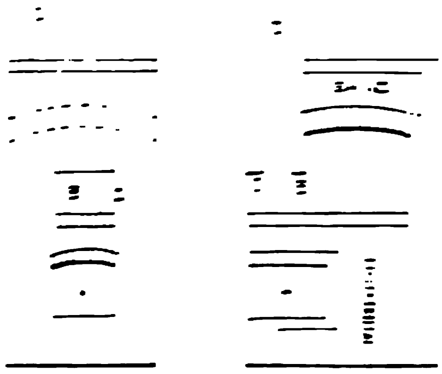

[illegible]

[illegible]—Indicator Diagrams.—[illegible]

[illegible]—Indicator Diagrams.—[illegible]

[illegible]

[illegible]—Spirit Lamp.—Use earthenware [illegible] instead of brass; they won't conduct [illegible] as is the case with brass, and thus cause [illegible] to get on fire.—HENRY J. HARDY, [illegible] Sheffield.

[illegible]—Spirit Lamp.—The lamp is too small. [illegible] you cannot have it a couple of inches [illegible] wicks altogether, and use [illegible] filled with sponge, [illegible] covered with brass or copper wire gauze. This kind of lamp gives greater heat [illegible]. Personally, I have never found wicks [illegible] satisfactory.—A. F. SHAKESPEAR, [illegible]

[illegible]—Electro-Plating.—The article to be [illegible] should be thoroughly freed from all dirt, grease, &c., and this is best done by first washing with [illegible] and potash. Afterwards dip in dil. [illegible] acid until surface is quite bright, wash with [illegible] distilled water to prevent oxidation, and immediately plunge it into a solution of mercurous [illegible] for a second or so, until an [illegible] of mercury is deposited all over the surface. This offers a splendid uniform [illegible] surface for the plating process. The article thus treated may be washed, and placed in the [illegible] silver and potassium cyanide in the [illegible] and connected with a one-pint cell, [illegible] I find this invariably gives good results.—[illegible]

[illegible]—Tricycle Enamel.—I should not [illegible] machine—at any rate, [illegible] of the wheels—as it soon gets scratched [illegible] and it looks worse than ever then. [illegible] same thin enamel, such as [illegible] and when it dries some off apply some [illegible] gets hard it is no easy [illegible] to scrape it off when you want to apply [illegible] and unless you do scrape it off the [illegible] look well.—W. HOLDER, [illegible]

[illegible]—Mechanical Support.—Would it [illegible] make the writer [illegible] desk for her work—for, at all [illegible] of the time, and thus cure the [illegible] mechanical restrictions, [illegible] for it?—R. H.

[illegible]—Mechanical Support.—The young [illegible] forward in writing. Let [illegible] back from the table that [illegible] leaning forward, to [illegible] her work, and she will be [illegible] back perfectly straight.—[illegible]

[illegible]—Mechanical Support.—I cannot understand why the leaning forward of a female's [illegible] steel, as it seems [illegible] (the busks) were got to [illegible] shaping. If it was purely by the [illegible] I should think the wearer more [illegible] or something of the sort [illegible]: but I should [illegible] steel, as it would suit the [illegible] about a quarter of the [illegible] in shaping, and not get it [illegible]. When shaped and finished off, heat it [illegible] in the water, and when [illegible]-stick, generally [illegible] very gradually until [illegible] smoke, not blaze. When [illegible] the stick at all parts, lay [illegible]. Don't put it in the water [illegible] will not break unless cracked [illegible]. [illegible] on floor and [illegible] and see if it springs or allows [illegible] soft.—L[illegible]

[illegible]—Writing and Stooping.—"Willing [illegible]" seems to aim at two incompatible [illegible]—to write for some hours, and [illegible]. But it is possible and easy to stand [illegible] nearly all day if you rest [illegible] and it is well known that the appliances [illegible] are effective and beneficial and [illegible] to stand much longer without [illegible]. There has been a correspondence about [illegible] in the *Family Doctor*, in which, [illegible] from personal experience, [illegible] who abhor such [illegible] say they won't believe it, [illegible]. The former class recommend and [illegible] kind of stay-busk from the [illegible] steel one, which "Willing [illegible] to break, and then may do much [illegible] a thin steel one of what is called [illegible] is not brittle), curved sideways, [illegible] concave inside and convex outside, and [illegible] vertically. The dimensions [illegible] were about 6in. wide near the [illegible] to 2in. at the top, and 19in. [illegible] have heard of some being worn longer [illegible]. Also thin busks of hard wood of [illegible] have been recommended; [illegible] the steel are preferred—[illegible] with leather. It is true that [illegible] attached to the stays behind pulls them.

idea of the R. of g.s. wire, as it varies so enormously. The best series of coils is certainly 1, 2, 2, 5, 10, 20, 20, 50, 100, &c.—S. BOTTONE.

[61830.]—**Galvanometer Coils, Wire for.**—Depends somewhat on the work the instrument is intended for.—Unless the currents are very large, No. 20 is large enough, and a dozen turns of this wire is ample.—S. BOTTONE.

[61830.]—**Galvanometer Coils.**—About 6ft. of ·036in. wire, silk-covered, R = about ·008w., wound in one layer 3ft. each coil, does very well, and with one Leclanché cell No. 1, but no porous pot, will give 60° def.—OHM.

[61831.]—**Telescope Eyepiece.**—"Amateur" does not give the focal length of his 2in. o.g.; but, taking the average length, I should advise a power of from 80 to 100 for planets. In ordering his eyepiece, he must give the focal length of his o.g.—H.A.

[61831.]—**Telescope Eyepieces.**—If "Amateur's" 2in. be a good one, he may employ powers of, say, 40 and 100 on the planets. He will, however, fail to grasp any detail, and will probably find that with such an aperture the moon is about the only object that will repay examination.—ARTHUR MEE.

[61834.]—**Plumbago Crucibles.**—I do not know from personal observation how they are made; but if done in the same manner as the clay crucibles, they are moulded in a bored out and oiled iron flask, a central plug of wood or iron squeezing the clay outwards, and giving to it its interior form. A pin at the bottom end centres the plug, and the hole which it makes is filled up after the separation of the crucible from the flask. These are allowed to dry slowly for several days before being finally annealed in a furnace. Crucibles are also moulded by machinery. The proportions for plumbago crucibles are two of plumbago to one of fireclay, each ingredient being well ground and sifted before mixing. Iron is melted in a brass furnace either in clay or plumbago crucibles like the brass itself, and cannot become contaminated by the coke as in a cupola.—J. H.

[61835.]—**Eclipse of Sun, August 19, 1887.**—At Moscow, and at Yeddo (Japan), this eclipse will be total. The hours at above-named places can be reckoned by Greenwich time, where eclipse will be partially visible at 4h. 53m., ending at 5h. 7m.—EOS.

[61835.]—**Eclipse of the Sun.**—According to the *Nautical Almanac*, the limits of the total phase are as follows:—

	Northn. Limit.		Central Line.		Southn. Limit.	
h. m.	E.	N.	E.	N.	E.	N.
16·15	28° 40'	56° 9'.	32° 18'	55° 52'.	35° 23'	55° 29'.
18·50	163° 11	28° 13'.	160° 33'	28° 8'.	158° 12'	27° 58'.

—H. A.

[61835.]—**Eclipse of the Sun, Aug. 19th.**—The following extract is from "Eclipses, Past and Future," by the Rev. S. J. Johnson, M.A., F.R.A.S.:—"August the 19th: There is an eclipse of the sun, which at one time was thought likely to prove total in England; but upon more accurate examination the whole phenomenon is found to end here just after the sun has risen. The total phase is presented to view in Eastern Europe and Asia, commencing in Germany. At Wilna, the easiest point reached from this country—i.e., by steamer to Riga—totality comes on less than an hour after sunrise, with the sun at an altitude of 10°. The more easterly observers can get, the better chance they will have."—SIMPLEX.

[61836.]—**Flash Point of Mineral Oil.**—In the absence of a proper apparatus for testing the flashing point of mineral oil, "N. M. M." will find the following answer his requirements:—Take an ordinary glue pot (the smaller the better), and clean it out thoroughly, fill the water space with linseed oil, and in the receptacle for the glue place some of the oil you wish to test, place a thermometer in the oil (see that the bulb is covered), and place underneath the pot a lamp, watch the thermometer, and as the mercury rises keep a lighted match or taper over the oil until it flashes; when it flashes, the reading of the thermometer will be the flashing point of the oil.—T. R. SAXTON.

[61836.]—**Flash Point of Mineral Oil.**—A simple and ready means of determining the "flashing point" or temperature at which an oil commences to give off an inflammable vapour may be easily performed in the following manner:—Take a platinum, copper, brass, or even a small glass beaker about 2in. deep by about 1½in. diameter, and fill it to within about ½in. from the top for the oil to be tested. Stand the vessel and contents on an iron plate supported on a tripod stand, and heated by means of a Bunsen burner. Suspend in the oil a chemical milk scale thermometer that will indicate a temperature of not less than 300° C., so that the scale faces the operator and the bulb dips below the surface of the oil; but, at the same time, it must not be allowed to touch the bottom of the vessel. The oil is then heated so that the temperature rises somewhat gradually. At every few degrees a small gas flame about ⅛in. long is allowed to play for a moment over the surface of the oil. As soon as the oil is seen to "flash" (not permanently take fire—this is the "fire test" or "burning point"), the temperature indicated by the thermometer is read off; this is the flash point. If the temperature is wanted in Fahrenheit degrees instead of centigrade, double the degrees centigrade, subtract from them one-tenth of their quantity, and to the remainder add 32, the result is the corresponding degrees Fahrenheit.—HENRY J. HARDY, F.C.S., Sheffield.

[61837.]—**Photographic.**—"Beginner" asks what is the focal length of his Optimus lens. That is exactly what he must tell us in order to answer his question. He must focus the ground glass of his camera sharply on some object 30 yards away, and then measure the distance between the stop and the ground glass. This is the focal length. He should buy Platt's "Exposure Tables and Note Book" (Cartwright and Rattray, publishers, Manchester, 1s.), and he will get all the other information wanted.—B.SC., Plymouth.

[61839.]—**Twist-Drill Apparatus.**—Would not the much simpler fluted drill serve your turn? That could, I suppose, be made with milling cutters. For some purposes they are certainly superior to the twist drill.—W. A. S. B.

[61839.]—**Twist-Drill Apparatus.**—*Vide* "Harrison's Mechanics' Tool Book," page 111, showing two ways of making them, but so laborious and slow that it is not worth while to any but a machinist; besides, the cost of necessary tools would amount to the price of a large ready-made supply. With me, breakages are not frequent. I utilise all such pieces by grinding a new point. I have now the half of a ¼in. so treated, has done hard work for a year or more. If the points of these drills are not sharpened to correct angles, they will not penetrate the work; then they snap like sticks.—EOS.

[61839.]—**Twist-Drill Apparatus.**—In reply to "Country Parson," there is no lathe attachment for milling made that will make twist drills satisfactory, and they must be done on a milling machine, which is an expensive tool, and "Country Parson" will get a properly made drill, and really cheaper than attempting to make, by buying them as made. I have purchased them from Messrs. Buck and Hickman, of 280 and 281, Whitechapel-road, London, E., of the genuine Morse Company's make, which I consider are the best and cheapest any of "ours" can get. Probably this firm would grind any drills "Country Parson" may have broken.—ROC.

[61839.]—**Twist-Drill Apparatus.**—I think the most likely place would be Smith and Coventry, Manchester, as they make them for milling machines. I have never seen one made by a firm for lathe use; but I have seen several—also made several—to answer special purposes of small drills. You do not say what size drills you generally require. Why not make one to suit your purpose, as they consist of coarse pitch screw and a few change wheels, which, as you have a lathe, you might easily fashion and make it yourself. If your lathe is a screw cutter, make the screw and make pattern for boss, &c., to suit your height of centre and get it cast, and you can get the wheels on pinions very cheap. I always get mine from Lloyd's, of Birmingham. They want very little trouble spent on them. The boss is solid, and you could bore them to your own sizes: but if you only want one size, cut a screw same pitch, then you will not want gear. I shall be glad to give any further information, if required.—LUMSIE.

[61841.]—**Reservoir for Oil.**—Should say that iron would be the best metal for "A. H. J."—OS.

[61841.]—**Reservoir for Oil.**—I have made these out of tin, and have not found the oil act on the metal at all.—EDWARD CONRY.

[61841.]—**Reservoir for Oil.**—As you do not say what oil, it is difficult to say of what metal to make the vessel: but surely tinplate would answer your requirements.—T. C., Bristol.

[61841.]—**Reservoir for Oil.**—The usual reservoirs for oil where glass is not adapted are made of brass, and do not appear to be attacked at all by the oil.—A. E. RICHARDSON.

[61841.]—**Reservoir for Oil.**—The querist should say what kind of oil it is he intends to use, as there is considerable variation in the action of different oils on different metals.—BERTRAM BLOUNT.

[61842.]—**Eyepiece.**—"A Constant Reader" may obtain what he wants in the Kellner eyepiece. I see one catalogued magnifying 85 with a field of over half a degree.—ARTHUR MEE.

[61842.]—**Eyepiece.**—A "Constant Reader" can, of course, procure a low-power eyepiece which will give him a view of the whole of the full moon, but if he wishes to use a moderately high power, he will have to be content to examine one portion of the moon's disc at a time.—H. A.

[61844.]—**Model Engine.**—Fit another eccentric the same size as present one, and another eccentric rod the same length. Now connect the ends of the eccentric rods to a curved link 1in. long, the curve to be struck from centre of crank-shaft with a radius equal to its distance from valve-spindle when valve is at half-stroke. Now connect valve-spindle to the block in link by means of a new forked end to spindle. Suspend link from end by two vibrating links connected to reversing lever. Not worth the trouble after all.—T. C., Bristol.

[61845.]—**Fluidity of Cast Iron.**—(1) Its fluidity is not necessarily the same even when melted in the same cupola, since that depends on whether or not the furnaceman understands his business. Bad coke will melt iron dull; so will an insufficiency of blast; so will an amount of coke disproportionately small. But the chief cause, perhaps, of dull melting is the neglect of proper slagging out. If the slag is allowed to accumulate the iron will not be fluid, but thick and pasty. How frequently slagging out should be done depends on the quality of metal and fuel. With burnt iron, for instance, the slag-hole must be kept open nearly all the time. (2) To a great extent it does. Hard iron is not so fluid as soft grey iron; and the mottled varieties are more fluid than the first, and less so than the second. Apart from its brittleness, therefore, hard iron is not so suitable for running thin castings as the grey. (3) Yes, if the iron is heated in a fire or furnace, and allowed to remain until the fire is gone out and cool, it will be partially annealed; or it may be made white hot, and covered over with small coal or charcoal until cold.—J. H.

[61847.]—**Eccentric.**—None; if you do not alter throw of eccentric. Why not shrink on wrought-iron band and turn down same size as before, or to fit worn eccentric strap, which would strengthen the sheave?—RUMBLE.

[61847.]—**Eccentric.**—If you do not alter the eccentricity, the reduction of diameter of sheave will not affect your valve travel. You will, of course, have to bush your straps to meet the reduction. The less the diameter of sheave, the less the circumferential speed and the less the wear.—J. Q. D.

[61847.]—**Eccentric.**—As you do not say the throw of valve, one can only say generally that if the lead of eccentric remains the same, it would decrease the lead of the valve; but would not open the valve so wide, and would cut off earlier; but the difference would probably be trifling.—T. C., Bristol.

[61848.]—**Botany.**—Bentley's "Manual of Botany," fifth edition, just published by Churchill, price 15s.—G. BROWN.

[61848.]—**Botany.**—I think that, while about it, "Inquiry" should have given the full title of the book he got. However, I am very glad to say that Prof. Bentley is in perfect health, and I have quite lately seen the fifth edition of his "Manual of Botany, including the Structure, Classification, Properties, Uses, and Functions of Plants," Churchill, 1887.—S. J. G.

[61848.]—**Botany.**—Dr. Lindley's "Vegetable Kingdom" (last edition) is the most complete work; I always carried it with me in my foreign travels; price about 30s., but can be got second-hand. Balfour's "Class-Book of Botany" (two vols.), published by Black and Co., Edinburgh, is a good book, cheaper, I believe, than the above, but very inferior to it as a reference.—EOS.

[61849.]—**Wheel-Cutting Machine.**—I should advise "A. J. L." to make simple templates, knowing diam. at pitch line, strike portion of circle, and set out two or three teeth; then make sheet steel templates from those set out, as he will want them to make his cutters from. I find it the simplest and best plan.—LUMSIE.

[61850.]—**Crab.**—You can lift almost any weight by means of a crab and suitable blocks and falls. To know what strain could be put on the chain on drum, supposing frame would stand it, multiply all the teeth in the spur wheels together, and divide it by the product of the teeth in all the pinions. This gives the power gained by the gear, and this must be multiplied by the length of handle, and divided by radius of drum; the result is the number of times the power you apply at the handle that the crab will lift, neglecting friction.—T. C., Bristol.

[61852.]—**To "T. C., Bristol."**—(1) Make no alteration to valve if it cuts off at ¾ stroke, but throttle the steam; this acts as an imperfect cut-off valve. (2) Any of the heavy mineral oils; I do not care for tallow, if steam is used for heating the feed water. I have also used engines without lubricating the steam; but it depends on the

d also the pressure. I advise to lubricate.
Bristol.

.]—**Mechanical Telephone.**—You could
t any communication would be audible to
telephones. You would have to arrange a
of signals to show which telephone was
-one signal for each.—EDWARD CONRY.

.]—**Reversible Gear.**—The handle is
dy by means of a toothed quadrant.—A. F.
PEAR, Lüttichaustr. 14, III., Dresden.

.]—**Reversing Gear.**—The link is sus-
either from the middle, or one end, by
a link or rod at each side, and these allow
to work while the rods vibrate, like a
m at each stroke.—T. C., Bristol.

.]—**Reversing Gear.**—The reversing
an engine is held in position by a bolt
at its side, and kept in the notches of the
by a spring. This lever, by means of the
r, shaft, and levers, moves the link up or
required. The eccentrics are so placed
rank-shaft that when one is in the right
to enable the engine to move forward, the
in the position for moving backward; by
r lowering the link by means of the re-
levers acting on the link so as to bring the
lock in a line with one or the other of the
rods, the motion proper to that rod will
unicated to the valve, and the engine will
ckward or forward accordingly. The link
refore, receive a reciprocating motion on
e, since when one eccentric is moving one
e link in one direction, the other eccentric
moving the other end of the link in the
direction; so if you imagine the link
rking on a pivot at the end of the valve
you will see that the bolt on the reversing
quite sufficient to prevent it oscillating.—
XTON.

.]—**Proportions of Model Engines
lers.**—Models are made by rule of thumb
t if you make the boiler five times as large
cylinder, it will be sufficient.—A. F.
PEAR, Lüttichaustr. 14, III., Dresden.

.]—**Proportions of Model Engines
lers.**—It is impossible to lay down a hard
rule for the proportions of model engines
rs, because the following factors vary—
sure, shape of boiler, and length of run.
al boiler with a working pressure of under
th a furnace for burning charcoal or coke,
g 10in. by 8in., will run an engine 1in. by
horizontal boiler 9in. by 3½in., with spirit-
uld also run an engine of above size, but
ell.—ELECTRICIAN.

.] — **Declination.** — The limit on the
ich horizon is 38°; but this will be still
reduced by the prevalent fog and vapour.
he comet mentioned by "O. B.," the moon
lower than that herself.—ARTHUR MEE.

.]—**Declination.** — A star having such
declination means that its position is N.
the equator, as the case may be. The alti-
the equator above the horizon depends
observer's position, being the co-latitude,
minus latitude. Thus, Greenwich is in lat.
38" N., and the co-lat. or height of the
above the horizon would be 38° 31′ 22".
's comet, therefore, would be 16° 10′ below
22° 21′ 22" above the horizon. The most
ory way would be for "O. B." to get one of
erous and cheap elementary primers on
y, and study the matter for himself.—

.]—**Lead in Varnish.**—Procure from
ufacturing chemist a solution of hydrogen
in glycerine. Add a few drops of this to
ected varnish. If it contains any appre-
mount of lead, it will surely blacken it.—
ONE.

.]—**Lead in Varnish.**—I know of no
way than the following:—Heat cautiously
ll porcelain crucible till the solvent of the
has been driven off; gradually increase the
all the organic matter has been burnt,
only the mineral matter or ash. Into the
(when cold) put about a teaspoonful of
tric acid, about one part of acid to three
water; cover it with a watch glass, and
ntly for about ten minutes. Then remove
h-glass, and carefully evaporate the con-
the crucible to dryness. To the residue
add a little warm water (distilled), and
a short time, to dissolve as much of the
s possible. If the solution be turbid filter
few drops of ammonia, and then a little
d, till it gives an acid reaction with litmus
A few drops of a solution of bichromate of
e then added, which cause the formation
w precipitate if lead be present. Barium
give a similar precipitate, but is not, I
ely to be present in varnishes. I have
the method, step by step, as simply as
thinking you to be unfamiliar with analy-
rations.—BERTRAM BLOUNT.

[61861.]—**Earthquakes.**—Some theorists have supposed that the contraction of the earth's crust on the gradually cooling centre is sufficient to account for these phenomena. Another explanation is that water finds its way to the molten interior of the earth. This will certainly account for volcanic action, as large masses of water might suddenly be converted into super-heated steam. This would expel a portion of the earth's contents, whatever they are. The supply of water being stopped by the closure of fissures, or from other causes, might create a large vacuum, which would be sufficient to induce a movement of the crust. It does not follow that this vacuum should be in the neighbourhood of an active volcano, as the rotation of the earth would be constantly changing its position (that is, of the vacuous cavity), and it would have time to find out the weakest spot and take advantage of it. That is, assuming the interior of the earth to be a molten fluid, and it can hardly be anything else, or we should hardly have molten lava finding its way to the surface. I don't mean to say that a movement might not be caused also by excessive steam-pressure, as either pressure or vacuum might do it. I am inclined to think it is sometimes one, and again the other.—OS.

[61862.]—**Gherkins.**—In England and elsewhere the growers refused to destroy their juvenile cucumbers (for such they are), pleading that if left to grow they would fetch a good sum in the market. Accordingly, I raised my own; the best I found was "Cuthill's black spine cucumber," which must be raised in a frame with hot bed. There are several new ridge kinds introduced for open-air culture; you might try them in a warm sunny part of a southern county. As you cannot get many at one gathering, only at intervals of days, you have to store them in a large jar of strong brine. When enough have been procured, take them out of the brine, and pickle them quickly, or they will shrivel and turn yellow.—EOS.

[61863.] — **Roses.** — I have always followed Cranston, the great Herefordshire grower, by pruning in February, March, and April. His show-case at an exhibition of the Royal Agricultural Society was far beyond all competitions in size, shape, colour, beauty, and novelty. You should get his very complete little book,—so many kinds of roses require different treatment in cutting away wood. Cranston is very clear and concise.—EOS.

[61864.]—**Butterflies, to Render Supple.**—Place them, one by one, as wanted for setting, on a large bung, in a saucepan of boiling water. Put the cover on and allow them to stand until well steamed, and they will be found quite flaccid again, as if only recently killed.—S. BOTTONE.

[61864.] — **Butterflies.** — "Lu" can set his butterflies if he holds them over boiling water till soft. I have treated butterflies this way after five years, and I lately released some foreign beetles 14 years after their death. They maintain their new position when dry, and give no signs of drooping; but it is best to leave them on the setting-board for, say, a week.—ELAG.

[61866.] — **Pabst Battery.** — The following description of this cell appeared in these columns some time ago:—"A new iron cell devised by Dr. Pabst, of Stettin, is said to be finding favour in Germany. Carbon and wrought-iron plates dip into ferric chloride solution, and the action is maintained at the expense of the iron and the oxygen of the air, ferric oxide being deposited in the cell. The Pabst cell is said to be self-regenerating and practically unpolarisable; but its E.M.F. is only ·78 volt." I have not used the cell myself, and consequently cannot give any details of its working.—E. E. V.

[61867.]—**Oval Lake.**—It is very seldom necessary to puddle the bottom. Only embankments and artificial portions require it. The clay is cut in cubes of 6 to 9in., moistened and built along the face of the bank and then beaten down with a rammer. Never allow it to dry, or it will crack. Get Weale's "Irrigation and Water Supply," by Professor John Scott (Crosby Lockwood and Co., 1s. 6d.), and it will tell you all about it. As to the depth, that depends on the make of the boats you are going to put on it; but for ordinary two-oared pleasure boats, 2ft. will be sufficient.—B.SC., Plymouth.

[61868.]—**Cremation.**—On application to the office at Woking, where an incremator has been lately constructed, they will give you full information. About once a week they receive a corpse. At Florence this mode of disposal is becoming very popular, as also at Milan. Many years ago a very sensational appeal was made to the inhabitants of the first-named fair city—i.e., an exhibition of wax figures representing the corruption of the human body in all its fearful stages, with close imitations of the vile insects preying on putrefaction; hence came cremation in Europe. As I expected, I find well-educated, refined women all expressing a preference to the pure chemical transformation by fire as far superior to the lone rottenness of sepulture. Men seem more careless of the difference.—EOS.

[61869.]—**Fleas.**—Let "C. M. R.," if these gentry are in the carpet or floor, remove the carpet, and give the floor a good scrubbing once a week with carbolic soap or coal-tar soap, or water the floor with one part of carbolic acid to ten of water, letting it soak in well, and, unless his fleas are of a very strong-minded breed indeed, they will soon disappear.—B. H.

[61869.]—**Fleas.**—It is perfectly possible to procure insect powder which will kill fleas, and there is nothing equal to it, but it must be unadulterated and good. If the bedsteads are wood the joints might be painted with a solution of corrosive sublimate. I don't think they could withstand this. Chemist would supply it.—OS.

[61869.]—**Fleas.**—Reading "C. M. R.'s" moving appeal, I bethought me of the African method—smearing the floor with fresh cow-dung. This may not seem very savoury; but it was practised by Mrs. Moffat, the worthy partner of one of the most heroic of missionaries; see her biography.—ARTHUR MEE.

[61870.]—**Thermopiles and Electric Railways.**—A very simple but effective form of thermopile consists of a number of short lengths of stout copper and German-silver wires, No. 16 gauge, the lower extremities of which are firmly twisted together for about an inch, so as to form a number of V-like pairs. The upper ends of these V's are then soldered together, care being taken to solder one copper to the next German silver, and so on. The two last ends are soldered to stout copper wires as poles, and the soldered ends all clamped between two well-seasoned oak strips. The projecting or twisting ends are to be heated to produce a current. The little galvanometers described in my book, "The Dynamo," and which consists of fifty turns of No. 24 copper wire round a magnetised needle, will give a deflection of 20° under the influence of one single twist or pair of elements described above, heated with a match. I know of only two electric railways at work in Great Britain—viz., one at Brighton and one in Ireland.—S. BOTTONE.

[61871.]—**Straw Bottle Envelopes.**—These are made by children. "D. M." should take one to pieces; he will find two threads are used, and if made by hand the threads are tied, the straw being put between the threads by nimble fingers (they are also made by sewing-machines, the straw being fed up to the machine), it is then bent round a wooden roller and tied, the top of the envelope is tied in a peculiar machine. The straw must first be cut level and straight at the bottom, it is then put over a wooden model of a bottle, and rests upright on a kind of platform or stage; just above the neck of the bottle are two stiff pieces of iron with half-round or U-shaped notches, the upper is hinged at the left-hand side, to the right it has a handle; the notches are so fashioned that they gather the straw together at the top. It is compressed with the aid of the handle on top plate and kept in position by a foot-lever, then tied with twine, the straw ends cut off, and the thing is finished. It is many years since I have seen one; it was a rough contrivance, and could be improved I believe—they called it a clip-tying bench. Some envelopes are made without being tied at the top; these are very cheap, but I think, if I remember rightly, good ones were worth from 2s. to 4s. per gross.—OS.

[61875.]—**Opals.**—The following is Mr. Cowan's formula:—Silver nitrate, 950 grains; sodium chloride, 480 grains; Heinrich's gelatine, 960 grains; distilled water, 30oz. Dissolve the silver in 10oz. of the water, the chloride and half the gelatine in 15oz., and the other half of the gelatine in the remaining 5oz., after being allowed to swell for some time previously. All the vessels are heated 120° or sufficient to thoroughly melt the gelatine, and are removed to the dark room. The silver solution is mixed with the gelatine, then slowly emulsified into the gelatine and chloride, afterwards poured into a flat dish and cooled rapidly with running water. When thoroughly set, wash in the usual manner. Develop with iron and oxalate.—B.SC., Plymouth.

[61876.]—**Lighting Billiards by Electricity.**—See my reply in last week's number (61716). Note that the depolariser should be chromic acid solution, and the excitant chloride of zinc. See also the description of battery and lamp given at p. 435, No. 20 of Vol. XLIV. "E. M.," Jan. 14 of this year.—S. BOTTONE.

[61876.]—**Electric Light.**—You may as well give up at once any thought of using primary batteries for lighting. It is a case of zinc *versus* coal, in which the former has no chance. Batteries may do very well for a small light for a short time; but you would require not less than six lamps of 16c.p., and this would require ¾H.P. to work from a dynamo. Presuming you are in the country, have you no water-power available?—OHM.

[illegible] 13lb.—**LEUMAS**

[illegible] a correspondent give [illegible] or hardness? Also the [illegible] of lime to precipitate [illegible]

[illegible]**.**—Will some of our corre- [illegible] construct an air compressor [illegible] a safe for perishables? [illegible] sketch would oblige—H. S.

[illegible] **Wire Resistance.**—Could [illegible] what are the formulæ for the [illegible] diameters—thus, what [illegible] wire would give a resistance [illegible]

[illegible] **Machine.**—Will some kind fellow [illegible] repair my sewing machine, the [illegible] the needle on descending catch- [illegible] causing the cotton to [illegible] cotton breaks in any fashion [illegible] machine is made on the same [illegible] Wheeler and Wilson machines.—

[illegible] **Battery.**—Can anyone suggest [illegible] a portable bell that will answer for [illegible] without attention? It is important [illegible] batteries, to take up as little space as [illegible] 4in. high, and 2in. deep. Have [illegible] but the powers are not lasting [illegible]

[illegible]**.**—I have made a [illegible] best broad reeds [illegible] purchased the pan from a good [illegible] in vain to make the [illegible] They do not seem [illegible] when in [illegible] closed, but they appear [illegible] the pan. I [illegible] is there any difference [illegible] or narrow reeds? [illegible]

[illegible] **Microscopical.**—[illegible] microscope [illegible] point? [illegible] between the upper [illegible] lower one of the [illegible] ascertain [illegible]

[illegible] **Telegraph and Telephone Line** [illegible] any of the readers of the [illegible] going abroad soon, and [illegible] work to do, and I therefore [illegible] some practical instruction [illegible] especially how to [illegible] the line when [illegible] the telegraph post and [illegible] and probable [illegible] manage.—W. [illegible]

[illegible] **Hackworth's Gear for** [illegible] any reader [illegible] sketch or description [illegible] succeeded in [illegible] which I have [illegible] by Timothy [illegible] of the well-known [illegible] Museum. [illegible]

[illegible]**phonic.**—Would [illegible] transmitter [illegible]

[illegible] **Stylographic Pen.** [illegible] best way and [illegible]

[illegible] **Spinner.**—[illegible] of the above [illegible] frame and wheels. [illegible] to finish it.—[illegible]

[illegible]**ration.**—I wish [illegible] either chemical [illegible] freeze, and what [illegible]

[illegible]**rature.**—At what [illegible] Ninety-four parts of [illegible] of starch, and one part [illegible]

[illegible]**.**—Would any reader [illegible] occur when [illegible] the form of [illegible]

[illegible] **Standards.**—[illegible]

[illegible] **Edward Cone** [illegible] camera [illegible] voltmeter [illegible] and I want [illegible]

[illegible] would be [illegible] information [illegible] burn gypsum [illegible] very glad [illegible] man of experience [illegible] rough [illegible] purposes. [illegible] principal [illegible] Cyprus.

[illegible] **Objectives.**—[illegible]

-Painting on Glass.—Will any reader ɔ directions for painting on glass? I wish to ɯ for short blinds to dining-room windows. ɪt of them would be 3ft. long and 16in. wide. ɔ to do them in sepia. I can paint on china, ater. What glass shall I require? Will one ɔia do, or shall I have several shades in brown? ı will be figures of children. Is there a book on it?—M. S. S.

-Lemon Soles.—What are lemon soles? I ly see them in the fish market at less than half of ordinary soles; but my local fishmonger ɔthing about 'em!" They are a larger fish than ɪry sole—not quite so tender, but very good CEPTIC.

—Cleaning Indian Brass Salvers.— : clean Indian and Japanese engraved brasses— ses, &c.? No acid will touch them—it darkens her; and thumb marks and tarnish seem e.—BRIC-A-BRAC.

—Screw-cutting.—Will "Goolwa" (61652, please give title of book on screw-cutting men- him in above reply? In reference to reply No. ɡe 571, I beg to thank him for the very clear , which he has described the construction of the ikes." For years I have been puzzled to under- nd have applied to the author of the work in ppears for further explanation, but received no is a pity that a work containing really useful ɔn, as "Greenwood's" does, should be so dread- together. A more exasperating book I never now, anxious not to trespass, I will conclude by oolwa," as he states the tool in question is not trouble of making, does he know of anything l, if so, will it be asking too much for him to t, with an illustration, if possible? It is quite e thanks of a very large number of subscribers to ANIC will be his if it can be done.—ONE DEEPLY ED.

-Soldering Lamp.—Can any of "ours" ıe one of the different lamps that are used by linesmen for soldering the line wire? I require ; and what oil or spirit to burn, and kind of ELEGRAPHIC.

—Cement.—I have some vitrite caps for fixing scent lamps, and tried to fix the same by means of-Paris and marine glue, but both have failed. of "ours" give me a good practical recipe? ent is generally used?—ELECTRA.

—Hot-air Oven.—I wish to make one of laboratory. Will Mr. Bottone, or some other of cal contributors, help me? Size inside, about e. Please give directions how to make it, and per to use.—CHEMICO.

—Annealing Boxes.—What is the usual of these for small work? Also, how long do I recently made one of 1-16in. iron plate; it sted to the fire for about 20 hours altogether, ch time very little of it remained.—A. F. EAR.

—Screw Taps.—A foreman once told me that taps were far superior to any other. I am un- —A. F. SHAKESPEAR.

—Enamel or Polish on Indiarubber —Can anyone tell me how the fine polished . or glazed surface is obtained on fine rubber h as surgical articles? The articles I mean are ɪr, not vulcanite or ebonite.—CHARCOAL.

—Curved Mouldings.—Would any brother ıdly give me information about working mould- ɪrved and irregular surfaces in hard woods, like hairs and other furniture, or the title of some moderate price which treats of the subject? to wax-polish oak?—LAUSANNE.

—Lens.—Will anyone tell me what the "recti- ns is? Whether it is useful for taking machinery landscape? If not, will some of our able photo- recommend a good lens for all-round work, and cost, &c.?—W. HOLDER, Newport, Mon.

—Double Star near Castor.—1° *n. f.* neat double, about 4" apart, 8th and 9th mags. any list?—E. HOLMES.

—Brazing Bicycle Head.—Can any reader ɔw to braze steering head and forks of bicycle Particulars as to best means of getting suf- ıt and best braze to use for such steel work?— THY.

—Expansion Valves.—Would any of our ndly give me a little information on the action ansion valves of compound horizontal engines— ; them, &c.?—ONE WILLING TO LEARN.

—Water Wheel.—I wish to make a water- ıbout 14-horse. It must be made of yellow deal ɔ other kind of wood). Will one of your corre- kindly inform me through your columns by ɪulse I should calculate the strengths of the arms rength and size of the shaft, which will be square 35ft. long?—A NORTHERN READER.

—Logarithms.—What is the best book con- garithmic tables suitable for use in steam calcu- I want one which shall give a clear explanation l of their manipulation, and not necessarily he method by which they are arrived at, for that ot, with my very meagre calculating powers, be derstand.—SHINY BOOTS.

—Modelling.—I want to model (and colour aint) some flowers to put on vases, plates, &c. I guttapercha. Can any subscriber tell me of ɪr other substance, which will, when moulded, ite firm, so as to resist water, without necessity ; to be fired?—C. NORTH.

—Valves of Air-pump.—What is the strip l used to cover holes of base and plunger and alve? It looks like a membrane, and is not y affected by oil.—C. H. G.

—Working-man's Bicycle.—How can a made and affixed (for a man using heavy tools) em on a safety bicycle—both wheels same size?

[61937.]—**Webb's Automatic Air-brake.**—Can any reader say what Webb's air-brake is that is reported to be the one that is to be used on the North Western? I do remember seeing a model carriage fitted up with it at the "Inventions"; but do not understand its working.—L. AND N. W.

[61938.]—**Cylinder Flute.**—Will any musical reader kindly give me the distance from the centre of embouchure to the tone holes for extra D key, and shake for high E, and F sharp? Also the B lever key?—IMPECUNIOUS FLAUTIST.

[61939.]—**Optical Lantern Lens.**—I have a pair of single achromatic lenses of 2in. diam. and about 9in. focus for use in the optical lantern. With the stop necessary to give a sharp picture, I cannot get sufficient illumination on the screen at long distances. I shall be obliged if any reader can tell me if there is a lantern lens (of not less than 9in. focus) that will give a sharp picture without the use of a stop. I have double combination lenses that work most satisfactorily without stops, but their focus is only 6in.—W. M. B.

[61940.]—**Rear-driving Bicycles.**—As these cycles are coming to the front just now, perhaps others besides the writer would appreciate a competent opinion on the following points. What are the disadvantages of the rear-driving bicycle? Is it easy to steer? Should it be direct or self-steering? Is not the seat rather too far back from the handles? Would not free pedals and no chain be an advantage? Is the "tangent" the best kind of wheel? Is much power wasted by friction in the chain? Is there a saddle made which completely prevents perineal pressure?—QUIS EST.

[61941.]—**Dipsomania.**—I believe a great many people, myself among the number, would be greatly obliged to "Reclaimed" (who, in his letter 26885, p. 564, says that "rack root" is a "perfect cure for drunkenness") if he would be a little more explicit respecting the "cure." I have searched three herb books, but can find no such root mentioned. I have also inquired of a medical botanist in large practice, and he knows nothing about it. Would "Reclaimed" kindly say if "rack root" is the only name it is known by, and, in making the tea, how much of the root should be used, say, to a quart of water? Should it be boiled, or should it be made in the same way as ordinary tea? Also where the root is to be got at?—ANXIOUS.

[61942.]—**Magnetic Coil.**—I wish to make a magnetic coil, to support (in a vertical position) a soft iron core 1⅜in. diam. and 20lb. weight. If some reader will give me the desired information I shall esteem it a favour. Also the battery power necessary.—F. W. DARLOW.

[61943.]—**Steam.**—What would be the thickness of iron plate for a boiler with a shell 6ft. 4in. in diameter for a pressure of 40lb., the greatest tensile stress to work safely being 5,000lb. per square inch? In some text-books the rule is—$T = \frac{S \times D}{5,000}$ and in others $T = \frac{S \times R}{5,000}$ Where T = thickness, S = pressure, D = diameter in inches, and R = radius in inches. By first rule, the thickness would be ·608in.; and by second rule, thickness would be ·304in. First rule gives a plate twice as thick as the second rule. Now, which rule must I use when sitting for an examination? Any information on the subject would be thankfully received by—NOVICE.

[61944.]—**Piston for Gas-Engine.**—Can anyone inform me whether it is possible to make a really efficient metallic spring-packed piston for a small gas-engine, the cylinder (brass) of which is only 2½in. bore?—ST. MALO.

[61945.]—**Lamp Oils.**—Will any of "ours" be kind enough to enlighten me about lamp oils? I am now cut off from gas, hence the question. There are "fins," and "senes," and colzas at from 10½d. to 3s. a gallon, and the thing to know is, which of them can be recommended for safety and economy, taking all qualities into consideration. I work "under the tiles," and an inkling on the subject of "one-man" lamps would be gratefully accepted. I see that pillar lamps throw too much shadow for me, and I am somewhat inclined to the standing bracket or "Queen's" lamp.—DIMLIGHT.

[61946.]—**Niaudet's Battery.**—Will Mr. Bottone and Mr. Conry kindly give particulars of above? 1. Proportion of salt and water. 2. Most suitable form of zinc. 3. Is carbon placed in a porous pot and surrounded with chloride of lime. 4. How often does this cell require charging when used for a bell? And any other information will oblige.—J. W. O.

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ANSWERS TO CORRESPONDENTS.

◆

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 9, and unacknowledged elsewhere:—

F. N. MASSA.—D. W. Armstrong.—C. Holmes.—J. Brogden.—G. P. Smith.—T. R. Clapham.—Pearson and Bennion.—G. Read.—H. Skinner.—Bolton.—Stand Still.—H. A.—Cicero.—Hosein Imra.—Bramley.—J. H. R.—Iota.—Essex.—C. H. O.—Nemo.—H. J. Hardy.—Borneo.—Pitch Boiler.—Woodcroft.—Mechanical Power.—Gris de Fer.—W. B. B.—Schoolboy.—A Country Wheelwright.—A. B.—T. N. C.—A Subscriber's Wife.—Harry Frivoli.—Sexton.—M. M.—E. L. G.—H. C. C.—J. T. N.—Eos.—L.B. and S.C.R.—K. C. B.—Severga.—Engineman S.—J. A. Armstrong.—We Four.—Sen.

JOHN CURRIE. (You have made a strange mistake. See Hints No. 5 above, and please understand that the Replies are *by* correspondents, and are not editorial answers *to* correspondents. The correspondent referred to offered to give information, and for that reason appended his address.)—F. N. MASSA. (Send on, and we will do the best we can with them.)—AVEYRON. (See indices, or procure the directions given by "Sable" in Vol. XII., and published in book form by Mr. Hughes, Brewster House, Mortimer-road, Kingsland, N. As a rule it is cheaper to buy the slides, for they require special skill and much practice to produce satisfactory results.)—H. CARMICHAEL. (Perhaps Nichol's "Porcelain: How it is Made" will suit. It is published by Putnam; but you can no doubt find it in Manchester. For the manufacture of pigments a separate work must be consulted. As to the photographs, see p. 432 last volume, and the indices generally.)—COSIS. (More trouble than it is worth. The best way is to exchange; but perhaps the makers may be able to alter it cheaply.)—LLAWKRIK. (The design may be anything to suit the taste, unless an automatic sprinkler of the dry earth is required. Otherwise, all that is needed is a receptacle which can be removed readily, and a reservoir of fine dry earth or cinder ash.)—J. L. MECHANIC. (The cause is a want of the synovia, a lubricating liquid, or "joint oil," as it is called. You have probably caught cold, or the limbs have been exposed to cold, and there may be a touch of rheumatism. Attention to the laws of health will be the best remedy, unless something special is required; then consult a medical man.)—ARMATURE. (Hot-air. A spring will only give out a portion of the power put into it.)—VIR SAPIENTIÆ. (The only patents in connection with electric clocks refer to special details and devices. Anyone may make an electric clock, and in back volumes you will find several designs. The arrangement referred to is an old one.)—SECOND SIGHT OR WHAT? (The secret is in the questions. She could not say unless the key were given in the form of the question. Otherwise, she is directly informed by a confederate. See indices under heads Clairvoyance, Second Sight, &c.)—JOHN SMITH. (Water entering the state of ice expands about 10 per cent. We do not know of any calculations as to the pressure per square inch.)—VIOLA. (The best way is to get a tutor to show you, as it is not easy to explain. Briefly, it should be held much in the same way as the violin, and as to the hard skin or "corns," they are natural, and eventually useful.)—COSMO. (There are many recipes for varnish in back volumes; but unless you want to make on the large scale it is cheaper to buy what you require. Winckler and Andes' Treatise, Spon, 12s. 6d., is a useful work.)—CYMRO. (Why not enter at one of the art schools? It is a plastic clay, to be obtained at any pottery works. Failing that, use pipe-clay. If you were in London you could have lessons for about sixpence or a shilling a week at several of the art schools.)—A TINKER. (A similar query was inserted on p. 487, and if not replied to will go into the "Unanswered." If your description is correct, the acid is already killed with iron, and useless for making soldering fluid.)—O. C. S. (Celluloid is used. See article on p. 534, number for Feb. 18.)—A. O. (If the ivory on your piano keys is tolerably thick, you can improve the appearance by scraping, glasspapering, and polishing with whiting and spirit on a piece of baize; but as a rule very little can be done in restoring the white colour.)—A. F. H. (Your query is incomprehensible. Do you want to plate brass and copper with other metals? If so, what metal?)—EDWARD WRIGHT. (The bichromate. Mr. R. A. Lee, of High Holborn, has a useful battery for the purpose; but see indices.)—J. R. (Aluminate of sodium is generally made from Bauxite; but a rather expensive and extensive plant is required. It is an article of commerce, and can be purchased from dealers in chemicals. The hydrate is caustic soda, and can be obtained from the alkali manufacturers.)—J. G., ONE IN A FIX. (Look at some of the diagrams given in recent numbers, and then trace the wires of your indicator. See that they are not broken or displaced, and look to the connections and the contact surfaces of the pushes. The size of battery depends [illegible] which are not [illegible]. [illegible] can [illegible] for what you can do [illegible] very difficult or [illegible] (We [illegible] have no space at present for [illegible] There are plenty of [illegible] Your query about [illegible] [illegible] p. 45 and replied to on p. 807, [illegible] (If you had read recent [illegible] you would have learned that the greater the [illegible] the higher the temperature.) [illegible] (We do not know of any books which will [illegible] at a high price which contain detail [illegible] Some time ago Mr. Hallewell, 80, Hanover [illegible] published useful working drawings [illegible] engines on sheets.) J. R. [illegible] (We [illegible] the make, and it is doubtful if any one can [illegible] without inspecting the engine. Apply to the [illegible] the second name.) R. AUSTIN, Clapham. (One [illegible] soaked in water till soft, then drained; four [illegible]; the two melted together, whiting [illegible], and the whole poured out into shallow [illegible] G. (Depends on the climate; earlier in hot than in cold.) J. MARSHALL. (Send the cell [illegible]tician, such as Lancaster and Son, Birmingham [illegible] have it fitted with a new object-glass. That [illegible] can do; but probably it is scarcely worth the [illegible] it is only a "ten-mile range telescope." 2. [illegible]etter than guttapercha for self application. [illegible]lices for other methods.)—CAMERA. (There [illegible] of handbooks, and several firms give lessons, [illegible]ll see by consulting advertisements.)—J. G. L. [illegible]edical column of the *Weekly Times and Echo* [illegible]s back.) R. S. T. (By heat and pressure—the [illegible]er heavy. Not much can be done with it in [illegible] way, as suitable appliances are required.) [illegible] A PUZZLE. (Not to be explained in a few [illegible] the indices of Vols. XXXIV., XXXV., and p. 196, No. 840. The Greenbank Alkali Co., [illegible], issue a circular giving directions for [illegible]soap by the cold process.)—H. SCRIVEN. [illegible]asspaper smooth, and polish in the usual way.) [illegible] WANT. (There are several such machines. [illegible] T. S. and W. Taylor, Slate-street, Leicester, [illegible]r about one we shall probably describe soon.) [illegible]. (If you have the numbers describing the [illegible] the pipes, that is sufficient. There is nothing [illegible] since, and the good old patterns are still fol[illegible] R. H. H. (The address was given at the time [illegible]eward, 406, Strand, W.C. We do not recol[illegible]rice.)—BOOTMAKER. (Rather peculiar work; [illegible]tter to procure one properly made, as injury [illegible]one if it does not fit. The covering is com[illegible] an easy matter: it is the tempering and [illegible] of the spring that requires special skill.)— [illegible]Y. (To make a dulcimer, see No. 914, p. 97.) [illegible] A FIX. (For a description of luminous paint [illegible]4, p. 471.)—COAL BOY. (No space for a list [illegible]n Grecian and Roman "Morthology," nor do [illegible]tand what you mean, unless you assert that [illegible]ntions were myths. 2. Why not try the ex[illegible] with a piece of glass? There is nothing [illegible].)—ANXIOUS. (Aquarium cement in No. 1110, [illegible] to making one, what size is required, because [illegible]al depends upon that; but why not take [illegible]isting examples?)—STATIC. (Will not black[illegible] That is a good conductor.)—A LABOURER. [illegible]t understand the question.)—H. G. B, Hants. [illegible] a secondary battery, of course, and have [illegible] the weight of lead plates necessary to light [illegible]amp 16c.p. 100 volts. You will find directions [illegible] secondary batteries in many back numbers; [illegible] want a portable one you must have a lamp of [illegible] voltage than 100.)—ELECTRICAL. (Zinc, [illegible] tin. See the list in the books.)—ASTRO[illegible] You say "chromatic," but presumably mean [illegible]tic." You ask what should be length of tele[illegible]e answer depends on the focus of the object[illegible]h. of course, you do not give. Then you say, [illegible]o not refer to back numbers," as if we could [illegible] for all the queries which reach us every [illegible] will find eyepiece powers for telescopes of [illegible]al length on p. 14 last volume.)

Meet a Man suffering from Asthma, [illegible], or any Pulmonary Affection, tell him he [illegible] and effectually cured by simply using the [illegible]. This remarkable instrument will last for [illegible] only 21s. post free. New Pamphlet, containing [illegible] of Testimonials, post free to any address on [illegible] the MEDICAL BATTERY COMPANY (Limited) [illegible] LONDON, W.

[illegible]GES FOR ADVERTISING.

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[illegible] words	2	6
[illegible] succeeding eight words	0	6

[illegible] Advertisements Five Shillings for the first 40 words [illegible] per line. Paragraph advertisements One Shilling [illegible] page or paragraph advertisement inserted for [illegible] Shillings. Reduced terms for series of more than [illegible] be ascertained on application to the Publisher. [illegible] IN EXCHANGE COLUMN—for

	s.	d.
[illegible] words	0	3
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[illegible] be borne in mind that no Displayed advertisements [illegible] the Sixpenny Sale Column. All advertisements [illegible] no reduction is made on repeated insertions [illegible] when the amount sent exceeds One Shilling, the [illegible] be granted. If a P.O.O. could be sent and not [illegible] however, preferably halfpenny stamps, may be [illegible] in order to obtain P.O.O.s.

[illegible] included as part of the advertisement and charged [illegible]

[illegible] must reach the office by [illegible] Wednesday, to [illegible] in the following Friday's number.

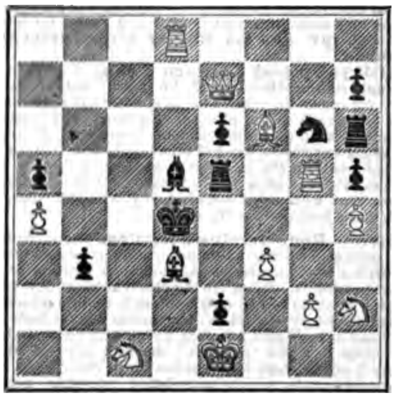
[illegible]y's Pills [illegible] all the [illegible] [illegible]

CHESS.

All Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXXIV.—BY J. PIERCE.

Black.



White. [12 + 11

White to play and mate in three moves.

SOLUTION TO 1,032.

White.	*Black.*
1. Kt-Q 5.	1. Anything.
2. Q, R, B, or Kt mates.	

This is the author's intention; but the problem can be solved in other ways.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,032, by J. Mackenzie, Major, A. Dean (3), H. Hosey-Davis (5), V. S. Pochin (3), W. J. Carpenter (2), J. W. Hamill, F. Krasser (2), T. H. Billington (5), Snowdrop (5), Black Pawn (5), A. Bolus (3), Country Boy (3), G. A. A. Walker (5), J. Palmer (2), and A Beginner; to 1,031, by Snowdrop, T. H. Billington, J. J. Spence, J. W. Hamill, Hensing, G. A. A. Walker, J. Palmer, and Avon.

W. HEWSON-KILBEE.—If in 1,032 1. Kt-Q B 8, Kt-K 6.

WE regret to have to record the death of the celebrated problem composer, Mr. H. J. C. Andrews, for some years one of the editors of the *British Chess Magazine*, and joint author of the work recently noticed in this column, "The Chess Problem Text Book." Here will best be seen some of his imperishable contributions to chess literature in the shape of problems which, for their depth and beauty, are in their own style matchless. Several have won prizes in Tourneys. We append one, giving the key move:—White: K-K Kt 7, Q-Q B 7, R-K R 4, Bs-K R 3, Q 6; Kts-Q 3, K B 3; Ps-Q Kt 5, Q B 6, K 2, K Kt 4. Black: K-K 3, Q-Q 8; Rs-Q 5, K B 5; B-K R 2; Kts-Q B sq and Q B 6; Ps-Q R 4, Q Kt 6. White to play and mate in three moves. 1. B-K B 8.

MR. ABBOTT, formerly editor of this column, has brought out a collection of 121 of his problems. Most of our readers know some of these stratagems, as they have appeared in different chess columns and several have won prizes. The following among the two-movers have appeared to us the finest: Nos. 4, 8, 11, and 13. Most of the other problems are three-movers, and these, of course, will most repay study. We subjoin No. 25:—White: K-K R 8, R-K B 5, B-Q Kt 3; Kts-Q B 4, K B 2; Ps-Q 2, K Kt 7, K R 5. Black: K-Q 5, R-K Kt 3, B-K Kt sq; Ps-Q 2, Q Kt 5, K R 3. White to play and mate in three moves. When we add that the work is very neatly printed with large diagrams, and that the price of the book is only 1s., few of our readers we should think will hesitate to secure a copy before the work is out of print. It is published by Wade.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Wanted, **Launch Engine**, Propeller, Lathe, Tricycle, Perambulator or Parts, for new Tools, Cutlery, Plate, Miscellaneous Hardware, Sewing Machine, Revolver, Air Gun.—HARRISON, Devoran, Cornwall.

Will exchange 55in. Matchless **Bicycle**, good condition, balls both wheels, for Lathe, with slide rest, &c.—PENNEY, Highcroft, Dyke-road, Brighton.

Steam Gauge, 2in. water gauges, safety-valve, all new; 8in. Invincible Lawn Mower, cost 30s. Exchange offers.—Letters to W. SMITH, Bilston-road, Wolverhampton.

Phonograph.—Wanted, a first-class loud-speaking instrument. Must be low in price and on approval. Cash or exchange.—F. H. D., 38, Shrubland-road, Dalston, London.

Telescope, 2½in. by 31in. long, [illegible], 3 glasses, also [illegible] Rifle, [illegible] bore, breechloading, both articles in excellent condition, take offers for both or separate [illegible] lathe tools, books on lathe, or ENGLISH MECHANIC, bound or unbound.—MASTER, Dundalk [illegible], Ireland.

Slides, many different, [illegible], &c. Exchange [illegible]. Also exchange two samples [illegible] for any [illegible].—[illegible], Coltman-street, Hull.

Roman Brass Coins, also Foreign Stamps. Will exchange for rare stamps, or offers.—EDWARD W. [illegible], [illegible] Coltman-street, Hull.

Gas Engine, 4in. bore, 8in. stroke, nearly completed, [illegible] cylinder, [illegible] engine, [illegible]—Particulars—[illegible] Engineer, Hull.

Books.—[illegible] odd numbers ENGLISH MECHANIC, [illegible] M[illegible] and M[illegible] [illegible] Wm. [illegible] and [illegible] offers.—TOWNSEND [illegible] Market, Bury, Suffolk.

7 by 5 **Bellows Camera**, [illegible] with [illegible] whole-plate portrait [illegible] printing frame. Wanted [illegible] value of 45s.—H. WEBB, [illegible]-street, C[illegible]

Wanted, Ruby Lamp, Developing and [illegible] ½-plate printing frames. Exchange [illegible] appar[illegible] MORRELL, High-street, [illegible]

Life in Australia.—Slides for Lanterns [illegible] ture gratis.—W., [illegible] Villa, London-road, [illegible]

Exchange 3ft. **Telescope**, on stand, by Doll[illegible] o.g., 6 eyepieces, [illegible] clockwork m[illegible] good 3in. Slide-rest and [illegible] Chuck, Apparatus.—M., 16, King-street, Ealing.

Bicycle, 52in., bent handles, ball bearin[illegible] plated and japanned, quite new, value [illegible] Offers re[illegible] GOUGH, 16, Haggar-street, Blakenhall, Wolverhampton.

Wanted, half-horse Engine and Boiler, o[illegible] separately. Must be in good condition and cheap. N[illegible] wanted. Give Electrical Apparatus, &c.—[illegible] H. MARTI[illegible] poration-road, Middlesborough.

"**Inventor's Mart Journal**," 33 number[illegible] ENGLISH MECHANIC up to date. Offers.—NOY, Water-si[illegible] Colchester.

Turner's Tools wanted in exchange for 1½in. [illegible] OAK PANEL, 20in. by 14, female head (outline sent), val[illegible] —H. KNIGHT, 20, Llanarth-street, Newport, Mon.

Wanted for lecture, thorough well made [illegible] ENGINE (double cylinder preferred), horizontal, beam [illegible] by 1½ stroke. Good exchange or hire.—Mr. HOW, 75, G[illegible] land-street, W.

Microscope or ½-plate Instantaneous Lens and [illegible] wanted in exchange for 1H.P. engine and boiler, value [illegible] RICHARDS, Maesbury, Oswestry.

Gas Meter, dry 3-light; Asbestos [illegible] Ste[illegible] patent, large sealskin, alum dressed, fit for coat; electric [illegible] battery, perfect, wanted.—BUSY BEE, Upton Park, E.

Wanted, Steam Launch Hull, iron or wood, ab[illegible] long, must be sound. Exchange new 3H.P. engine, 15l. [illegible] cash.—BARTRAM, Engineer, Tunbridge.

Nine new **Electric Incandescent Lam**[illegible] and 20c.p. Will exchange for smaller incandescent lam[illegible] 5c.p., or other electrical apparatus.—R., 53, Brook-green, [illegible]

Diamond Drills for china, glass, dental, [illegible] purposes, &c. Offers.—C. BLANCHARD, 29, Earl-street, Lis[illegible] London.

Vols. XXXV.—XLIII. "**English Mechani**[illegible] five bound, 30s., or exchange for ½-plate rectilinear le[illegible] lantern, 4in. condensers, difference in cash.—G. M., 12, [illegible] road, Twickenham.

Electrical.—Small 4-volt Pocket Accumula[illegible] lish, quite new, fairy lamp for do. Want offers for new b[illegible] plates, &c.—111, King Henry's-road, N.W.

Wanted, light Rudge Tricycle. Exchange [illegible] practical printing outfit, to print 16pp. pamphlet.—[illegible] Thomas-road, N.

Modern tourist **Photo Set**, cabinet size. E[illegible] for tools or scientific apparatus, or models in or out [illegible] HOWE, Newbury, Berks.

Books.—"Knowledge," Vols. I. to IV., indi[illegible] [illegible] "Telescope" (Kitchener), scarce; "Violin" (D[illegible] "Violin Technics"; "Organ" (Edwards). Offers.—HO[illegible] [illegible]-road, Stamford-hill.

Wanted, a Kipp's **Gas Apparatus** and othe[illegible] [illegible] instruments, also a small Hand Dynamo, all in good [illegible] Good exchange.—ISSELS, Coral-street, Saltburn.

Burgin Series **Dynamos**, for 4 arc lamps. E[illegible] for good Screwcutting Lathe, or Vertical Drilling Ma[illegible] McLUSKEY, 357 Duke-street, Glasgow.

Burgin Shunt **Dynamos**, to light 50 60wat[illegible] descent lamps. What offers in Machinery?—G. McL.

Compound Crompton **Dynamo** for 75 ligh[illegible] change for Tools, Lathe, &c., or cash offers.—G. McL.

Crompton E **Arc Lamps** sent on approv[illegible] change for Tools, &c.—G. McL.

Set of four **Arc Lamps**, Crompton DD, and [illegible] [illegible] Siemens make, and Dynamo for same. Wh[illegible] —G. McLUSKEY, address above.

Brass horizontal slide-valve **Model Engin**[illegible] [illegible] by [illegible] bed plate screwed on mahogany st[illegible] for above [illegible] by 15½in., burns coal, water sp[illegible] furnace, for parts for tricycle, or modern books on engin[illegible] lathe.—R[illegible], [illegible] Mather-street, Newcastle-on-Tyne.

Royal Salvo **Tricycle**, in good order, cost [illegible] [illegible] also splendid double-barrelled, [illegible] breechloader, [illegible] action, new, cost £10, with loading [illegible] &c. Will exchange either of above for second-hand [illegible] cutting lathe complete, or both for either 4in. or 4½in. [illegible] A. STEWART, [illegible]-street, Waterford.

Powerful **Medical Coil**, all brass fittings [illegible] [illegible] large Electric Machine Cylinde[illegible] [illegible] mahogany stand. What offers.—M., 99, Hi[illegible] [illegible]

What offers for first volume of "**Cassell's** [illegible] [illegible] and shilling Geometry Box of Drawi[illegible] ments, [illegible] silver Quadrant, steel plated, also new [illegible] Board, [illegible] by [illegible], and T-square. No cards.—SMITH, 21, [illegible]

Wanted, 3 or 4in. Screw-cutting Lathe, comple[illegible] change my silver English lever, centre seconds stop [illegible] lady's English lever, engraved case, genuine. App[illegible] C. EAVES, [illegible], Trafalgar-street, Coventry.

Crest Album, Stamp Album, and Hand-nu[illegible] Machine [illegible] for large single Photo. Lens.—JO[illegible] Wellingborough-road, Northampton.

Silk Umbrellas.—Job lot received from [illegible] Offers invited in exchange (value 1s. 3d. for [illegible] or more.—WAITE and CO., Brighton.

4in. stroke **Slotting Machine**, Manches[illegible] compound circular table, self-acting all motions, top [illegible] power, nearly new, cost £45. Exchange offers.—64, Park [illegible]

"**Amateur Mechanics**," eighteen [illegible] numbers, many large illustrations. Will accept anythi[illegible] value had [illegible]—[illegible] London, S.W.

[illegible] centre **Lathe**, with slide-rest, face-[illegible] Exchange or offers.—W. S., 7, Gladstone-street, Batterse[illegible]

Will exchange Vols. XLII., XLIII., and [illegible] Mitcham or anything useful.—W. S., 7, Gladstone-street, [illegible]

Table Knives and Forks, 6 pairs, best [illegible] [illegible], exchange to value 40s. Approv[illegible] M[illegible], [illegible] Observatory-road, Roshill.

Last 3 volumes of "**English Mechan**[illegible] board and Writing Desk for Photographic Apparatus [illegible] or offers.—R. T. W., Gwyn-street, Alltwen, P[illegible] [illegible]

[illegible] Concert **Flute**, 8 keys, splendid to[illegible] exchange for good Microscope.—W. PITT, British Sch[illegible] Oak-street, Abingdon, Berks.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 18, 1887.

NIBLETT'S NEW SCREW-CHASING APPARATUS.—II.

HAVING in the first paper explained the principles of this novel and clever device, I will now enter more fully into details of its construction. In its improved form it is much simplified by the removal of a rather complicated piece, of which, in default of a satisfactory explanation of its action, I could only write "it must be seen to be understood"; at the same time, I still have it on my own lathe, and it acts perfectly. Nevertheless, we all know, or ought to know, that the fewer the parts and simpler the arrangement, the more satisfactory are the results. Personally I hated that part because I could not write a clear description of it, and I rejoice that it is now relegated to limbo. As now constructed nothing can be simpler, and it is but due to the maker to testify to the excellence of his work, which looks as if it must be very difficult to fit with exactness. The only fixture properly so called is the cast-iron boss which is bored to fit the special mandrel to which it is to be applied. On this fits an eccentric ring, which is attached by two small screws. Upon this comes an eccentric hoop of brass or gunmetal, on the outside of which are cut cogs to gear with, similar ones cut inside the grooved collar, which is the next piece to fit on, and which will be understood from the drawing. I may explain it as a box with two or three grooves of square section cut outside it and cogs on the inside, the mandrel passing through a hole in the bottom of it.

FIG. 6.

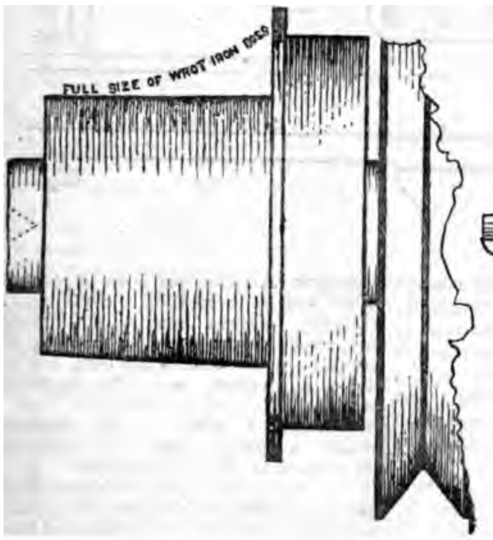
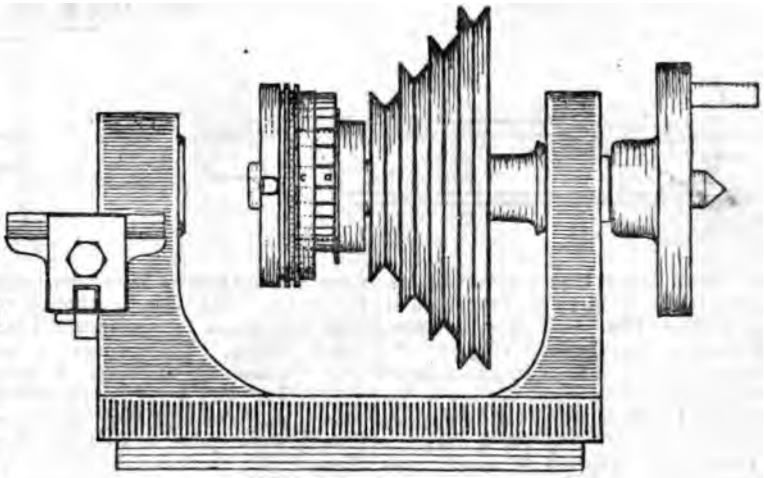
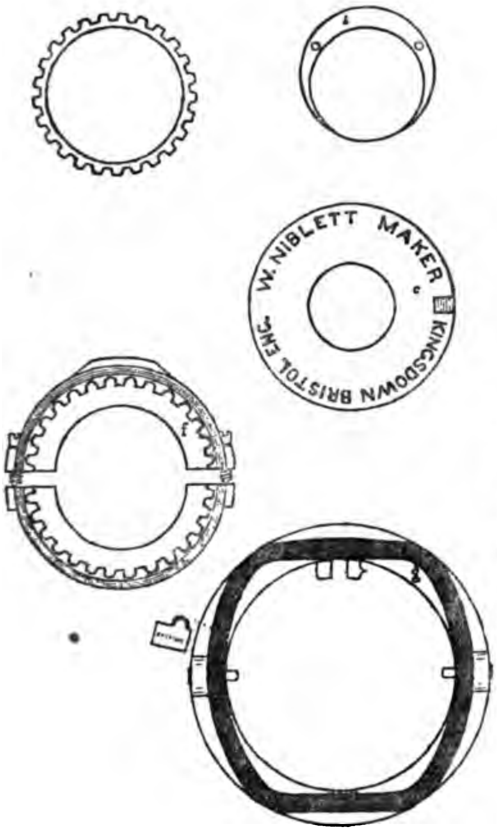


FIG. 5.





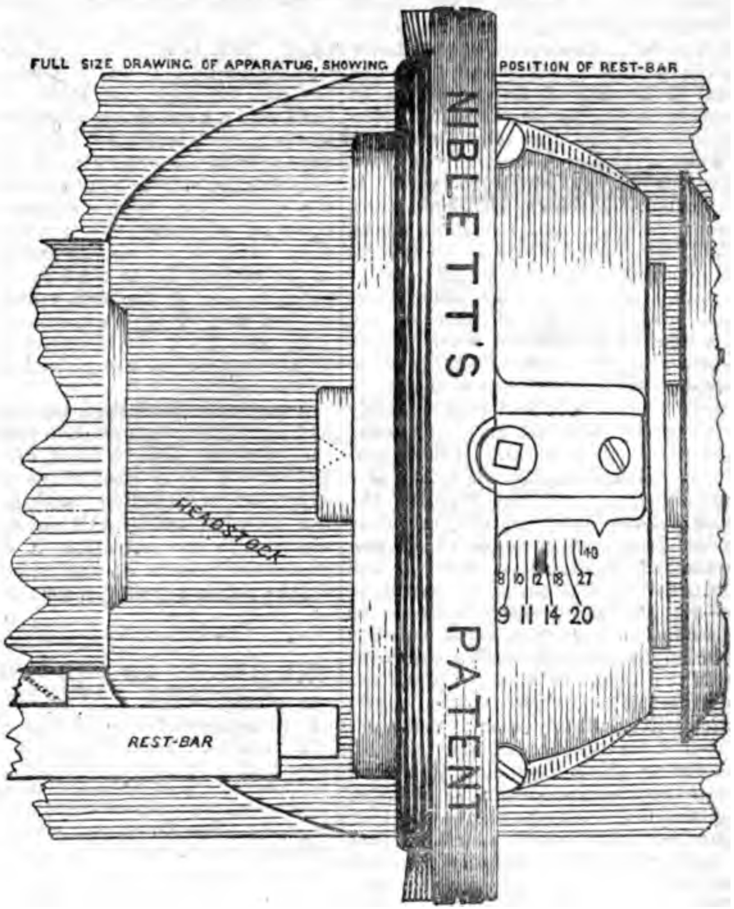
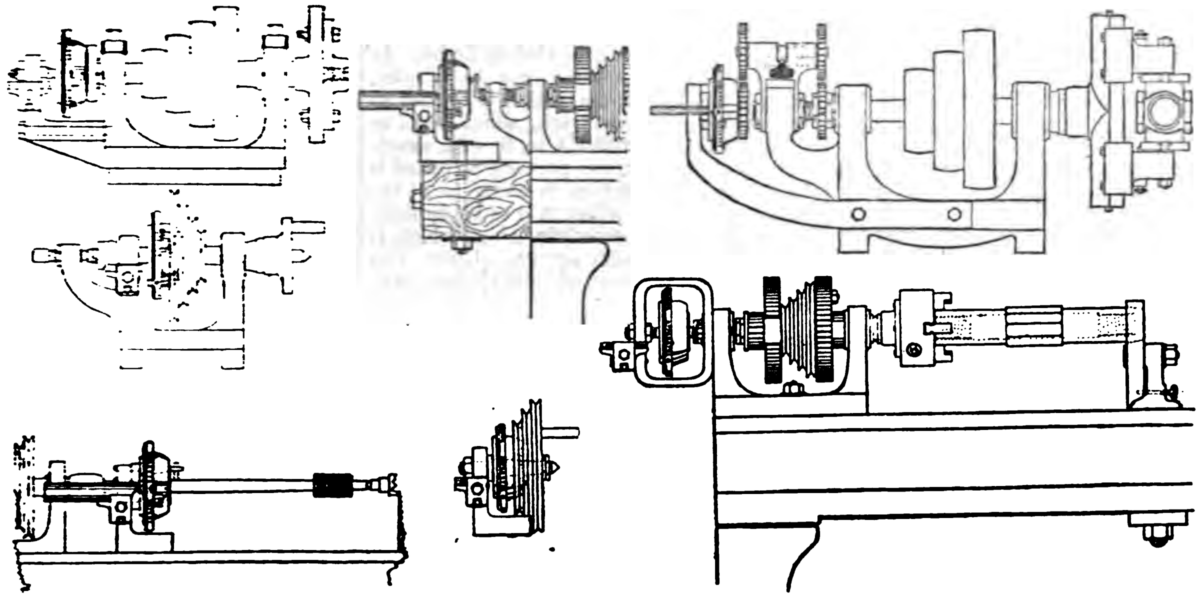

FULL SIZE DRAWING OF APPARATUS, SHOWING POSITION OF REST-BAR
NIBLETT'S PATENT
HEADSTOCK
REST-BAR
40
8 10 12 18 27
9 11 14 20

FIG. 7.

This grooved collar does not fit the eccentric hoop; but the latter oscillates inside it, and when the apparatus is in use the collar is fixed by the sliding forward of the rest-bar into a hole made to receive it. The eccentric wheel then, as it oscillates, comes into contact with this circle of fixed cogs, and is itself compelled to revolve slowly upon the boss. The eccentric hoop cogs are made wide enough to project beyond the grooved collar, the teeth of which therefore only occupy about half of its own, leaving the rest to engage those which are cut inside the outer case, which carries the swash-plate. This case has inside grooves fitting those of the grooved collar, upon which it turns smoothly without shake, the eccentric hoop picking up, as it were, a cog at each oscillation. The outer case is made in two halves, united by a couple of screws, and can be readily opened for cleaning if necessary.

In the full-sized drawing the part marked "Niblett's patent" is an iron or steel ring, seen again in the smaller drawing on the left, with

FIG. 8.



the black barrel-shaped figure upon its face. The pins on which it turns are those seen at opposite points. The black line indicates the back face, and is a raised ridge of the form shown, which is filed to just that curve which will impart isochronous motion to the roller arm and bar described in my first paper. Referring again to the full-sized drawing, which is a view of the apparatus as seen from above, the pointer and scale of screw-threads will be recognised, marking the angle at which the disc is placed. The square-headed screw clamps it in position. A key and wrench to fit the nut of the rest-bar clamp is sold with the apparatus. The mode of fixing given here is that adapted for lathes with one conical collar and a back centre; but there is no pattern of headstock to which it is inapplicable. My own Britannia Co.'s lathe, with double cones, has it as shown here; but Mr. Niblett prefers to reverse the pulley, and thus allow part of it to be placed inside it. In other cases it is not placed on the mandrel at all, but on a bracket behind, and is driven by a pin or catch-plate on the mandrel. It is not necessary, however, for me to particularise all the methods of fitting, which may be safely left to the maker to decide, my object being merely to give such an outline of the invention as may suffice to explain its action as a screw-cutting device. Since writing the first paper I have been carefully repeating experiments long since made as to its usefulness and capabilities, and there is one point in its favour I ought by no means to pass by—viz., the facility which it offers for cutting an inside or outside screw which is limited in length like that inside a box-cover or outside the tenon of a box. When the tool is once set to cut to the required depth, the motion will absolutely cease at that point which cannot be overrun, as, after a short interval, during which the tool is just eased out of contact, the motion will be reversed, carrying the tool back again; it will then again stand still, after which it will advance in the old cut, and to precisely the same distance. Not the slightest attention need be paid to the disc and the roller arm, and all that is needed is to place the tool each time so that it will cut to the right depth, and for this I would again remark, as a special feature of the apparatus, that the total cessation of action after each traverse gives ample time for the most accurate adjustment. It will be a great mistake if this invention does not meet with support. The facility which it offers for copying any screw is very great. I have tried it myself by moving the pointer to a point between two of the marked divisions, as I happen to have two hand-chasers for a ¾in. bolt, which, though nominally alike, are not so in reality, and I can readily match either. This would be impossible with a traversing mandrel. I have not a V-tool for soft wood screw-cutting; but such a tool could be very easily used, and should work quite as well as an ordinary chaser.

Mr. Niblett states that, as soon as the lead is obtained, the screw is to be finished by hand. This is under-rating the powers of the apparatus. I find it perfectly easy to continue the cut to the entire depth, and I have used a hand-chaser after getting a true lead, and then laid it down and taken a finishing cut with this apparatus, as the most delicate shaving may be removed, the motion of the lathe being also continuous, which is again an advantage over a traversing mandrel. But, of course, its great advantage in this respect, lies in the fact that it can be fitted to any of the plain lathes that are in general use. I have experimented successfully also on a double thread, fixing the pointer for six, and using a tool to cut twelve to the inch.

I must now leave the invention to its fate, and for further information refer readers to the patentee, Mr. Niblett, of Kingsdown, Bristol. A good deal of money has been expended in devising machinery for its manufacture, and if this novel contrivance meets with the attention it deserves, the productive powers of that same machinery will be put to a pretty severe test.

O. J. L.

THE REPORT ON THE WORKING OF THE NEW PATENTS ACT.

AS mentioned last week, the report of the Board of Trade Committee appointed to inquire into the working of the new Patents Act has been published, and now that it has been examined, it is seen that it will not satisfy anybody. The Committee make certain suggestions, and recommend, if they are carried out, that another committee should be appointed to make a further inquiry. As briefly stated last week, the Committee recommend that the system of examination of specifications, in order that applicants might be informed if anything similar had been received, but not published, should be dropped, as it has not worked satisfactorily, and involves the expenditure of several thousands of pounds yearly in paying examiners who would be more profitably employed in bringing up the abridgements to date, and in doing other work which has fallen into arrear at the office. At first sight it would seem that an applicant should be informed if a previous specification embodying
the same invention has been deposited w
what may be termed the "close time," o
interval between receipt and publica
because he has no means of knowing whet
similar specification to his own has not
deposited within, say, the previous tv
months, and may, therefore, be wa
his time and money on an invention
which a patent will, in ordinary co
be granted to the first applicant. In prac
it has been found impossible to derive
cient information from the provisional sp
cations to carry out the intention of the fra
of the Act, or rather of the special cl
referred to; for notices of interference
been forwarded to subsequent applicants,
eventually the inventions, though si
enough in the preliminary descriptions, tu
out to be very different, and, on the other
the office has sometimes failed to detect, o
omitted to give notice, that a subsequent a
cation was identical with one already rece
If the scheme of giving notice could be
ciently carried out, it would be of adva
to intending patentees; but, after he
evidence, the committee consider that i
worked rather mischievously than other
and they consequently recommend that
practice should be dropped. As a substi
however, they suggest that if the subseq
applicant should find that he has been
stalled by a prior applicant, any fees pa
the office should be returned on notice l
given of the abandonment of the applica
say, within two months of the grant o
patent. Possibly that may be the bes
rangement from the point of view of the
mittee; but it is easy to conceive that it w
be better to insist upon the provisional sp
cation disclosing the nature of the inve
in such a manner that an experienced exa
could determine whether or not it di
terfere with a prior application. I
however, a difficult matter to decide,
it is obvious that the mere permission to
any warning or information from the
may open the door for underhand proceed
With reference to the examination of
specification for form and completenes
which cases, when objection is made, appli
are allowed to amend, abuses have undoub
been perpetrated, and the committee co
that unless the amendment is made withi
month the patent should be granted only
the time when the application is made
formable to the rules, and not from the
of the original application. On reflecti
will be seen that those defects woul
obviated if the provisional specification
more complete, or the applicant were
pelled to state at once exactly what he cla
for, as matters are, provisional specifica
are sent in in the vaguest terms, and then
they are returned for amendment the a
cant can embody in his final specificatio
information which he may have been ab
glean from published specifications of a

ıan his own application. Evidence that
practices have been pursued has been
›ming, and the committee accordingly
ıt the "complaints are to some extent
›unded, and that, at all events, there is
from an indefinite time being allowed
.endments." Writing soon after the Act
ssed (p. 590, Vol. XXXVII.), we said :—
re inclined to believe that the examina-
ill in practice be a farce, and that the
result of the clause in the new
rill be to provide fairly comfort-
.tuations for 'examiners,' who will per-
their duties in the most perfunctory
r possible." On p. 73, referring to the
roposal to disclose the specification before
ng the patent, in order that opponents
be able to see what they had to oppose,
›te : "It will never do to expose an inven-
.nd then invite those who may be inter-
› attack it ; for they may discover their
› in the facts stated in the specification,
›viously no invention would be worth
ng if it were exposed before patenting to
nterested in opposing it, especially as the
›n of patent or no patent will depend on
cision of the law officer. It would be
› leave this part of the subject as it is at
." The committee have discovered that
ıblication of specifications before the
is granted is a disadvantage, and has
the door to abuse ; but instead of boldly
›ack to the old system they recommend a
ıtion of the time during which a specifi-
may be amended. The system of exami-
has, in fact, failed at all points, for it
luced a number of inventors to draw up
wn specifications, and the consequence
many patents have been granted on
ations which would be utterly value-
a court of law—the office not having
l that the claims should be properly
ated. Thus, to take an instance, the
›r of an improved flying machine, the
for which was sealed only at the
ing of the present year, claims :—"1.
his machine can be used to carry mes-
n a quicker manner than any other in-
until now known. 2. That I am the
nd sole inventor." It might be per-
y urged that in this case it does not
matter what form the "claim" takes ;
is an instance of the character of the
ıation carried on by the office, and of
ınders committed by many who make
ir own specifications instead of employ-
perts. We have no doubt that many
ienced applicants, relying upon the
ınt that specifications are examined by
ce, have sent in specifications which are
worthless, and the committee would
› have acted wisely if they had boldly
l the abolition of examination altogether
g that in the one case where it might
ul to applicants they confess it cannot
ied out ; while on the other points the
as at times interfered vexatiously, and
ers allowed the vaguest provisionals to
ıd be followed by very comprehensive
te specifications. It is no part of the
s of the office to dictate to an
ınt what he shall claim ; but it is its
tive duty to see that a complete
ation does not go further than
nvention shadowed forth in the
onal. The officials know very well that
iderable number of the specifications
they have to pass could not be main-
in a court of law ; but the majority of
›ecifications are sent in by inexperienced
who have some idea that if they are
d by the office they must therefore be
ıt. Applications for patents and specifi-
describing inventions must be made in
form and manner, and the examination
he office should be called upon to perform
that these forms are adhered to ; if any
nent is required it should be made at
the patent should date from the time
amendment. The report of the com-
leals with some minor matters—notably
gestion that a "roll" of patent agents
be formed, but the evidence which ac-
ies it, and the recommendations of the
sioners, show conclusively that the
ıich is little more than three years old,
already been amended in some details,
further amendment—this time of a
character. What we prognosticated on
Aug. 31, 1883, has been abundantly borne out, for we then wrote, "while inventors have cause to be thankful for the reform, we think they will speedily discover that in some respects the new Act is not by any means an improvement." They did discover its defects, the committee was appointed, and the results are the recommendations above mentioned. What will follow remains to be seen.

SIMPLE EXERCISES IN TECHNICAL ANALYSIS.—XX.

By an Analytical Chemist.

Neat's-Foot Oil.

(276.) THE presence of fat is objectionable in oils intended for use as lubricants ; although it is not unusual to meet with oils which consist almost entirely of solid fat at ordinary temperatures.

(277.) *Sp. Gr.*—Usually stated to be ·914 to ·916. The lower limit is seldom reached, however, in commercial samples ; and ·915 to ·917 appear to be the more usual gravities, as shown by the following table :—

Sp. gr.	·914	1 per cent.
	·915	19 „ „
	·916	27 „ „
	·917	15 „ „
	·918	11 „ „
	·919	8 „ „
	·920 and upwards.	19 „ „ (Adulterated or entirely solid at ordinary temperatures.)

(278.) *Rise of Temp.*—This varies considerably, as might be expected ; but 75° Fahr. to 80° Fahr. may be taken as a fair average rise.

(279.) *Cooling.*—Much fat should not begin to deposit above 30° Fahr. ; but as before stated, it frequently does at ordinary temperatures. If the oil is not required for lubricating purposes, it should not be condemned because of the presence of fat at temperatures even somewhat below the ordinary, because there is no good reason for supposing that a mixture of oil and fat is not as suitable for leather-dressing as a clear oil would be. In judging, therefore, of fitness or otherwise, the intended use should be always kept in view, and also the price of the oil.

(280.) *Drying Properties.*—Neat's-foot is a non-drying oil, and gives in the Elaïdin test a yellowish white solid.

(281.) Neat's-foot oil is of a pale yellow colour, fatty odour and taste.

(282.) *Colour Test.*—With sulphuric acid, a brownish orange, or faint chocolate clot is produced.

(283.) *Acidity.*—The free acidity in neat's-foot oils is often considerable, and, of course, always objectionable when the oil is required for lubricating purposes. It may vary from mere traces to ·96 per cent. calculated as acetic acid. The effect upon copper should also be determined in oils intended for lubrication. (See Art. 246.)

Lard Oil.

(284.) This oil has a sp. gr. of ·917, gives a rise of temperature of 108° Fahr., and begins to deposit solid fat a little below the freezing point. It usually contains about ·15 per cent. of free acid (calculated as acetic), and under the action of hyponitrous acid is readily converted into solid elaïdin. It is not examined frequently, and the above are the results of a limited experience.

Sperm Oil.

(285.) *Sp. Gr.*—Although the sp. gr. is usually given ·875 in the textbooks, the following is the result of the writer's experience :—

Sp. gr.	·876	8·75 per cent.
	·879	8·75 „ „
	·880	17·5 „ „
	·881	43·0 „ „
	·882	17·5 „ „
	·884	4·5 „ „

So that 78 per cent. of the samples examined fell between the gravities of ·880 and ·882. These figures show either that the standard gravity or the quality of commercial samples is too low.

(286.) The rise of temperature varies from 70° to 79° Fahr. Genuine oils are fluid when cooled to 48°, and do not begin to deposit fat until 45° Fahr. is reached.

They slowly form a solid elaïdin with hyponitrous acid, and a yellowish brown clot (free from purple tinges) with sulphuric. The free acid varies from ·04 to ·08 per cent., and the action on metals is therefore scarcely perceptible. Its viscosity is low, its tendency to develop acid is slight ; but its high solidifying point reduces its value as a lubricant.

Cod Oils. (*Pale and dark brown.*)

(287.) *Sp. Gr.*—The following are the results obtained :—

Below ·922	7 per cent.
·922 to ·924	40 „ „
·925	7 „ „
·926 to ·928	27 „ „
·929 and above	19 „ „

All these oils were intended for leather-dressing purposes, and are in no way comparable with the cod-liver oil for medicinal use.

(288.) The rise of temperature in a large proportion of the samples was between 140-150 Fahr., and in another large proportion between 160-170 Fahr. In cold-drawn oils fat does not begin to deposit above 20° Fahr. The colour with sulphuric is some shade of brown—sometimes reddish, sometimes chocolate, and not infrequently with a violet tinge. The free acidity varied from 0·16 to 1·16, and oils with the higher acidity do not appear to have any very injurious effect upon leather.

Seal Oil.

(289.) The sp. gr. varied between ·925 and ·927 ; the free acidity between 0·08 and 0·4 ; concentrated nitric acid gave a reddish pink colouration ; and concentrated sulphuric a faint violet tinge rapidly changing to brown.

Whale Oil.

(290.) Sp. gr. varied between ·925 and ·938 : the rise of temperature with sulphuric was about 161° Fahr. ; the colour with sulphuric, reddish brown gradually deepening to dark chocolate ; the free acidity about 0·4.

(*To be continued.*)

ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS.—XIII.*

By S. R. Bottone.

Ammeters.

§ 49. THESE instruments are intended to measure the amount of current in ampères passing through any given circuit. One ampère of current, passing through a solution of sulphate of copper, is capable of depositing 17·35gr. of copper per hour.

To make such an instrument, suitable for the general purposes of the amateur, and capable of reading from 1 up to 5 or 6 ampères, the following mode of procedure may be adopted :

§ 50. Procure a square piece of deal 4in. × 4in. × ½in., smoothly planed up ; also a glass-capped circular cardboard box, 3in. diameter by 1¼in. deep, inside measure. (Such boxes are sold by mineralogists, &c., for preserving specimens.) Push the cardboard bottom out of the box. This bottom may be used as the "dial" whereon to inscribe the degrees of current. Stain the wood black, or any desired colour, and varnish it. Now trim the edges of the bottom of the box into an exact circle, capable of entering *easily* into the box from which it was removed. Describe near its circumference three circles in ink with a pair of compasses. Let these circles stand about ⅛in. from one another. Describe also a small circle about a ¼in. diameter in the centre of the card, to serve as a guide for a central hole, which must be punched out with a ¼in. circular punch.

§ 51. Now make a small glass pivot, as described at § § 5 and 6, about ⅜in. long, and not more than ⅛ in. diameter at its base. When made, test it for freedom and absence of friction by poising it on the point of a very fine needle, the head of which is stuck in a bung. If it spins round quite freely without any hitch, well and good ; if not, make others until you get one *perfectly freely suspended.* This is most essential.

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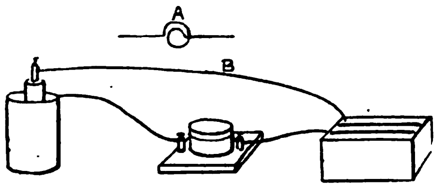
* All rights reserved.

Procure a strip of copper sheet, about $\frac{1}{20}$in. thick, 4in. long, and ½in. wide. Punch three ⅛in. holes in it, one at each extremity, wherein to pass the binding screws, and one in the centre. Lay this strip on the little wooden square, across its centre, and screw it down to the square by means of two small binding screws, taking care that there is space left for the cardboard box to stand between them without touching either. Now stick a fine, bright, and sharp No. 8 needle, point upwards, into the centre of the square, just where you have punched the central hole in the copper strip. Care must be taken that this be perfectly perpendicular, and clear the glass top of the capped box by about ¼in. when this latter is placed over it.

§ 52. With a pair of round-nosed pliers, make, from a short piece of No. 16 pianoforte wire (steel), a single coil to fit tightly round the base of the glass pivot, having a straight ⅛in. prolongation on either side of the central loop or coil, as shown at Fig. *a*. This must be thoroughly magnetised by rubbing with a good horseshoe magnet, and then fastened with a drop of glue to the base of the pivot, extreme care being taken that no glue touches the rim of the pivot, otherwise it will not hang freely. The pivot must now be placed on the needle in the centre of the square and the punched circle, which is to serve as a dial, held over it, and lowered down over it until the point of the pivot protrudes about ⅛in. above the central aperture, and the magnetised needle below clears the card also by about ⅛in. The dial is to be fixed in this position by gluing three corks of the right height to the square, and then gluing the card on to them. Here again care must be taken that the pivot does not touch the card dial at any point, and also that the magnetic wire needle below is clear of the dial.



A small *pointer* in black paper, straw, or any other very light rigid material, about 1¼in. long, is to be lightly glued to the top of the pivot *at right angles to the needle* below. The glass-capped box may now be placed over all, and glued to the square by running a little thin glue round its bottom edge. When quite dry, the grading may be proceeded with.

§ 53. To grade correctly, at least 10 quart Daniell cells will be needed. These must be freshly made up, and filled to about half their capacity. A decomposition cell (a stoneware basin or foot bath will do), capable of containing two squares of copper sheet, facing one another, at least 6in. × 6in., must next be provided, and filled with a strong solution of copper sulphate slightly acidulated with sulphuric acid.

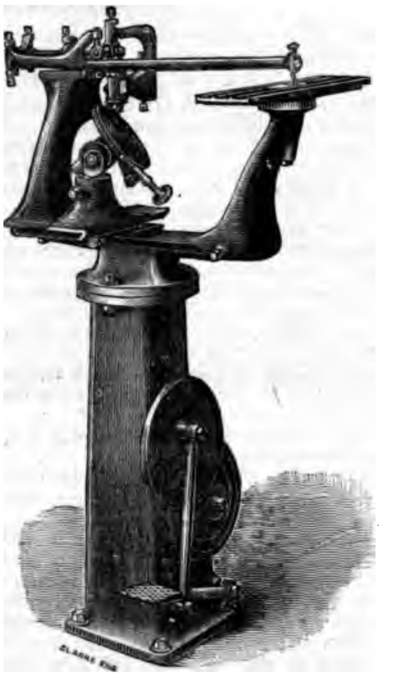
The copper plate which it is proposed to attach to the negative pole of the battery (the zinc end) having been carefully weighed in a balance capable of turning to the $\frac{1}{100}$ of a grain, and its exact weight noted, a Daniell cell, the ammeter, and the decomposition cell are arranged in series as shown at *b*, and allowed to work for one hour exactly. At the end of that time the copper plate is withdrawn, washed (not rubbed), and dried. When dry, it is weighed, and the increase noted. If exactly 17·35gr, well and good; if not, alterations must be made until the deposit reaches exactly this amount.

Should the deposit be *less*, then approach the plates in the decomposition cells, and add more fluid to the battery cell, until the deposit reaches exactly the 17·35gr. per hour. If the batteries are less than quart cells, two may be needed to produce the desired result. Should the deposit be *greater*, remove the plates in the decomposition cell farther apart, in either case carefully noting the distance. Once the desired result attained, the greatest care must be taken to maintain all *in statu quo*, and the exact position of the two copper plates in the decomposition cell being marked, the temperature of room taken, the height of the fluids in the battery cell, or cells noted, &c. One pole of battery is now detached from the ammeter, and this latter moved round until the magnetic needle lies quite parallel with the copper strip, hence the pointer exactly at right angles to it. The spot at which the pointer stands is marked with O. The battery is again attached to the ammeter, and the deflection, when the needle comes to rest, noted. This deflection corresponds to 1 ampère of current, and should be marked as such on the dial. To get the corresponding deflection on the other side, the poles of the battery must be reversed.

All the other degrees may be got in precisely similar manner, multiples of 17·35gr. of copper being considered and counted as so many ampères, more cells being connected up, *in parallel* to obtain the desired weight of deposit per hour.

NEW MACHINE FOR ENGRAVING AND DIVIDING.

THE machine illustrated in the annexed engraving has been produced for cutting designs, letters, and figures on metals, wood, ivory, glass, vulcanite, and other materials; for straight dividing, and circular dividing on flat, bevelled, or cylindrical surfaces. As shown in the illustration, a copy of the design to be cut is placed on the table supported at the right-hand end of the bed. The copy itself may be a line drawing on paper, or preferably a line engraving on hard wood, vulcanite, or metal. For simple lettering and figures, a standard hard brass copy is used, and is set up in grooves in the table. The style shown on the right is moved by hand along the lines of the copy, and by a simple system of levers (forming in effect a common pantograph) guides a vertical revolving cutter in a similar path over the surface to be engraved. The cutter runs at a high speed, and may be of any form suited to produce the required effect. For simple lettering on finished work, where no burr is admissible, it takes the form of an ordinary flat double-edged drill, which makes a clean, brilliant cut. Lettering to be filled with wax is best effected by a longer-pointed drill, leaving the sides of the cut steeper, and the bottom sufficiently rough to hold the wax. The cut, in fact, may be of any form—circular, bevelled, rectangular, or even dovetailed. Dividing is done with a very long-pointed drill, a square cutter, or a simple point, according to circumstances. The cutter may be revolved by the treadle motion shown (the gut band and guide pulleys being omitted for clearness), or it may be driven by power, for which purpose a special countershaft is made. The work to be operated on is secured to the table shown in the middle of the bed, which can be raised or moved in any direction, and firmly held where necessary. The swivel joint is used for working on bevels. For circular dividing, the work is chucked centrally on the table, which can be revolved by a tangent screw. The number of teeth to the worm is suited to requirements, and when more than one number is necessary, special arrangements are adopted. A spring catch determines the proper amount of revolution of the screw. A quick withdrawal is provided for lifting the revolving cutter when it is necessary to start working at fresh points, and the cutter is readily replaced at its original depth. The spindle runs in its own lubricator. The machine is specially adapted to cutting names, trade-marks, lettering, and figures on instruments, tools, dies, name-plates, &c., as it will operate on anything, from beech wood to cast steel. As a dividing machine, it is suited to producing indicator dials for scientific instruments, gauges, and many other purposes, and all necessary lettering and figures may be cut at the same setting of the apparatus. We have seen specimens of the work done by this machine, which is made by Messrs. Taylor, Slate-street, Leicester, on view during the present month at the agent's, Mr. Martin, Birkbeck Institution, Bream's-buildings, Chancery-lane, E.C., and can recommend it to the attention of all who have quantities of engraving or lettering to do, as no special skill is required, while the work is accomplished rapidly and satisfactorily.

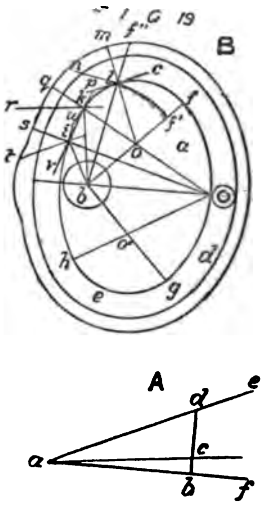


THE THEORY OF MACHINES.—V.

By Francis Campin, C.E.

Grooved, Face, and Box-Cams.

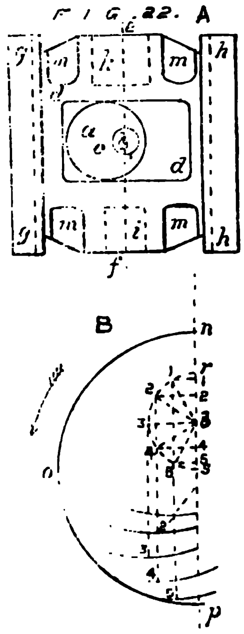
IN movements where no heavy work is to be done, the friction is not a matter of great importance, except as it affects the wear of the machinery; but where considerable power is being transmitted, the designer of cam and similar combinations should, as far as circumstances permit, arrange for the most favourable angles of friction to coincide with the points of greatest pressure, as the resistance of friction is proportional to the insistent force upon the surfaces of contact. Let the angle made by the lines *a e*, *a f* at A, Fig. 19 represent any limiting angle of friction. In *a f* take any point *b*, and draw *b d*, meeting the straight line *a e* in the point *d* at right angles to *a f*; then it has been shown (in Art. II.) that the ratio of *b d* to *b a* represents the co-efficient of friction; hence the co-efficient being known, the limiting angle may be set out. Thus the co-efficient for lubricated surfaces being 0·1, mark off from *b* upon *b d*, $bc = \frac{ab}{10}$, then will the angle *b a c*, be the limiting angle of friction for such surfaces of contact.



$\frac{bd}{ba}$ is called, mathematically, the tangent of the angle *e a f*, so the co-efficient of friction for any pair of surfaces being given, the limiting angle of friction may be obtained from inspection of any table of *Natural Tangents* (to be the semi periphery of the eccentric in its lowest position. *r*, 1, 2, 3, 4, 5 *s* show the path of the geometric centre of the eccentric during half a revolution. The top and bottom of the box *d d* are assumed to be made at right angles to *e f* or to *n p* in the diagram B. The semicircle *r* 3 *s* is divided into six equal parts corresponding to six positions of the eccentric, 1, 2, &c., and the lowest points which will necessarily be also the points of contact of the eccentric with the bottom of the box *d d* are indicated by the figures 1', 2', 3', 4', 5', and through these points the vertical force will be communicated to the box *d d*. These points are found by drawing the lines 1, 1', 2, 2', &c., from the geometric centres of the eccentric in each position parallel to *n p* until they meet the arcs corresponding to the lower parts of the periphery of the eccentric for the same positions.

The distances, then, at which the driving force acts upon the bottom of the box *d d*, with regard to the centre *b*, will be represented by the lines 1, 1, 2, 2, &c., drawn at right angles to the lines 1 1' 2 2', &c., therefore dividing the moment of driving force, which is taken as uniform for the half-revolution, by these distances the pressure upon the eccentric box for each point is found.

FIG. 22.



Let the mean moment of driving force equal 7,000ft.-lb. The radius of the semicircle *r* 3 *s* is 2in., the whole stroke or travel of the punch being, therefore, 4in. The distances are 1, 1, and 5, 5 = 1in. 2, 2, and 4, 4 = 1·733in. 3 *b* = 2in., or 0·083ft.; 0·144ft., and 0·166. The vertical pressures will, therefore, be respectively $\frac{7,000}{0·083}$ = 84,000lb.; $\frac{7,000}{0·144}$ = 48,611lb.; and $\frac{7,000}{0·166}$ = 42,000lb.

From these numbers, it will be seen how rapidly the pressure is increased towards the end of the strokes, which is a great advantage, as it is towards the end of the stroke that the work is done.

Theoretically, the pressure would become infinite at the end of the stroke: hence the work should be finished a short space before that point is reached, as, in case of some unusual obstruction occurring, the machine, if at that point, would, instead of being stopped by it, destroy itself, provided the resistance were sufficiently solid.

PORTABLE PHOTOGRAPHIC APPARATUS.

AMONGST recent inventions in portable photographic apparatus, we note the improved pocket cameras, which form part of a patent ([illegible], 1886) granted to Mr. W. H. Payne Gallwey, of Chelsea. The camera consists of the usual lens and box with a "shutter," by which an instantaneous or prolonged exposure of the sensitive plate may be readily effected, with which is combined a duplicate camera and field plate, adjacent to the photographic camera, by which a duplicate field may be rendered visible to the eye of the operator in use, similar to that which is thrown upon the sensitive plate of the photographic camera. Both lenses are simultaneously focussed by means of an ordinary tangent pinion and rack. This arrangement serves the double purpose of easy adjustment to any required focus, whilst at the same time, by the withdrawal of the lens-piece, the external dimensions of the camera are much reduced. A spring shutter is fitted to the mouth of the lenses, so that when withdrawn the shutter closes over them and protects them from dirt. The eyepiece of the field-finding camera is telescopic, and flies out to its proper position when a detaining dedent is released. Within the photographic camera box is placed the "shutter," which is in the form of two hinged doors supported on parallel axes on one of each of their respective edges, and placed at right angles to one another, so that when one of the shutters—say that in a vertical plane—is rotated on its axis, and thus exposes the plate behind it, the other shutter—say that in the horizontal plane above the vertical shutter—is actuated by a spring, so as to fall rapidly, and immediately thereafter close the aperture. To the axis at the lowest edge of the vertical shutter is fitted a milled thumb nut, brought outside the box, and fitted around its axis with a spiral spring, which serves to bring the shutter always to its normal closed position in a vertical plane. The axis of the upper horizontal plate is also provided with a spiral spring, tending to make it close into a downward vertical position. A quadrant is affixed to this axis, bearing with its corner upon a grooved cam upon the axis of the other shutter. When the camera is set for operation, the lower shutter stands in a vertical plane, closing the aperture. The upper shutter is then set by hand against the reaction of the spiral spring, so that it stands horizontally, with the quadrant on the axis of the upper shutter pressing against the cam on the lower axis. Upon rotation of the lower axis, either by hand or automatically, the sensitive plate is exposed until the cam allows the upper shutter to fall by the reaction of the spiral spring, when the aperture is at once closed. It may be noted that this combined shutter cannot be left open by accident and thus spoil a plate. For the storage and supply of the sensitised plates, the patentee attaches to the side of the camera a cylindrical drum. This drum is provided with a series of grooves round the interior of the outer wall of the box, and around the interior boss, through which a stud fixed to the camera passes, by which the box is attached in place upon the camera. The grooves are so arranged relatively to one another that the sensitised plates are arranged partially tangentially to the inner boss, and a considerable number of plates is thus accommodated in the box. The box is also provided with a series of indents in an external flange corresponding in number to that of the sensitised plates, with an additional serration corresponding to one blank space left solid between the boss and periphery in the body of the drum. The cover of the drum towards the camera is fixed relatively to the camera (the drum being free to revolve upon its central axis), and is provided with a slot corresponding in size to the edge and in angle to the position of the sensitised plates in the drum. This plate or cover is also provided with a spring catch engaging in the serrated flange on the body of the drum, in order that the position of the drum, when rotated, may always be exactly determined, so that the divisions in the drum are exactly opposite to the slot in the fixed plate. The slot in this slotted plate or cover is caused, when fitted to the camera, to correspond exactly to a slot in the side of the camera box, such slot being normally covered by a slotted sliding plate, which may be withdrawn or moved so as to cause all the slots to coincide, by means of a spring handle outside the camera box. When it is desired to supply the sensitised plate to the camera, the sliding plate is withdrawn or moved, so that the slot in the sliding plate coincides with the slots in the drum and the camera, and a sensitised plate can then be delivered by gravity into the camera. When the photograph has been taken, the plate can be returned by tilting the negative plate into its own compartment in the drum. The drum is then rotated through an arc corresponding to a division, so that the next sensitised plate coincides with the position of the slots ready for the next photograph. The serrations on the external flange of the drum, corresponding to the sensitised plates, are all numbered, and one serration bears the words "drum shut," indicating that position in which the slot of the rotating cover is opposite to the blank partition in the drum. A catch and pointer are provided, affixed to the camera, to indicate the successive numbers. This catch prevents the drum from being removed from the camera until the said pointer is engaged in that serration corresponding to the words "drum shut," in which position the drum cannot be turned any further (which avoids danger of double exposure of any plate), and may be removed, entire and closed, from the body of the camera, by the release of a nut. A duplicate drum may then be attached with a fresh supply, or the plates may be removed in a suitable manner, and a fresh supply of sensitised plates be introduced. It will thus be seen that as the drum can only be removed from the camera in the one position, namely, when the delivery slot is opposite and closed by the blank metallic partition in the box, absolute security is afforded against the admission of light to the sensitised plates.

THE LANTERN MICROSCOPE.*

SOME eight or ten years since I felt dissatisfied with the results which I was then able to obtain with the ordinary lantern arrangements for projecting microscopic objects upon the screen, and began to make experiments with the aim of getting more successful illumination. The amount of light transmitted through the bi-lens lantern condenser being in the inverse ratio of the square of the distance between it and the luminant, I tried to shorten the space b, the well-known device, first introduced by the Rev. W. T. Kingsley about 1855, of adding a third lens to the other two, and thus shortening the compound focus. But this I soon found was, without further addition, of no use whatever, as the cone of rays at its apex was so large, or the light passed through it at so great an angle, that it was impossible to transmit it through both the object and objective. Thus the beam of light, however strong it might be at the focus of the condenser, did not reach the screen, and therefore served no purpose except that of boiling the object in the balsam used in mounting it. I next placed another lens in the cone of rays a little beyond the focus, and hoped by this means to so lessen its diameter as to make it capable of transmission. This was a sort of substage arrangement, and was found to be a great improvement when the lens was of the right focus for the objective, and was situated at the right distance from both it and the object. To be able to thus place it at the right distance from both, meant having a sub-stage lens for all objectives differing widely in power, the focus of each being such as the power and construction of the others might require. Rack-and-pinion movement was also found to be necessary, so that the rays might be properly focussed on either side of the object. The lenses used should be large enough to take in the whole cone of the principal condenser, and for the higher powers it is requisite to combine two or three of them together. The highest as well as the lowest powers may thus be made useful for lantern projections. Mr. Kingsley stated in his paper upon this subject at the time I have just named, that he could transmit as much light through the higher as through any of the lower powers, and gave diagrams of the arrangement which he made use of.

So much for the past; now we come to the present. The objectives which I shall use this evening are 2in., 1in., and 1/10in. The 2in. requires the sub-stage lens to be a little over 2in. focus, 1⅜in. diameter, plano-convex. A similar kind of lens, 1½in. focus, proves in my hands to be a good all-round condenser for all powers from 1½in. up 1/10in. objectives. By liberal use of the rack and pinion and of the concave lens to be presently described, this sub-stage lens gives the most brilliant results throughout this wide range of powers. The ¼in. objective, when it is desirable to use it for photographic purposes, requires two lenses; the back one to be 2½in. focus and 1⅜in. diameter, and the front one 1¼in. focus and 1in. diameter, both plano-convex. This also makes a good condenser for the 1/10in. objective. All the lenses must have the curved surfaces turned towards the lantern. The luminant goes to within 1¼in. of the back lens of the principal condenser with the 2in., and to within 2in with the other two objectives. I have tried it closer than this, by using a back lens of shorter focus without advantage, in fact, considerably otherwise. If a flint concave lens is placed in the cone of rays about 1in. or 2in. before the really active ones begin to cross, the light is much improved. The concave which I use is about 6in. focus and 1¾in. diameter. It is so placed in the tube which carries the other sub-stage lenses that its distance from the principal condenser can be altered so as to modify the length of the cone of rays to adapt the focus of the other lenses to the objective when they do not exactly meet its requirements. My lantern condenser is 3¾in. diameter, with a plano-convex 3½in. diameter and 7in. focus, mounted upon the back of the tube which carries the other lenses.

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* Extracted from a paper by W. LEACH. Read before the Manchester Microscopical Society.

In lantern microscope projection three things are essential. The first is brilliant illumination, the second large amplification, and the third clear display of detail. But brilliant illumination does not mean a dazzling display of light upon a large white screen, showing a dark, patchy outline of an object, without detail. Objects shown in this way are far inferior to an enlarged woodcut. The light must be made to enter the object so as to bring its structure out to the eye of the onlooker. But no amount of light will do this if its dimensions are too small for the crystalline lens to form an image of it upon the retina. With high-power objectives the light must, in the nature of things, be greatly subdued. Still, a large image, moderately but properly lighted, can be far better seen than a small one many times as bright. An object may in fact be too bright to be seen. If rays of great angle are too powerfully converged upon it, the image becomes as bright as that part of the screen which represents nothing but bare glass. It is in this case just like an over-exposed photograph, flat and without contrast. The image may, therefore, be too bright for the screen, just as it may be too black for it, and what we have to aim at is that mean which will show the detail in one without making the other too glaring. Having made our arrangements according to what is here advanced, we ought to be able to show the various minute organs of insects and the details of vegetable and animal tissue. I have shown very finely the blowfly's tongue over 16ft. long, and the male flea with its outstretched legs 12ft. long. Sections of spine of echinus may be magnified to 7ft. or 12ft. diameter, and section of a rat's tail 8ft. diameter. Mites in cheese with such powers become large as guinea pigs, and *Volvox globator* gracefully rolling over a 16ft. screen are larger than tennis balls. The cornea of the Dytiscus is a most wonderful object when shown 8ft. to 10ft. diameter.

Since the foregoing pages were written I have fitted up a 1in. objective which is very satisfactory. It transmits a large beam of light, and gives a flat field of great size, the central and marginal definition being fairly good at the same time. As a rule, the best ordinary objectives give no definition beyond a small circle in the middle of the field.

THE CONSTRUCTION OF ELECTRIC MOTORS.

AMONGST the papers read at the recent Electric Light Convention held in Philadelphia, was an interesting contribution to the principles of electric motor construction by Mr. Stephen D. Fields, from which we extract the following:—

Almost all the modern dynamos are based upon the inventions of Pacinotti and Alteneck, and between the relative merits of the two inventors I believe there is no choice; that is, with the same amount of wire and iron equal results either as a generator or motor will be obtained for the same expenditure of power. Much, however, depends upon the disposition of the wire and iron, an apparent advantage of one system over the other may easily be shown should the two elements not be placed to their greatest working advantage. A marked analogy is seen between the behaviour of a magnetic and an electrical circuit, and pole pieces of dynamos are made of greater section than the magnet cores, with a view of diminishing the air resistance between the armature and the field magnets. I believe that lamination of the pole pieces of a dynamo is of benefit in exposing a larger surface from which the lines of force may flow, and diminished heating results from this fact, and not from the suppression of Foucault currents, as has been by many assumed. It is difficult to see how Foucault currents could be generated in a piece of iron which is sensibly constant at all points to the flow of a steady current.

In the earliest forms of electric motors direct magnetic attraction and repulsion was employed. Experience with this form of motor shows that the greatest effect is obtained when the armature is polarised to an exact equality with the fixed magnet. A somewhat similar relation of parts can be found in the modern motors. It would seem that the greatest amount of work will be obtained with a given current when the armature and field have equal magnetic strength. I imagine that a great loss occurs when the field magnet does not have properly polarised armature to act upon. A good dynamo electric generator is one having the least possible amount of wire on its armature to produce a given current. The best motor is one that has a sufficient amount of wire on its armature to bring it to a magnetic strength exactly equal to the polarisation afforded by the field magnet. Many assume that a slow-running motor is a very inefficient contrivance. Such should not be the case. A perfect motor is one which will give the same return for a given amount of expended energy, whether run at ten or one hundred revolutions per minute; that is, for every 746 watts that it receives, it will raise 33,000lb. one foot high in one minute, no matter what its number of revolutions. To approximate this result it is obvious that the magnetic pull must increase as the speed diminishes, and more iron must be used than has been as yet. Want of iron in the armature is particularly noticeable in motors of the Pacinotti type. In some cases, particularly railway motors, too much iron can hardly be employed. In an arrangement of apparatus for use on high potential arc light circuits I would arrange a shunt motor, the wire on the shunt having much greater section than that on the armature. I would place these motors in series on the circuit, and by means of a ball or torsion governor cut in more or less of the shunt, as the power called for may require; always preserving such a relation of resistances that magnetic equality between field and armature is assured. By this arrangement only the necessary amount of current to do the work will be taken from the exterior circuit. When the motor is running idle almost the whole current will pass through a very few turns of the shunt, going on to some other point on the circuit where its energy may be needed. I am aware that objections have been made to this system of distribution on account of the reactionary effect which seems to occur between different motors on the circuit. This defect, however, is so easily remedied that it ceases to be a factor in the problem. A great deal of late has been said and written about constant speed motors, self-regulating motors, motors with differential winding, &c., &c. It seems to me that nearly all these schemes amount to using current for the purpose of breaking itself—an arrangement which has about the same mechanical economy as would be obtained in admitting steam simultaneously on both sides of the piston of a steam engine when ever it had a tendency to run too fast. In the adaptation of motors to railway propulsion we seem to be in the same state that engineers found themselves about the time of the introduction of the locomotive. It really looks as if we never should hear the end of various schemes involving the use of friction clutches, gears, pulleys, chains, belts, and screws. As with the locomotive so with the electric motor—there is but one way to practically convey the power, and that is by direct coupling. The necessity for great periphery speed of armature ceases when plenty of iron is used, and in some cases multipolar motors employed.

The brush lead of dynamos and motors is a point upon which there is a wide difference of opinion. Some manufacturers have, I believe, gone so far as to twist the connecting wires back upon the commutator, giving an apparent line of commutation at right angles to the pole pieces, under the supposition that such a position would give an appearance of great efficiency to the machine. When we reflect that the lead is due to the magnetic distortion caused by the opposition of the polarity induced by the current flowing in the armature, to the polarity given by the field magnet, it would seem that a dynamo without brush lead would be a monstrosity. In a good motor, when in a state of rest, the brushes should have a backward lead of 45°. As the motor gathers speed this lead will become less and less, varying with the speed. If the motor be propelled mechanically, as in the descent of a loaded elevator, the lead will be found to have shifted to a forward position, as in a generator; hence, in variable speed large railway motors automatic brush regulation would seem to be a necessity. Motors propelled by secondary batteries have yet to prove their position; for railway propulsion they afford a beautiful experiment, but their excessive weight, together with cost of introduction and operation, renders their employment in this service extremely problematical.

You gentlemen who represent the electric lighting interests of the country should make use of your facilities; I doubt if there is a company doing an arc light business that cannot make twice as much in the distribution of power.

Use any of your continuous-current dynamos as motors, only put in more iron and balance the magnetism in your armatures and field. Don't waste your time on mechanical gymnastics, but use what you have and are sure of, and the time is not far distant when small steam engines will be unheard of, and large ones only known in localities where cheap fuel abounds.

MINIMA VISIBILIA AND SENSORY CIRCLES.—II.*

THERE is an idea of motion when an image traverses the retinal disc of a motionless eye, or when the finger is passed over the surface of the skin; the prevalent doctrine accords the resultant perception to a consecutive excitation of impressional areas. Advantage may be taken of the present opportunity to instance a few arguments justifying the classification of apparent motion with the secondary perceptions.

1. No progressive motion is experienced in a train passing under a dark tunnel, or in a ship's cabin because the muscular system is quiescent. But out progress when walking in the dark is quite perceptible. How is this? It cannot be due to the tactile impressions made on the feet, even granting them to be unlike, since no idea of motion is presented by a succession of dissimilar sounds, or by the different thoughts of ideation. Neither can it be explained by noting the time that it occupied in each step, since time and motion are not to be confounded (Locke). This philosopher imagines the sun to be a fire lighted in the same meridian every twenty-four hours, and asks whether such a regular appearance would not serve to measure duration as well without motion as with it. No solution is available saving that of muscle-perception.

2. Apparent motion is realised by the aid of the thaumatrope or zoetrope; but it is inconceivable (as with different sounds or thoughts) that the retinal representations of a number of successive attitudes —the consecutive phases of a horse leaping a gate, say—should generate the mental notion of a motion, inasmuch as there can be no possible relation primarily between any two such mechanical representations. Contrariwise, however, as the hand perceives an object in two positions by movement of the arm through a certain angle, so the secondary perception of the horse in one position is amalgamated with a similar perception of the horse in another position. It is the linking of these like perceptions that is essential to the idea of a perceived motion.

3. Objects are perceived to gyrate round the individuality after rapid rotation of the body, notwithstanding their retinal images are fixed. The general rotatory muscles in this case cause the centre of perception to spin round in one direction, whilst (by sympathetic secondary abeyance) the straight muscles of the eyeball give rise to objective gyration in the opposite direction; when walking rapidly along a road, in like manner, the adjacent hedge-rows seem to move oppositely. Here is evidence that the secondary perceptions of vision are persistent after absolute cessation of the antecedent bodily movements, and we have already employed this principle of persistence in the formation of visual angles.

4. Let a traveller by train fix his optical axes on an object some 300yds. distant, he will observe that the nearer edges move rapidly in one direction, while the more distant trees move slowly in an opposite direction; this effect may be likened to the arms of a balance swaying horizontally about the binocular centre. It is true that the nearer objects are depicted on the upper and those more remote on the lower retinæ, but the main incident resides in the images of both sets of objects floating over the fundus in the same course; how, it may be asked, are such contradictory results to be reconciled excepting by some process of secondary perception? Whilst confessing that the paradox awaits a definite solution, I cannot omit to note its striking analogy to the twofold forms of monocular relievo, wherein a superficial extension is seen to face towards the right under one form and towards the left under the other form (conversion of phase).

Resuming our data, when the points of a pair of compasses are applied to the skin of a blindfold person, they require to be separated by a certain interval—the diameter of a sensory circle (Ernest Weber)—before they can be identified as being duplicated. Apparent number, consequently, has been viewed as resulting from the intervention of one or more sensory circles or retinal cones; but our proposition makes it to consist in the appreciation of two or more distinct directions, and the phenomena of single and double vision or touch (already cited) are a sufficient illustration. Number, indeed, is related to two classes of perceptions entirely distinct; it is a secondary perception in connection with extension and form, and
primary in its relation to time—so man
striking the tympanum per minute. Th
tion between the mental ideas of numbe
tant, furnishing a satisfying clue to the
impossibility of squaring a circle; th
thread is readily convertible into the sq
tion (secondary), whilst the feat is i
by mathematics (primary); a straight
is unity in a secondary aspect, but

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* By the late Brigade-Surgeon T. OUGHT
Medical Department, in the *Lancet*.

abstracted into any number of primary measures (and the same for a superficies). Take another example of number: a printed word appears *per se* to be a unit (secondary), although its several letters may be counted; the mental idea of number, in this instance, is *primâ facie* so many distinct volitional impacts, but it is really a question of time together with a succession of primary perceptions.

Sensory circles vary in size in different parts of the body. The adjoining table gives their apparent diameters according to different authorities:

	Weber.	Le Conte.	Bernstein.
Tip of tongue	½ a line	1/20in.	·039in.
„ fingers	1 to 2 lines	1/6 to 1/12in.	·079in.
Palm of hand	5 „	½in.	—
Back „	14 „	½ to ¾in.	·157 to ·196in.
Arm	30 „	½ to ¾in.	—
Back............	30 „	3in.	1·97 to 2·36in.

Fineness of tack conjoined with correspondent mobility in various parts has long been recognised, as in the elephant's trunk, the beaver's tail, &c.: such a constant ratio between sensory and muscular acuity (well shown by the table) has been viewed in the light of a mere coincidence; but it is offered as varifying a motor causation. The dimensions of sensory circles have been attributed to textural fineness of nervous organisation; thus, if we suppose 100 tactile papillæ to exist in a circle of the back (3in. diameter), there will be a like number in a circle of the palm of the hand (½in. diameter), whereby the hand's sensibility is so many times greater than that of the back. But, by the proposition, the cutaneous nerve-expansion may be universally equisensitive in so far as the present phenomena are concerned; and what are the practical facts concerning increments of sensibility? I consider that sensibility is best measured directly by passing the forefinger lightly over different surfaces of the skin. If we adopt this method, a tolerable equality of sensation will be felt between the palmar aspect of the forearm and hand; these surfaces appear to be more sensitive than that of the forefinger, whilst the back and flanks are highly sensitive. Then, touching another point, it has been assumed that 100 cutaneous corpuscles in a sensory circle really signifies a corresponding number of fibrillary terminations in the brain; how is the single impression disposed of? Mental essence, according to the *adhuc* highly mechanical but rather speculative neurologists, now steps in with its stately faculty to charm away every dilemma; the mind, it is said, whilst it can easily identify each fibrillary stimulation, is limited in its differentiation of an aggregation of impressions unless more than a certain number (a 100 say) of fibrillary insertions are excited. I am not aware that it has been decided whether or not the fibrillary insertions are more compressed in some cerebral areas than others; but here, in the absence of an explanatory *modus*, I contend that the foregoing hypothesis is foundered. Truly says Locke, "In bare naked perception the mind is passive, and what it perceives it cannot avoid perceiving." In truth, physiology points everywhere to conscious mind as being an impressional resultant rather than an impresssional generator or modifier.

Proceeding next to examine a few data which seem to be intelligible only on the terms of the proposition, the first remark is that the minimal visual angle of 44″ is an invariable value in every part, lateral or direct, of the retina. On the terms of Le Conte, however, (1) that the size of the cones determines the minimum visibile, and (2) that the cones of the macula lutea are far smaller and more numerous than elsewhere, it will result that minimal angles are more acute in the axis, rather than that a hyperæsthesia ensues. Sensory circles are of variable, and visual angles of uniform, value; in the latter case, because ocular rotations affect equally the entire retinal expansion.

The following facts, lastly, refer especially to the tactile faculty, and possesses a marked significance:—(*a*) Sensory circles differ in size in different individuals, well shown in the above table. Does a more close disposition of nervelets in some persons offer a satisfactory reason for the difference? (*b*) They differ in size in the same person at different times. Has the mind an influence to contract or dilate cerebral impressional areas, and irrespectively of volition? (*c*) They are developed by assiduous exercise—e.g., the blind man reading with his fingers, or the armless woman sewing with her toes; the sensibility in these cases is increased in an equal ratio with the mobility. Is this a mere coincidence? Let us draw a simple parallelism in reply to these queries. Thus: some persons play billiards better than others; they are in a better one for play at some times than others; they profit by practice. Well, then, has primary sensation any causative bearing on either parallel?

Addendum.—At the close of a protracted investigation concerning the nature and various phases of the secondary perceptions, comprising several memoirs which have been honoured by insertion in these columns, I may be permitted to add a few general remarks. My hypotheses on erect and single vision, visual reliefs, &c., have been present to my mind in a more or less imperfect shape for upwards of a score of years. These several subjects tend to elucidate, and have been elucidated by, what a strict inductive system seems to justify me in styling a theory of secondary or acquired perception. The main feature of the theory consists in a brainward transmission of the *vis insita* of voluntary muscular tension, to enter into a combination therein with relational centripetal currents of primary perception for the evolution of appropriate forms of secondary perception—that is, for the mental declaration of the primary qualities existing in natural bodies. I am happy to say that the theory does not seem to be invalidated by, but rather harmonises with, the experimental researches of Professor Ferrier on the motor areas of the cortex. Professor Wyld states for instance, in reference to the faradisation of the anterior lobes giving rise to contractions of the head and limbs of animals, that he is not disposed to surrender his admiration of the forehead as the seat of intelligence; I cannot subscribe to his position, however, seeing that by far the major part of intellectualism is a motor process. The following remarks of Dr. James Davey bear directly on the context, and I cordially endorse them. He writes: "The application of stimuli to portions of the cerebral surface beget, as a matter of necessity, certained and defined muscular movements; but such are no kind of proof that a centre or source of mere motive power has been reached or excited to action. The movements observed are, to all intents and purposes, due to another cause, and that a psychical or mental one." Then he points out that this must be so, since the stimuli may produce like motor results indirectly through the instrumentality of one or more of the external senses—the sense of sight, or touch, or sound, and so on.

One or two words more. The muscle sense of Sir Charles Bell has especial reference to a recognition of the position of the limbs and other movable parts of the body, together with sensations of solidity or impenetrability (not solid form), the weight and other resisting properties of essences; hence it is a line of research having only a remote connection with the various doctrines enunciated in these columns. It might repay investigation to trace the reason that a Chinese or Japanese painting exhibits such vivid colouration, whilst their crude notions of perspective clearly evince a defective or modified secondary perception; their statuettes, too, are such grotesque contortions. Is it dependent on their sedentary habits co-operating with a perfunctory exercise of secondary attention, or are their muscular dispositions irregular? Not the least claim of the above theory is that it establishes a sound substantive basis for positive or realistic metaphysics; its obvious tendency is to deal a heavy blow to every ideational and intuitional form of philosophy as touching initial conscious states.

FIG. 2.

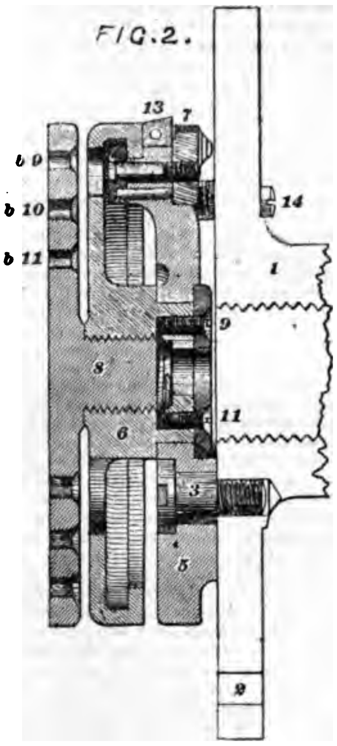
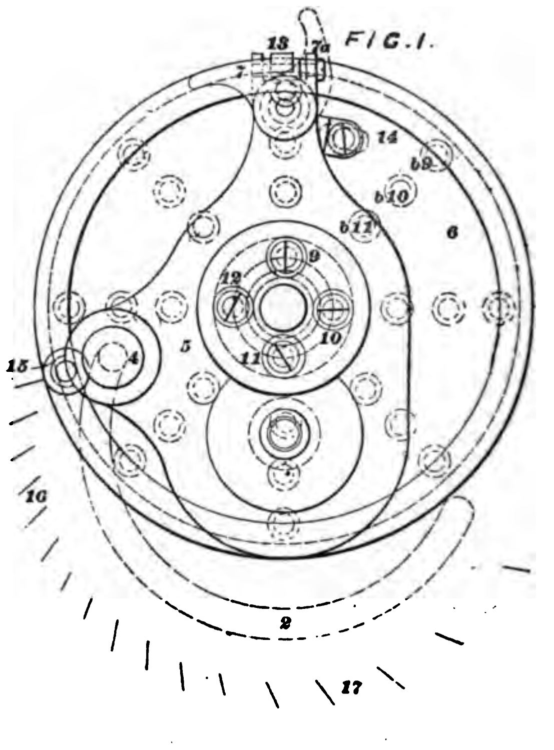


FIG. 1.



PATTERN-MAKER'S CHUCK.*

In describing the chuck illustrated in Figs. 1 and 2, let me say that there is no patent on it that I know of, neither is it manufactured by any firm or company. I never saw but one like it, or made on this principle, and that one I made myself. I found it very useful, and, trusting that it may prove equally useful to others, I will try to explain it, and also show how it may be used. Similar figures refer to like parts in the two views. Fig 1 is a view from the back side of chuck, or the side nearest the face-plate marked 1 in Fig. 2. This face-plate is not shown at all in Fig. 1, but is removed to allow a better view of the chuck. This face-plate forms a foundation for the chuck proper, which is fastened to it by the centre pin 3, and also by the clamp screw 4 in Fig. 1. The circular slot shown by dotted line 2 in Fig. 1, and also at 2 in Fig. 2, allows the arm 5 to be swung round on the pin 3, and fastened in any position by the clamp screw 4. This clamp screw is provided with a capstan head, that it may be operated when the chuck is in the lathe. The arm 5 has pivoted to it the circular piece 6, the centre of the pivot being at the same distance from centre of pin 3 that the latter is from the centre of face-plate 1, or the centre of lathe.

This is an important point, because it enables us to bring the centre of our chuck into the centre of lathe, which we couldn't do if the distances specified were unequal. A good way to accomplish this is to bore the socket for pivot, while the arm 5 is held by its centre pin 3 and clamp screw 4 on the face-plate 1, and held in the lathe by this face-plate. This will insure its being central with face-plate 1.

The circular piece 6 is held to the arm 5, by the washer and screws shown at 9, 10, 11, 12. It may be clamped fast to the arm 5, by the washer, screw and lever at 7. This screw may be adjusted so that a very short movement of the lever will serve to tighten it, as is shown by the two positions of lever; in Fig. 1, 7 *a* is the lever when loosened to allow 6 to revolve on its pivot; 7 the lever when clamped fast. The washer, which has its outer end nearly square to give it a better hold on the flange of 6, is kept in place by a small pin seen just below the screw. The pin prevents the washer from turning round and becoming jammed when the part 6 is revolved. This piece 6 is bored at the centre and threaded to receive face-plates, one of which is shown by 8. This face-plate may be removed for fastening on work, or other plates may be substituted in its place, and when screwed fast to the dividing-ring 6 will move with it on the pivot of 6. Thus any piece of work fastened to the plate 8 may be swung out of the centre of lathe to any poition within the limits of the chuck, and as the arm 5 is intended to swing through 180° the eccentricity which may be obtained will be twice the distance between centre of pin 3 and centre of plate 1. Then, after the arm 5 has been clamped fast in any position within these limits, the work may be revolved on the pivot of 6, and any point within straight line would have been quite sufficient to affect the measurements.

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* By J. W. Burrows, in *American Machinist*.

Mr. Gill: The cord is stretched so tightly that there is no perceptible deviation from a straight line.

Mr. Ranyard: If there were no sensible catenary at starting, a very slight decrease in the humidity of the atmosphere would give rise to very perceptible curvature of the string between the posts. I think that it does not follow because Mr. Gill's results, obtained in the morning and the afternoon, did not differ by more than ·015 of an inch, that the readings of his thermometers can be relied upon as being correct to one-fiftieth of a degree. There are many other things than temperature to take into account.

Mr. Gill: It was not the measures made in the morning and evening that matched to ·015 of an inch. It was the probable errors. If there are many sources of error, it would tend to increase the probable error of the whole.

Mr. Ranyard: It does not by any means follow from such a small series of coincidences that plus errors of temperature may not have balanced minus errors of something else.

Mr. Gill: It gives a fair probability with such a severe test as this.

Capt. Abney read a paper on the "Atmospheric Transmission of Visual and Photographically Active Light." Capt. Abney gave the numerical results which he had obtained in observing the brightness of different parts of the solar spectrum after transmission through various thicknesses of the atmosphere corresponding to different altitudes of the sun. The observations had been made both by eye comparisons, and by comparing the photographic action of various parts of the solar spectrum, after transmission through various thickness of the atmosphere. The general results obtained were, shortly, that the atmosphere is itself colourless, and that different wave-lengths are transmitted in different proportions, owing to the particles suspended in the air, which disperse light of different wave-lengths, according to a law first pointed out by Lord Rayleigh, who proved that in the case of particles, the diameters of which are small compared with the wave-length of light, the intensity of the dispersed light varies inversely as the fourth power of the wave-length. The results of Captain Abney's observations seem to show that the particles suspended in the atmosphere are, on the whole, small compared with the wave-lengths of the visible spectrum, and that there is no other perceptible loss of light due to the natural colour of the gases forming the atmosphere.

Several notes on the Occultation of Aldebaran of 2nd March, 1887, were read, from which it appeared that the phenomena observed differed greatly at different observing stations, even though they were only a few miles' distance apart on the earth's surface, and a number of papers were also taken as read.

Bronzing Metals.—The wonderfully well-coloured articles of bronze, now seen in the market, and showing all tints, and adhering thoroughly to the metal, is a French process, but it is no longer a secret. The method of manufacture lies in the use of solutions of sulphides of antimony and arsenic which were applied to the bronze or brass articles. After thoroughly washing them with water, since every trace of acid left in pickling would show black spots, they are thoroughly dried, and then the sulphide solution is applied with a brush. The best way is to begin with a dilute solution of ammonia, giving one application. After drying, the coating is brushed, and then the dilute solution of sulphide of arsenic in ammonia is used, which produces a yellow colour. The oftener this sulphide of arsenic is applied the browner will be the colour, and a deep tint may thus be finally obtained. By solutions of sulphides of antimony, either in ammonia or in sulphide of ammonia, the tint is reddish, and it is possible in this way to obtain either the most delicate red or the deepest dark red. If some of the parts of the article are rubbed more strongly a high metallic lustre is obtained. Ammonia or sulphide of ammonia reabsorbs the brenzing, and in this way defective spots may be improved. It is possible also to use solutions in caustic soda or potash, or the sulphides of either.

The "Optimus" Camera Lens.—Messrs. Perken, Son, and Rayment, of Hatton Garden, send us one of their photographic lenses known as the "Optimus," which is worth the attention of photographers as an excellent and cheap combination of the rectilinear type. The combination is accompanied by half a dozen stops from *f*-8 to *f*-64, and is well adapted for amateur use, as it will do quick work, and lends itself better than any other arrangement to a great variety of purposes. It is especially adapted for instantaneous photography, will give good portraits wherever the light is sufficient, and is equally adapted for landscape and architectural pictures, while the angle it will include is enough for all ordinary cases.

SCIENTIFIC NEWS.

Corrected elements of Barnard's second comet (D 1887) by Prof. Boss approximate to those by Dr. Oppenheim, which we gave on page 30, last week. For Greenwich midnight on March 21, Prof. Krueger calculates from the elements of Prof. Boss the position R.A. 49° 46′; N. Dec. 55° 46′.

Prof. Tacchini calls attention to the remarkable absence of sunspots during the last quarter of 1886, when from Oct. 31 to Dec. 12 scarcely a spot could be discovered. M. Riccò, of Palermo, also refers to the matter, and anticipates the true minimum of the eleven-year period in 1890.

The death is announced of the distinguished American engineer, Captain James Buchanan Eads. He was born at Lawrenceburg, Indiana. in 1820, and commenced business-life in a store, afterwards accepting the post of clerk on a Mississippi steamboat. He devoted his leisure to the study of engineering, and in 1842 constructed a diving-bell boat for the recovery of cargoes of sunken steamers. For nearly 20 years he studied the question of the improvement of navigation, and in 1861 he was consulted by President Lincoln as to the best means for opening up the navigation of the Mississippi, when he designed and completed for the Government a squadron of eight light-draught ironclad vessels for service on that river. Captain Eads next designed and constructed six ironclad vessels, heavily plated, and having the turrets worked by steam, this being the first application of steam to the manipulation of heavy guns. Between 1867 and 1874 he designed and constructed the great steel bridge across the Mississippi at St. Louis. He was then intrusted with the important task of improving the channel of the Mississippi below New Orleans, which was seriously obstructed. In the space of five years, by his ingenious operations, he secured a channel 200ft. wide 26ft. deep, with a central depth of not less than 30ft. Capt. Eads also advocated the application of the jetty system to the improvement of the channel of the Mississippi as far north as St. Louis, and this undertaking has now been carried out. One of the most important projects advocated by Capt. Eads, however, was the construction of a ship-railway across the Isthmus of Tehuantepec. He asserted that this would be cheaper in construction and maintenance and more convenient for commerce than the Panama Canal, and in furtherance of his views had large scale models constructed of parts of the necessary works. With his death, however, this bold and ingenious scheme will probably be shelved.

The deaths are also announced of Dr. Birnbaum, professor of chemistry at Carlsruhe High School; of Dr. R. von Reichenbach, of Gratz, a distinguished chemist; and of Dr. August Wilhelm Eichler, professor of botany at Berlin University, and director of the botanical garden and museum of that city.

Reference to Berlin University reminds us that Prof. Du Bois-Reymond will celebrate this year the twentieth anniversary of his appointment as secretary of the Academy of Sciences of Berlin, and that the University now numbers on its roll no fewer than 5,357 students—the largest number ever enrolled by a German University. In the faculty of philosophy there are 1,984 students; in that of medicine, 1,297; in that of law, 1,282; in that of theology, 794. The number of instructors is 288, of whom 147 are in philosophy, 103 in medicine, 22 in law, and 16 in theology.

The will of the late Sir Joseph Whitworth has been proved. The estate is charged with the payment of £100,000 to the President of the Council—that sum being the capital of the Whitworth Scholarships, and besides that 200 shares in Sir J. Whitworth and Co. are bequeathed to Owens College, 80 shares to the Institution of Civil Engineers, 40 shares to the Institution of Mechanical Engineers, 40 shares to the National Lifeboat Institution, and 20 shares to the Orphan Houses, Ashley Down, Bristol. All Sir Joseph's pictures painted by members or associates of the Royal Academy are, after the death of Lady Whitworth, to become the property of the Manchester Corporation.

Applicants for a share of the Government grant of £4,000 for the "promotion of scientific research," may be reminded that March 31st is the last day of sending in the forms, which may be obtained of the assistant secretary, the Royal Society, Burlington House, W.

There are sixty candidates for election to the Fellowship of the Royal Society on June 9 next, and of these the Council will select fifteen, and "recommend" them to the Society.

To illustrate his paper on "The Etiology of Scarlet Fever," read before the Royal Society the other day, Dr. Klein showed under the microscope gelatine cultivations of the *Micrococcus scarlatinæ*, an organism which has been found in a certain disease of the cow, and also in scarlatina. It may be remembered (see p. 10) that the San Francisco Microscopical Society is also interested in the question of the alleged presence of pathogenous micro-organisms in the milk of the cow.

At the meeting of the Liverpool Biological Society held last Saturday, Mr. J. C. Thompson read a paper on "The New and Little-Known Copepoda of Liverpool Bay." The Copepoda are an old and degenerate group of crustaceans, both fresh water and marine, probably the lowest form of free crustacean, the one most familiar being the tiny Cyclops, which inhabits the ponds and ditches of the country. Like other crustaceans, they have theoretically 20 somites, but in reality they possess only 16 or 17. The sexes are always separate, and the structural differences are remarkable, many of which were shown on the screen and under the microscope. The observations of Mr. Thompson led him to believe that the existing median eye in Cyclops is the relic of an ancestral pedunculated eye, which would bring the family up close to the shrimps; but there is some doubt on this point, which can only be settled by long investigation. Of 140 British species, 40 have been found in Liverpool Bay, six of which were entirely new to science. A paper "On some Anatomical Abnormalities," by Mr. A. W. Collins, M.B., was also read. This was illustrated by diagrams, models, and preserved specimens, bones, and animal skeletons, showing various abnormalities, some of them of a most peculiar kind. One of the most interesting was a human heart, the owner of which had managed to exist for 60 years in spite of some peculiar malformation which theoretically should have prevented the action of the heart, but did not, owing to an abnormal modification. This paper raised an interesting discussion amongst the surgeons present, and brought out a great many strange facts discovered at post-mortems. In one subject there had been found seven muscles peculiar to apes; and many abnormalities of this kind point directly to and are explicable only on the theory of the evolution of man from a lower form.

At a recent meeting of the Zoological Society a paper was read by Mr. E. B. Poulton on his experiments on the protective value of colour and markings in insects (especially in lepidopterous larvæ) in their relation to vertebrata. It was found that conspicuous insects were nearly always refused by birds and lizards, but that they were eaten in extreme hunger: hence the unpleasant taste failed as a protection under these circumstances. Further, conspicuous and unpalatable insects, although widely separated, tended to converge in colour and pattern, being thus more easily seen and remembered by their enemies. In the insects protected by resembling their surroundings it was observed that mere size might prevent the attacks of small enemies. Some such insects were unpalatable, but could not be distinguished from the others. In tracing the inedibility through the stages, it was found that no inedible imago was edible in the larval stage; in this stage, therefore, the unpleasant taste arose.

Lieut. H. W. Seton-Karr read a paper on Monday last on the "Alpine Regions of Alaska," in which he stated that Alaska was one of the best regions for the study of the formation, movements, and extent of glaciers, the St. Elias Alpine region offering one of the best places for the study of glacial phenomena under the most powerful conditions. None of the old navigators saw the true character of the flat, broad plains which bordered the coast. To the east of Yakatat Bay, and to

[illegible]

[illegible] some age.

[illegible]

[illegible] and so on.

[illegible] Mediterranean, Prof. Dawkins [illegible] treated that [illegible] very differently. [illegible] that it has now deepened into a strait, and [illegible] had not entered and drowned that vast valley, which was probably antediluvian man's chief seat. The two lakes that received and evaporated all the rivers, must have been (like that which still receives the Jordan), at levels far below that of the contemporary ocean. He supposes them (or, at least, the one fed with the least rivers), no less than 4,000ft. lower than our present seas; and in support thereof, quotes from Mr. Maw this extraordinary difference between shores within and without the Mediterranean. "On entering the Straits of Gibraltar from the Atlantic, a notable change takes place in the aspect of the coast. Cape St. Vincent, on the Atlantic coast, presents a bold line of cliffs to the sea, and bluff cliffs extend many miles towards the Straits; but as soon as these are passed, a change of coast form takes place, which must be noticeable to every observer. Cliffs on the seaboard become the exception, and the general line of the coast is merely a shelving under the sea of the general hill and valley system of the land." . . . "Corsica, and the adjacent islands of Elba, Capraja, and Monte Cristo, are also remarkable for the absence of cliffs, and are wanting in those abrupt escarpments separating land and water which are so abundant on our own coasts. Their aspect is that of mountain tops rising out of the sea, suggesting to the eye the seaward prolongation of their sub-aerial contour." In short, says Dawkins, "the present aspect of the Mediterranean is, geologically speaking, a thing of yesterday." Before this recent irruption that drowned it, but has not yet had time to give it a proper coast line, all its present isles were mere hills, rising from European lowlands; and Sicily and Malta stood on a broad plain dividing the two lakes, and uniting Italy to Tunis. The Black Sea, Sea of Marmora, and Red Sea must also have been [illegible]

[illegible] the Ararat that caught Noah's ark after drifting five months, and during seven more hoisted and preserved its prisoners above the clouds in a pure air, necessary to them doubtless while the surrounding new plain, with wreckage of a world, was being prepared for them by a long summer's vegetation. Now, physical geography will show this to be the exact place where the newly added load on the globe was likeliest to cause such chief upheaval. The largest present inclosed basin (whence water escapes not) is the Asiatic one, containing the Caspian and Lake Aral; but equally large of old, or larger, was the Mediterranean one, now drowned. The valley of the Araxes, containing Ararat, is just that recess of the Caspian basin that reaches nearest the main hollow of the Mediterranean one. It is true the two are here separated by the narrow upper Euphrates vale, whereas further north the two great basins are conterminous; but that watershed where they touch is not between their centres or main hollows, as this Araxes valley is. Now, with equal downpour on the whole globe, both these vast basins had to retain at least four or five times the depth of water that could accumulate anywhere else. The Mediterranean has done so permanently, and the Asiatic must for some centuries, the Caspian having not evaporated down to its present limits till historic times. Just between the centres of those two chief-added loads was obviously the district wherein they would cause new upheaval, if anywhere.

Not only the valley gravels and river drifts, to which all healthy towns owe their salubrity, but the furrowing or shaping of our valleys themselves, everywhere, is mainly the work of nothing slow, [illegible] single day's catastrophe (the day that [illegible] ark"—not the month or week, but [illegible] flood came and took them all [illegible] this suddenness there is monumental [illegible] district where a succession of [illegible] some earlier and some later [illegible]. Till lately, only one such [illegible] the Auvergne district, with its 2,000 [illegible] the last eruptions having been in [illegible] part of which, modelled by [illegible] exhibited under a glazed case [illegible] stairs to the Jermyn-street [illegible] we hear of three exactly [illegible] in California, one in New [illegible] New Zealand (almost the very [illegible]). To imitate the model, [illegible] lot of clay, with uneven [illegible]. Pour a ladle of lead on the [illegible] runs down and hardens in [illegible]. Then put it under a water-[illegible] shower-bath will furrow out vales [illegible] of lead, which protect the [illegible]. When it is dry, pour lead [illegible] as before, and you will [illegible] those four curious coun-[illegible] exhibit, on such distant sides [illegible] vales (and consequently [illegible] in general) are the result [illegible] a catastrophe.

[illegible] Duke of Argyll ("Geology [illegible]") the extinction of the mam-[illegible] with much similar evidence, [illegible] and arranged by Mr. [illegible] as such, has been accus-[illegible] bringing facts together as [illegible] intellect of the conclusions [illegible] lead." But I find this [illegible] insisting on the necessity of a [illegible] Siberia at once, admitting [illegible] will believe in a "genera[illegible]" which is nearly equivalent to saying tha[illegible] are alive to-day. There is n[illegible] hardly any half so certai[illegible] of 50 centuries ago—i.e., fal[illegible] sky. But deluge and "sub[illegible]" [illegible] the Duke harps upon) ar[illegible] either may exist entirel[illegible]

E. L. G.

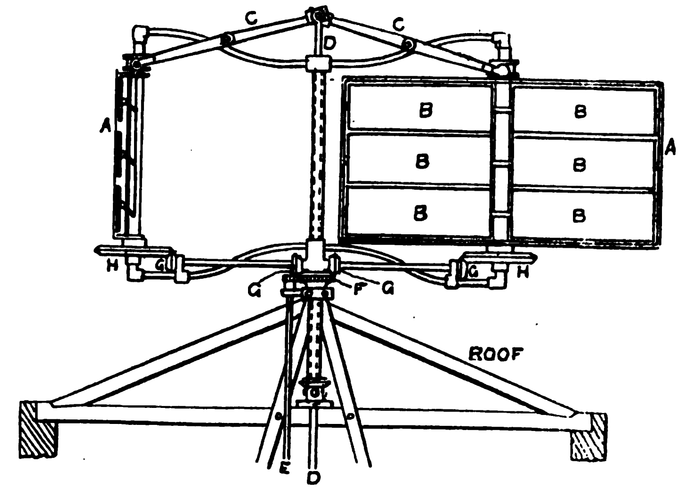
ANOTHER HYGROMETER.

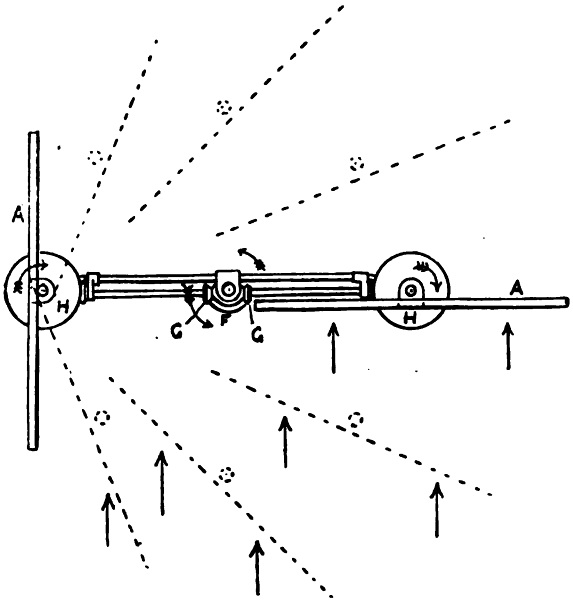
[illegible]—Now that the subject of hygrometry [illegible] readers, permit me to make mention [illegible] the hygrometer may be described [illegible] last week, I believe I have [illegible] that will beat it outright for [illegible] and tell-tale ability. I have neither [illegible] hygrometer, handled it, nor seen it in [illegible] apparatus, yet I have been acquainted [illegible] some two years or more, and always find [illegible].

Naturally, your readers will wish to know what [illegible]. Well, it almost puzzles me to tell them. [illegible] the manner in which the waste steam of a travelling locomotive conducts itself after leavin[illegible] the chimney. Does it linger in the atmosphere a[illegible] undecided whether to disappear or not? the[illegible] saturation point is not far away. On the othe[illegible] hand, if it is snatched up with avidity, depend upo[illegible] it is a dry day with no chance of falling rai[illegible] Dwelling within a league of one of our main line[illegible] I can testify of these variations from numerou[illegible] observations. I have seen, on a hot summer's da[illegible] passenger trains rising an incline near our statio[illegible] and therefore under full stroke of steam, withou[illegible] giving the slightest indication of their motiv[illegible] power, vomiting no smoke at the same time. A[illegible] another time I have just had time to detect it e[illegible] vanished. At others it has been visible for thre[illegible] or four yards, then for the whole length of th[illegible] train, and so on, finally stretching on damp and we[illegible] days a long distance away. I have seen in th[illegible] height of summer steam hang about considerabl[illegible] with large patches of blue sky overhead—a curio[illegible] revelation to me at first. Indeed, this hygromet[illegible] is a very delicate informant.

And some of the daily variations are not less r[illegible]markable. Working in a hayfield one day la[illegible] summer, adjoining the said railway, I was dete[illegible]mined not to let the opportunity slip by. Up [illegible] one o'clock each passing train had given a gloo[illegible] appearance, which seemed likely to continue, t[illegible] sky being overcast, while the hay or grass refus[illegible] to be made. But somehow soon after the sun bu[illegible] forth, the sky grew clear, and the trains beg[illegible] speedily to prophesy, if such it can be calle[illegible] Gradually the steam disappeared until entirely [illegible] the afternoon became exceedingly hot and nev[illegible] did hay make faster. It was carried that day; [illegible] course there was the same moisture in the air [illegible] before. The sun, in raising the temperature of t[illegible] atmosphere, had made all the difference in givi[illegible] it greater absorptive powers. A fortnight in t[illegible] early hay season of last year was declared by th[illegible] test to be phenomenally dry. Washerwomen ple[illegible] note when living near railways.

Bulkington, Rugby. **W. K. Fulleylove.**





-SAIL HORIZONTAL WINDMILL.

55.]—I SEND elevation and plan of a two- rizontal windmill, which is an improved and more practicable, though similar in le, to the one given in letter 26894, page This arrangement of mill I designed as far s 1874, at which time I made several models its effect and best arrangement.

chief difficulty with this form of mill is the atic adjusting of the sails, which will not h a vane on the top as "Tal" suggested 26894), as it does not keep steady, being partly round by the drag of the chain; this tates using the ordinary and expensive fan earing; but I prefer to dispense with all ng gear by using the mill in a vertical form, er practicable, as it is not then required, the self facing up to the wind. There is much aid about reefing gear, also automatic speed or, as only at certain relative speeds is the orking at its best; but as this mechanism r patent protection, I refrain from occupying r space.

RIPTION.—A, the sails; B, louvre-boards; rs to move louvre-boards; D, regulating rod ; through main axle to floor below; E, ng rod or shaft-actuating wheel; F, a com- spur and bevel wheel in gear with the G, which engage with the wheels H fixed sails. This gearing is proportioned and d to give the sails half a turn to one turn nill, but in a contrary direction (see arrows). The dotted lines in the plan show the ns of the sails at the various positions a revolution of the mill. The dotted show the direction of the wind. All the f iron. **Aerial.**

HORIZONTAL WINDMILLS.

6.]—THINKING it may be of use to some correspondents interested in this matter, I forward a mathematical demonstration seems to me to conclusively prove the in mechanical effect between the oblique d the direct one.

. B, Fig. 1, be the section of a plane, upon he wind blows in the direction of arrow C D, with such a velocity as to describe a given space B E, in a given time, say, one second; and let A B be moved parallel to itself in the direction C D. Now, if the plane A B moves with the same velocity as the wind—that is, if the point B moves through the space B E in the same time that a particle of air would move through the same space, it is plain that in this case there can be no pressure or impulse of the wind upon the plane; but if the plane moves slower than the wind, in the same direction, so that the point B may move to F, while a particle of air setting off from B at the same instant would move to E, then B F will express the velocity of the plane; and the relative velocity of the wind and plane will be expressed by the line F E. Let the ratio of F E to B C be given, say, as 2 is to 3; let the line A B represent the impulse of the wind upon the plane A B when acting with its whole velocity B E; but when acting with its relative velocity F E, let its impulse be denoted by some aliquot part of A B; as, for instance, ⅔ A B, then will ⅔ of the parallelogram A F represent the mechanical power of the plane; that is, ⅔ A B × ⅓ B E.

FIG. 1

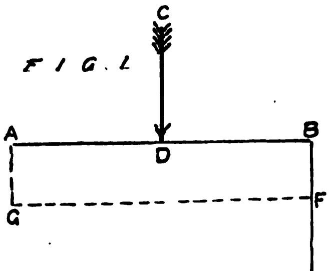
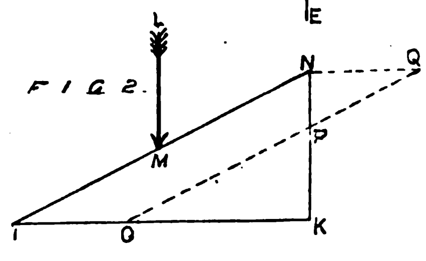


FIG. 2.



Secondly, let J N (Fig. 2) be the section of a plane, inclined in such a manner that the base J K of the right-angled triangle J K N may be equal to A B, and the perpendicular N K = B E. Let the plane J N be struck by the wind in the direction of arrow L M perpendicular to J K, then (according to the known rule of oblique forces) the impulse of the wind upon the plane J N, tending to move it in the direction of L M or N K, will be denoted by the base J K; and that part of the impulse tending to move it according to the direction J K will be expressed by the perpendicular N K. Let the plane J N be movable in the direction of J K only; that is, the point J in the direction of J K, and the point N in the direction N Q parallel thereto. Now it is evident that if the point J moves through the line J K while a particle of air setting forward at the same time from the point N moves through the line N K, they will both arrive at the point K at the same time, and consequently in this case also there can be no pressure or impulse of the particles of air upon the plane J N. Now, let J O be to J K as B F to B E; and let the plane J N move at such a rate that the point I may arrive at O, and acquire the position J Q, at the same time that a particle of air would move through the space N K; as O Q is parallel to J N (by the properties of similar triangles), it will cut N K in the point P in such a manner that N P = B F and P K = F E; hence it appears that the plane J N, by acquiring the position O Q, withdraws itself from the action of the wind, by the same space, N P, that the plane A B does by acquiring the position F G; and consequently, from the equality of P K to F E, the relative impulse of the wind P K upon the plane O Q will be equal to the relative impulse of the wind F E upon the plane F G; and since the impulse of the wind upon A B with the relative velocity F E, the direction B E, is represented by ⅔ A B, the relative impulse of the wind upon the plane J N, in the direction N K, will, in like manner, be represented by ⅔ J K; and the impulse of the wind upon the plane J N, with the relative velocity P K in the direction J K, will be represented by ⅔ N K; and consequently the mechanical power of the plane J N, in the direction J K, will be ⅔ of the parallelogram J Q; that is, ⅓ J K × ⅔ N K; that is, from the equality of J K = A B, and N K = B E, we shall have ⅔ J Q = ⅓ A B × ⅔ B E = ⅔ A B × ⅓ B E = ⅔ of the area of the parallelogram A F.

Consequently, we see that what is lost by obliquity of impulse is gained by the velocity of motion.

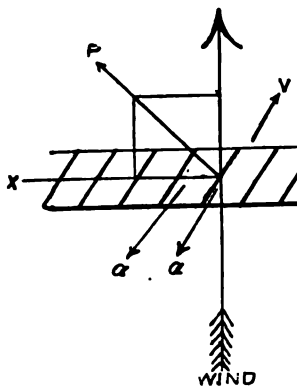
Now, this being so, and having regard to the fact that all the vanes or sails of a vertical mill act together, whilst in the best-designed horizontal, little more than one at a time can receive the impact of the wind, it is difficult to see how any possible combination of horizontal vanes can equal, let alone surpass, the old-fashioned vertical of good design. In my last letter on this subject I stated that the horizontal seldom reached much above ⅓ of vertical; but I find on making closer search that they have been known to reach as high as ½ the power of the old vertical mill. I find also that my last letter (26895) reads: "The disadvantage of horizontal windmills does not *merely* consist, &c." The word "merely" should have been deleted. **J. Q. D.**

[26957.]—"Q. E. D." (letter 26906) makes some extraordinary assertions. Thus I would like to know, what would be the measurements of a vertical windmill having four arms, a suitable axle and bearings, supported upon a wooden scaffold capable of revolution by means of a boom having a large wheel on the end of it, as I shall presently describe—the same to cost, if we are to believe him, the "prodigious" sum of £500. Next I would ask any sane mechanic, would it not take more timber, more iron, and much more labour to construct a horizontal than a vertical windmill? Is he not including in his ridiculous estimate "all" the gear requisite to convert corn into flour, &c.? I have only to go down to the docks and I can see handy little windmills upon many of the ships' decks pumping out the bilge water and turned head-a-wind by means of a handspike, such mills being, say, 10 or 12ft. diameter, and probably costing, say, about £3 or so. Within a few miles from where I write stands a vertical windmill. This consists of a circular stone base of some 12ft. high, and upon this base is erected a stout wooden framework, say about 20ft. high, which is weather boarded all around, and provided with suitable doors and windows. The mill spindle is under cover upon top, and gears on to a vertical spindle which rests in a sailblock upon the ground, the stone base being utilised to store corn in. I would guess that each arm measures, say, 25ft., and at the backside projects a long boom securely attached to the framework, and having at its outer end and at right angles to same a wheel of, say, 7ft. diameter, so that two men can turn the whole affair to any given point of the compass. Now comes the moral. This mill has done work to my knowledge for about 20 years without meeting with any serious mishap from storms; but some year or two since the lessee of same sat looking at it day and night for between two and three months, waiting in vain for a working waft of wind. The farmers carted away their corn in disgust to the steam mills contiguous, and I attended his funeral after he had driven a mortising chisel into his chest in despair. I think that "it is a mistake" to say that a ship sails faster before the wind than when "on a wind." This is the rock, I think, that horizontallers split upon. They ignore the fact that only for an instant is their one sail at right angles to the wind, that then it is moving in the same direction, thus reducing its effect, and presently the wind is, in nautical parlance, taken out of it by the "weather one." Also, my friends, no one is in the habit of putting a windmill head "close hauled upon a wind." **A.**, Liverpool.

HORIZONTAL WINDMILLS.

[26958.]—I HAVE read with great interest the letters from your various correspondents on the subject of horizontal windmills, and as I have been engaged on the subject for the past year at odd times, and have no particular interest in either type, a word or two on the subject may not be out of place.

About a year ago I made a model 3ft. in diameter on Mr. Russell's plan, and tried it in a strong gale of wind; it worked perfectly, and I did not find any of the banging your correspondents seem to think there would be. The sails seemed to be cushioned by the wind on account of the speed of the arms being nearly that of the wind itself. Probably, with a heavy load on, the case would be different; indeed, I now remember that when I nearly pulled it up by main force they did bang a bit, though not very noticeably on such a small model.



I hope to show, however, by means of a few simple considerations, that *unless a horizontal windmill of the above type runs very slowly it is no good* for electric lighting purposes.

My next development was that suggested by Mr. Button (letter 26893, p. 566), which form is certainly much superior to the flapping plan, pure and simple, and would probably give out double the power.

I am now, however, in favour of the vertical type (American) for the following reasons, which my calculations entirely justify:—(1) The *pressure on the vane varies as the square of the difference of the velocity of vane and wind.*

(2) For electric lighting, which is what I have in view, it would not be advisable to run the windmill slower than 100 revs. per minute, as the speed-reducing gear would otherwise be so wasteful that the small amount of energy would hardly reach the dynamo at all. We could not expect a 3-unit dynamo to work at less than 800 to 1,000 revs per minute.

I now proceed to give some figures for comparison between horizontal and vertical windmills. We will assume 100 revs. per minute to be the least speed of mill allowable on account of gearing:—

Horizontal Windmill.—Taking the eccentrically worked one, it is evident (by resolving forces) that this has *very nearly twice the turning moment of the ordinary flapping one.* Sails 10ft. high × 5ft. wide (six sails); circle described by sails = 10ft. (*at least*); windmill to develop ½H.P. for 18 hours every day; dynamo gives 50 volts and 6 ampères for 18 hours; ampère-hours stored in accumulator = 108. This gives us 20 ampères, at nearly 50 volts, for 5 hours; this = 15 20c., or 30 10c., lamps going for the 5 hours, which should be enough for a small private house at any one time.

At 100 revs. per minute the mean travel of centre of vane (at 5ft. *effective* diameter) = 1,000ft. per minute (backwards and forwards path *only* considered). Now ½H.P. = 16,000ft.-lb. per minute ∴ pressure required on vanes (at 1,000ft. odd per minute) = 16lb. Now effective area of the three vanes (two of them at 45° and one at 90° to the wind) = approximately twice that of the vane at 90°, therefore = 100 square feet; speed of wind required to give this pressure = 17 *miles fully*, taking the difference in velocity of the mean travel of vane and that of the wind into account. *Even at 50 revs. per minute, this mill would want 13 miles per hour of wind to work it to ½H.P.*

Now take an American mill, on the screw-propeller principle, whose disc has not (like our English windmills) gaps for the wind to blow through it, and see the result. Here we have none of that running away from the wind, or at most to an infinitesimal degree. Take a disc of 10ft., which even in its "slewing round" motions *takes no more space* (but less) *than the horizontal windmill.*

Taking a blade of the "propeller" and resolving forces, we find that the "turning force" X varies as P × cos. *a*, while P itself, the total pressure normal to the vane V, varies again as the pressure (in pounds per square foot) of the wind X sin. *a*. Therefore, the best angle for the vanes is 45°, where "sin. *a*" and "cos. *a*" are equal, and their product is approximately 0·5; therefore, to reduce the pressure of the wind at any velocity to the turning force, we multiply by 0·5.

Now taking a 10-foot disc at 100 revs.: effective area of disc (at *least*) is 80 square feet; effective diameter is (at least) 5ft.; mean travel per minute = 1,500ft. per minute. To get ½H.P. (= 16,000ft.-lb. per minute, we require 10lb. "turning force" (odd), or 20lb. *pressure* on the face of disc; *velocity of wind required is only* 7 miles per hour!

I need hardly say more: the comparison of the figures for the horizontal *under its best conditions* (50 revs. per minute) will show why I now prefer the vertical type.

As to regulating speed, this could easily be done electrically by making a shunt-wound coil from dynamo terminals to work a switch connecting two, three, or more branches of accumulators in parallel, thus throwing more work on mill, *without waste of energy*, in proportion to the speed of the wind. Accumulators could have their connections varied from parallel to series, by hand, when wanted for lighting. **A. M. Taylor.**

[26959.]—WHAT evidence is there that the relative cost of a horizontal and a vertical windmill to do any given work is as £50 to £500? I think more is required before "Q. E. D." can fairly be written after this statement.

In America, where they do use windmills, it takes a 25ft. wheel to develop a little over 1H.P. in actual work on the average for eight hours a day. The old computation is four to one for the relative efficiency of vertical and horizontal mills as known in Smeaton's time. Has the horizontal mill been as much improved as the vertical has by the Americans? Could we have a diagram of the spring and rope arrangements of Mr. Vallance's mill?

The single advantage horizontal mills appear to have at first sight is simplicity of gearing. It would be just as easy to erect a vertical mill on a city housetop as the other, perhaps easier. But if the horizontal wheel could be improved to, say, half the efficiency of the other, the simplicity of the gearing might give it the pull.

W. A. S. B.

[26960.]—IN answer to "A., Liverpool," page 543, I should like to remind him that a steam-engine would not revolve if the flywheel was taken off; still he would not like to say that it was inferior in power to the Eolipile of Hero the Alexandrian, simply because the engine had a dead centre, and the Eolipile had not. I should like to call the attention of those gentlemen who object to my windmills because of the noise and jarring of the sails against the framework, to two things that they appear to have overlooked—namely, the centrifugal tendency of the sails, and the fact that the framework which they strike against moves in the same direction, both of which would tend to prevent violent contact. However, should any of your readers who think of making one, still be in doubt on this point, it can easily be prevented by hinging the sails nearly at the centre (of the sails), leaving the longest sides pointing inwards when the sails are closed. If this is not sufficiently intelligible, and the Editor thinks it of sufficient interest, I will send another sketch. I should advise Mr. Barker Starkey to pivot his sails slightly eccentrical, instead of hinging them as shown in his sketch, or they will get wrenched off their hinges in a stiff breeze.

Walsall. **F. Russell.**

THE SILVER FILM OF NEWTONIANS.

[26961.]—MR. H. F. MADSEN, on page 537, Vol. XLIV., third column, misunderstands my meaning. As to the scratch I referred to, that a silver film is capable of receiving and of reflecting light from its sides, I did not mean a scratch through the silver, but a scratch on the silver film; such scratches I have seen by hundreds that have reflected light from their sides in a different direction from the light from the general surface, and it is, in fact, in this way that they become visible. To make this plain let AB, Fig. 1, represent a section of the silver film, greatly magnified, showing a scratch, C D. Now with my ½in. Coddington I can see that the light is reflected from its side C or D as a bright line, the depth of the scratch not going through the silver. Now, to show the application of this fact to the proof of what I said, in that part which Mr. Madsen quotes from my letter, let A B, Fig. 2, be a section of the silver film (greatly magnified of course to make the reasoning plain to the eye); we will suppose it has a depression 1in. wide, and that from the edge of this depression the silver gradually decreases in thickness to nothing at its centre C, and then gradually increases to the full thickness of the film at its other edge. We will take the thickness of the film to be $\frac{1}{200000}$in.; this is Dr. Draper's estimate, and is virtually accepted by Mr. Madsen; of course, much depends on the strength of the solutions. D E is the perpendicular of the general surface, D F is the perpendicular of the side of the depression C D, erected on the line C D G. Let D be the centre of a 12in. speculum of 100in. focus; now an incident ray E D falling on the general surface would be reflected back to I, the focus; but if it fell on the surface D C it would be reflected to H the same distance from F the perpendicular as E is from F. E F being the same distance as the thickness of the film, viz., $\frac{1}{200000}$in., therefore, E H would be $\frac{1}{100000}$in. Now E is only ½in. from D, but the focus to which the reflected ray D H has to travel is 200 half-inches; therefore the distance I J will be 200 times E H, *i.e.* $\frac{1}{100000}$ × 200 = $\frac{1}{500}$in. Now the same reasoning applied to the other side C B of the depression will show that the ray from that side will be sent to an equal distance K to the left of the focus I; therefore the distance K J will be double $\frac{1}{500}$, *i.e.*, $\frac{1}{250}$in. Now this is as viewed by the unaided eye, and is eight times as large as the $\frac{1}{2000}$in. That Mr. Madsen takes to be the "least particle which can be perceived by the natural vision," but we do not stop at the unaided vision—we use an eyepiece that magnifies the image. Now, supposing that a 1in. eyepiece magnifies five times, a ¼in. eyepiece would magnify twenty times; therefore, the $\frac{1}{250}$ × 20 = $\frac{1}{12}$in., which is 160 times the size of $\frac{1}{2000}$in. A speculum covered with a silver film would be utterly spoiled as to definition, if the silver film was covered all over with such depressions. I may just observe that no attempt at representing to scale has been made in drawing the figures, but merely to present to the eye an assistance to the train of reasoning; of course the silver film ought to be a curve,

FIG. 1

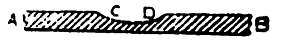
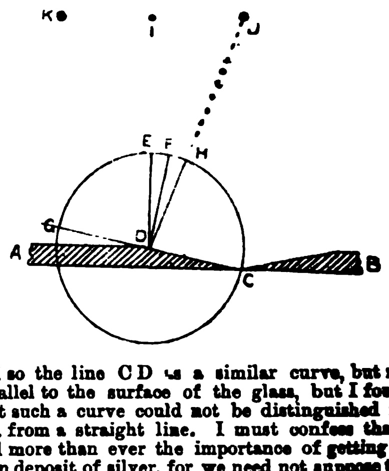


FIG. 2



and so the line C D is a similar curve, but not parallel to the surface of the glass, but I found that such a curve could not be distinguished for ½in. from a straight line. I must confess that I feel more than ever the importance of getting an even deposit of silver, for we need not suppose the depressions to go right through the silver; they need go only half through if we suppose them to be half the above width, and the same effect will be produced. Of course the unevenness of a silver film would be of an irregular character. I have supposed it to be regular on a small portion of the surface, so as to reason out the effect of irregularities within the limits of the thickness of the silver film. Now suppose that the irregularity of the deposit extends over 3in., and this I have certainly seen, and that the irregularity is only so great as to be one quarter the thickness of the film in depth. Now as the 3in. in width will reduce the evil effect to one-third the above, as shewn in Fig. 2, and the one quarter of the thickness of the film will further reduce the evil effect one quarter, it follows that the evil effect will be reduced to one-twelfth, and as I have above concluded that the evil as seen in Fig. 2 is 160 times what would be visible with a ¼in. eyepiece, the one-twelfth of this is about thirteen times larger than what could be seen, it follows that such an irregularity would be very detrimental to definition. I must further confess that such results greatly alarm me, and I shall be very glad if some error can be found in the reasoning or calculations, for certainly if correct, then a variation in thickness of $\frac{1}{3000000}$in. ought to perceptibly interfere with the definition with a ¼in. eyepiece. All this makes me think that the contact test is, as "Prismatique" has asserted, not to be relied on, and that he was not mistaken in his assertion that he has seen a flat that stood the contact test well, utterly break down under the telescopic test that he applies and recommends. I hope, as the subject of the effect of inequalities in the deposit of the silver film has now been brought forward again, it will be thoroughly thrashed out both by our mathematical and practical friends, and that in a friendly way, for I am sure we all wish to get at the truth about this most important question. I have long thought that one of the weak points, if not the weakest, of the modern reflector is its silver film, but I did not think it was so weak a point as the above reasonings and calculations seem to shew it to be. I had certainly come to the conclusion that a variation in the thickness of the film would be detrimental to definition; this I was sure of, from the fact that the sides of a scratch on the film did reflect light not to the focus but to the two sides of it, but I had not attempted to calculate it out. May some mistake be found in my calculation!

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

THE ETHER—SCIENCE AND METAPHYSICS—EVOLUTION.

[26962.]—IT is very natural that "F. W. H." (26883, p. 564) should find my suggestion as to "force" being superadded to matter "chimerical." He has so saturated his mind with the teachings of Buchner, Moleschott, and the other German professors of pure ultra-materialism, that he is unable to appreciate any idea of a power or existence not included in "matter and motion." I, on the other hand, see no reason to change the opinion expressed in the first sentence in the first edition of my "Electricity": "When we endeavour to analyse and simplify our ideas of the universe of which we form part, we find that we reduce it to three distinct conceptions, which we define as *essences* or *entities*—viz., *Matter*, *Force*, and *Spirit*. We cannot separate these or really conceive either one by itself, yet, as mathematicians abstract particular qualities and functions, and express them by symbols, so we do with these primary entities. The first we conceive as inert in itself, the second as that which acts upon and moves matter, and the third as that which controls both, and alone possesses volition and intelligence."

A school of philosophy which pretends to understand man, but ignores the soul; which hopes to explain the universe, while denying God—that is to say, which bases itself only on matter and motion, is to my mind so "chimerical" as not to be worth listening to. I should pay as much attention to the description of the scenery of a country by a man born blind, or to the artistic teachings of a person destitute of perception of colour.

Let us test this for a moment in the picture drawn by "F. W. H." of the "ether representing the ultimate state of matter, filling the universe infinitely distended, yet possessed of inherent forces residing in its minutest particles, becoming manifest and phenomenal by concentrations, such as the mutual attraction or repulsion of its atoms would cause." The relation of ether to matter being here the same as my own suggestion, of course, I do not touch. But we see at once that this school of thought has to start with some tremendous assumptions: it begins with the unexplained existence of this infinitude of atoms having *inherent* attributes which they do not manifest. It goes on to assume that the endless variations of action, of life and intelligence, arise from the mutual actions of these atoms under concentration—that is, *it wholly repudiates any force or any will distinct from or external to the material atoms.* That is, in fact, the basis of this school of philosophy.

Now, is appears to be a fundamental principle that no aggregation of units can possess powers beyond those possessed by the individual units. Organisation, therefore, can only exhibit and apply the powers existing in the elements out of which the organisation is constituted. The attractions and repulsions of atoms of matter can only be imagined to constitute a living, thinking man upon one of two plans. Either the primary atoms of matter must have in themselves the power of life and thought, or something not included in these ultimate units must be added to them.

It is at once demonstrable that the units or atoms of matter do have "in some occult way forces superadded," although that appears "chimerical" to "F. W. H." Energy is known to us only as displayed by matter; yet no one would venture to assert that energy is matter. But energy is no inherent property of the atoms of matter; if it were, the atoms could not part with it. Each atom must for ever retain any property which is inherent in itself, or it would cease to exist. Energy is, however, freely transmitted, and is, in fact, for ever flowing through the Universe; charged now upon one atom or aggregation of atoms, with the speed of light it is transferred to far distant atoms and aggregations.

I said, p. 543, that the very fundamental property of matter, its weight, "is not a property of *matter* at all—it is a measure of *force*, which, for all we know, may be a something superadded to matter," which is the remark "F. W. H." finds so chimerical. But he knows perfectly well that some forces, say heat, are absolutely thus superadded to the atoms of matter which display them. If they are transferred from one atom to another, they are superadded to the receiving atom, and they are something external to and distinct from the material atoms which manifest their existence. Truly, they are manifested only by means of material atoms, and their apparent existence is in the form of motion of such atoms. I say their *apparent* existence; our only measure of energy is the quantity of motion manifested by a quantity of matter, and though mathematicians sometimes talk about pure motion, motion apart from something moved appears to be an unthinkable notion. But that does not prove that "energy" has no existence of its own, that our *measure* of it defines its *essence* also. Every action of energy indicates the thought that its source is not *matter*, but *will*.

Here we come to the distinction between *force* and *energy* as to which much confusion exists. Force, mathematically considered, is something distinct from energy; but actually it is a manifestation of the presence of energy—it is the relation of energy to matter, either atomic, molecular, or mechanical. This is much too large a subject to touch on now, except to remark that while energy is transferred, and separate from matter, as we have seen, *force*, or some of the forces, are dependent on the nature of matter, and may be conceived as an inherent property, or as a capacity conferred upon the atoms of each kind, or consequent upon the combination of different atoms—that is, the capacity to exert force depends on special modes in which energy can be superadded to matter. This is easily shown in most of the forms of force or modes of energy; it is not so obvious in the case of gravitation, the fundamental natural force. None the less, it is clear that even gravitation is the expression of some relation of matter and energy, because the interchange of forms which is the basis of the correlation (or co-relation) of the forces and the conservation of energy includes gravitation, which force is, in fact, the great storehouse of potential energy.

"C." (26922, p. 14) asks us to reconcile two statements as to the doctrines of evolution. Canon Curteis says the doctrine merely explains the *process* of creation or coming into being of the actual forms of existence, but does not affect the idea of creation; but Herbert Spencer says, "If there has been evolution, there has not been special creation; unchangeable laws negative the conception of divine government." Why attempt to reconcile? Different people form different notions on all subjects, and more especially as to abstract ideas. Herbert Spencer is a man of the highest abilities; but we need not trouble ourselves about his notions further than to inquire what foundation there is for them. No one supposes that his dogmas have infallible authority, and as he most certainly does not himself know what he thinks or believes, he entirely fails to influence the thoughts of others. His intellectual tendency is to the hard atheistic school of materialism, while there is in him a moral, emotional force which tells him there is a something correspondent to it in the universe. While he talks about material forces and unchangeable laws, he admits a force in the universe making for good. But this is a moral control outside of material laws—the very thing he says is inconsistent.

In all these matters relating to the boundaries of knowledge, to the relation of the seen and the unseen, the material and the mental, that is, in other words, to the fields of physics and metaphysics, true wisdom lies in recognising that the modes of study are absolutely distinct, that different laws prevail, and that the very modes of thought and orders of mind which lead to truth on one side of the boundary are false on the other. Science (which is organised knowledge) is supreme on one side of the boundary; on the other side, science has no basis, because we have no knowledge; its methods are useless, because we cannot experiment in that field, therefore, the so-called man of science is an impostor. As I said in a discussion some time ago, any man of science who declares that all things are included in matter and motion, and that there is nothing besides them, *ipso facto* shows his ignorance, and proves himself a pretender. With equal truth it must be said that the man who applies, *within the true limits of science*, the knowable and the provable, any dogmas or notions derived from the other side of the boundary, commits a corresponding error. What he proclaims as truth, and which in its own department may really be such a glimpse of truth as we may hope to attain, becomes mere superstition, and defeats his own object by repelling those whom he endeavours to control. This is the real fact as to the pretended antagonism between science and religion. There is no such antagonism; there is a conflict between some men of science and some of those who claim to speak on behalf of religion, because neither will recognise that the two are distinct fields of thought, in which wholly different laws and processes prevail. Thus, in the special subject, evolution—the physical changes the universe and its constituents undergo—the laws which govern those changes belong absolutely to "science." The man of science, as such, has nothing to do with the question of creation, nor does his explaining the process of evolution, or his definition of the laws which govern the universe, affect the entirely distinct question of the origin alike of the universe and its laws. If he touches these on scientific grounds, he proclaims himself a pretender. But it is no less an error to attempt to bar the work of science within its own limits, or to condemn any of its results merely because they conflict with ideas derived from an entirely distinct source.

As to evolution, pretty nearly everyone who has gone into the subject has adopted that view of the processes of existence; but there remains untouched the fact, now proved, that no life, however humble, comes into existence except as a sequence of previous life; and the other fact, that the self-existence of material atoms with inherent powers, and the development of faculties of life and mind from them, is utterly beyond our understanding.

Sigma.

A METHOD FOR RAISING WATER AN UNLIMITED DISTANCE IRRESPECTIVE OF WHAT IS KNOWN AS THE 32ft. COLUMN.

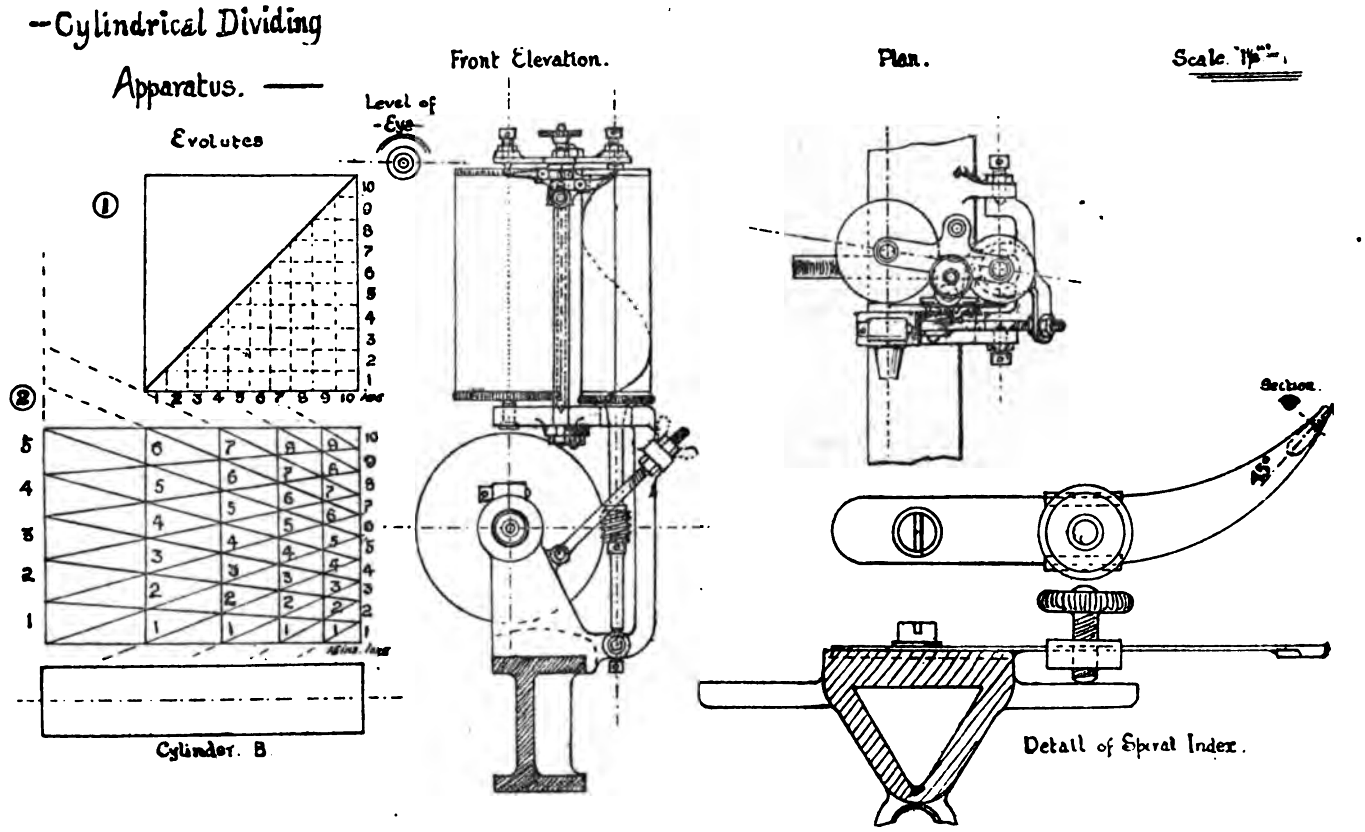
[26963.]—FIX a small cylinder about 12in. long at an elevation of, say, 50ft. At about half-way—viz., 25ft., place a close vessel, to hold about three gallons, from the bottom of which a ⅛in. lead pipe must be continued to the pump cylinder; and another ⅛in. lead pipe soldered to the top, descending into the well or basement. A third pipe must be soldered to the top of the vessel, and terminate near the pump cylinder, having a cock soldered to the end. This cock being closed and the pump worked, the air in the pipes and the vessel will be withdrawn, and the latter consequently filled with water by the atmosphere; then open the cock to admit the atmosphere to act on the surface of the water in the vessel, and by then working the pump, the water can be raised and discharged as above; or, in other words, by using a series of close vessels, water may be raised to an unlimited distance, irrespective of our 32ft. column.

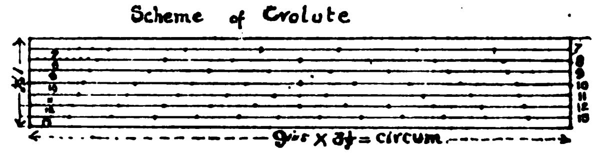
W. H. Wildig, Plumber.

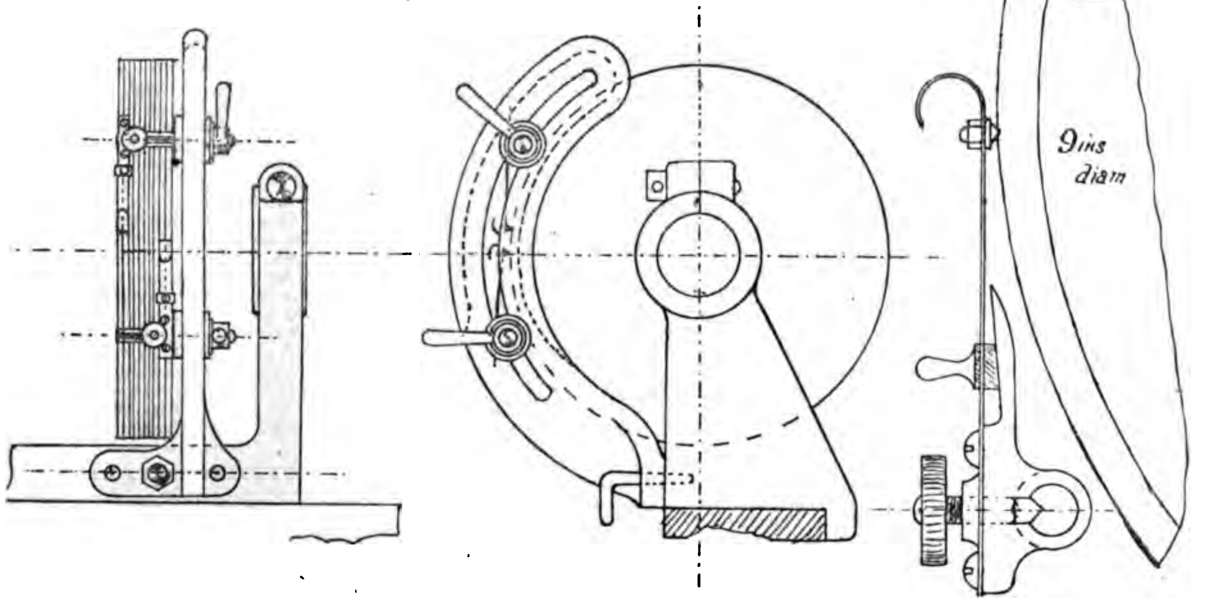
33, Grosvenor-street, Chester.

DIVIDING APPARATUS.

[26964.]—I SEND particulars of two ways of practically universally dividing circles in the lathe. One is a cylindrical apparatus, and in it "Reymond" will find some likeness to Prof. Fuller's instrument. The other is a plate divided on edge to attain greatest accuracy and convenience, and also to leave face free for inspection with any specially-needed prime numbers, &c. This device is simple and inexpensive, and is more capable than at first sight appears. Prime numbers can be got from it by dividing a circle into one that is less and another that is larger (to an equal extent), and then taking the mean distance by diagonal. Thus, in the "E.M." lathe a temporary edge might be prepared on the face-plate, the number made upon it, and afterwards transferred to surface of inside plate. Its total capacity is very large. Two indices are shown in the drawing, but a third would be handy for large numbers, and room is made on horn for it. The horn may be as stout as suits the maker's taste; but a maximum is shown by the outer line and a safe minimum by the inner and dotted one. The horn is removable from head, leaving the stud as a fixture, about ⅜ or $\frac{7}{16}$ diam. The holes all start from an axial line, that for appearance and convenience of numbering only, as any start does not affect the plate. Two or three circles might be divided on one line. 7, 9, 13 could, for instance, but that might lead to confusion and







error. Its simplicity renders it suitable for home construction, and its capacity to produce other plates for a not too expensive lathe.

The cylinders give every number by units from 0 to 250, and any multiple of 250 to 250^2, a wide range, and do not require any time or trouble to set them, nor any counting. If well and accurately made from the worm wheel upwards, they would work to great precision. One way to truly cut a worm-wheel is to cut it with two similar taps or hubs on opposite sides.

The evolutes show how the spiral (1) converts vertical linear units into horizontal circular, and the theoretical form of the linear (2) cylinder. Cylinder B shows how the evolute of (2), wound the reverse way, makes a unit-by-unit dividing cylinder. Practically, a number of discs on an axis, spaced by diagram to take intersections on their peripheries, and divided one end to zero and other to ultimate, the divisions being joined by joining spirals, would be divided into any intermediate numbers required. They could then be closed up together for a division cylinder, or kept for separate use. The linear cylinder is so economised, the divisions on it being equi-distant, 250 to zero being represented on an equal number of lines $\frac{1}{16}$in. apart; or the diameter may be reduced about 1in. by bisecting all the numbers in the first hundred, and then adding the even numbers of the second hundred, and the remaining fifty in series; but there are just as many divisions to mark off, and there is a little liability to error. The cylinder may be used with verniers, or a series of strips, fixable to either frame or index carriage, and divided 7 to 13, &c., may be substituted for it. The worm-wheel is supposed to contain 250 teeth; same number as lined cylinder's divided lines. Any number would do, of course, and when multiplying began, any divisor of it might be multiplied, as well as the number. The cylinders are turned by milled portions on base, though it is possible to make a strongly mounted index carriage rotate the spiral cylinder and worm; the spirals then being numerous and deeply cut, and the index being replaced by a nut of suitable form, and polythreaded also; the vertical cylinder is then the only one to watch and set index on. The index carriage is traversed by a screw and milled wheel, the first dotted in, and the latter shown above the carriage. It is quite convenient for a person of ordinary height, and the lined cylinder is in excellent place for seeing. By using magnifiers, the spiral and other divisions would give excellent results as marks only. The one cylinder might carry both spiral and vertical marks, with an annulus, or ring, for taking vertical measure, and a line or point to take spiral; but the rotation of the cylinder makes it awkward to see the marks. This whole device is, of course, rather a mechanician's than an amateur's. I will send particulars of a circle-dividing compass of great range—one that can be cheaply made, and as easily set and used as any ordinary dividers; also an extra, by the use of which in combination any number can be got. I think it is free and novel; but, though of my own recent devising, am not quite sure.

Vulcan.

OCCULTATION OF ALDEBARAN, MARCH 2.

[26965.]—I AWAITED last Friday's issue of the ENGLISH MECHANIC to see what other observers noted in this occultation.

Near Gioja, and between it and the N. Pole, are two short mountain chains parallel with the limb of the moon, and leaving a narrow smooth surface just at the pole. With a fine 3¼ achromatic Aldebaran was watched until it just touched the commencement of the narrow strip, then it appeared projected upon the strip; finally, before disappearing, mingling its light with the peaks of the nearer chain referred to. Its disappearance was instantaneous.

Seven minutes afterwards I looked again, and was surprised to see that the star had already emerged, having been occulted by a smaller portion of the moon's disc than I was led to expect. I am curious to know if any other observer saw the apparent projection of the star on the lunar face.

Woodbridge, March 14. **W. L.**

[26966.]—AS Mr. W. G. Franks (letter 26927, page 32) appears to doubt whether this phenomenon could have been observed so far north as Greenwich, I may inform him that it was seen under very favourable circumstances from the northern suburbs of London, and must therefore have been also visible from our National Observatory. I noted both the disappearance and reappearance of Aldebaran, which in each case appeared to be instantaneous, and the duration of the occultation agreed pretty closely with the predicted time for Greenwich.

Mr. Franks' surprise to find that the occultation was not visible at Leicester, nor even at Cirencester, the latitude of which he states is only some 14′ north of Greenwich, will perhaps be lessened, and his expressions of blame against the *N.A.* authorities moderated, if he considers that the limits of visibility as published in the *N.A.* do not mean that an occultation will be visible from "every" point included within such limits; but that the extreme points touched by the curves representing the limiting lines of visibility will be represented by the figures there given.

With the large body of observers who must have watched this occultation, favoured by the clear atmosphere which seems to have generally prevailed at the time, this must have been an unusually favourable opportunity for those situated near the line of limit for noting any special features, either of gradual extinction and recovery of brilliance, or of repeated disappearance and reappearance, of Aldebaran, due to grazing along the irregularities of surface of the lunar limb, and I hope we may learn that some observations of interest were secured. **W. T. N.**

THE PROPER MOTION OF 45 GEMINORUM AND STARS NEAR.

[26967.]—THE very unequal pair O Σ 165, 45 Geminorum, is entered in Gledhill and Crossley's "Handbook" as a probable binary, the change in angle being large, with a small diminution in the distance; but the change observed actually arises from the proper motion of the large star. The *comes* is very small, being rated 10·7 by O Σ, but 12·5 or 13 in Struve's scale by Burnham and Hall. Some of the measures are—

O Σ	130·70°	3·875″	(2 nights)	1847·22.
„	119·35°	3·335″	(2 nights)	1856·74.
„	89·70°	2·895″	(2 nights)	1870·24.
β	78·1°	2·45″	(2 nights)	1878·12.
Hall	73·13°	2·980″	(3 nights)	1879·19.

Dembowski failed to see the *comes* under the best conditions in 1865. I have, I think, alluded elsewhere to this object; but my attention was recently drawn to it by a request from Mr. Gore for its proper motion. For this Auwers gives – 0·0016s. and – 0·104″. κ Delphini is another object of the same kind, the change in both being at first sight apparently orbital. In the case of κ Delphini the angle changed through over thirty-three degrees between 1851 and 1872, the distance remaining constant at 10·3″.

There are a couple of very widely-separated stars near 45 Geminorum, which are moving in apparently the same direction as 45 itself, but with greater velocity. They form Nos. 66 and 67 of Argelander's "Untersuchungen über die Eigenbewegungen von 250 Sternen," and are P. vi. 329 and 332; the △ α, according to Wolf's measures, being + 11·8s. and the △ δ – 25·0″, the *p.m.* of the first being – 0·0008s. and – 0·217″, and that of P. vi. 332 being + 0·0007s. and – 0·208″. The places of these three stars for 1855·0 are—

	h. m. s.	° ′ ″	
P. vi. 329	vi. 59 43·07	+ 15 45 32·3	(Bischof)
P. vi. 332	vi. 59 54·87	+ 15 45 7·7	(Bischof)
45 Geminorum	vii. 0 2·95	+ 16 9 28·8	(Pulk. Cat. 1855)

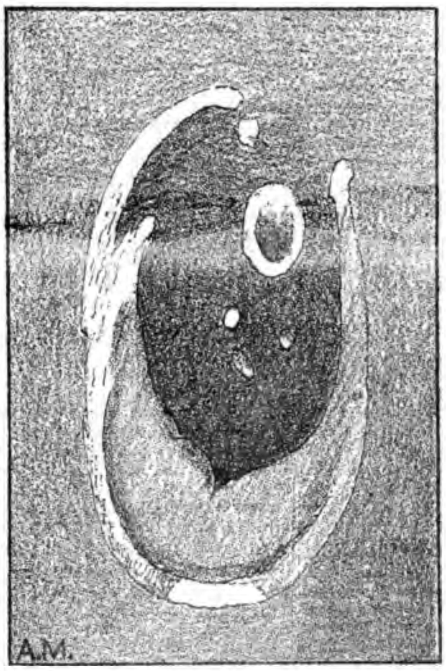
According to Mädler, the neighbouring star, Bradley 1036 (B.A.C. 2347), the place of which for 1855·0 is—

viih. 2m. 59·84s. + 15° 34′ 0·4″ (Pulk. Cat. 1855),

is moving in almost the same direction and with the same velocity as 45 Geminorum, the secular proper motion of Bradley 1036 being, according to Mädler, 10·0″ in 166·1°, while that of 45 Geminorum is 11·5 in 178·8°. The value adopted in the B.A.C. gives for the secular *p.m.* of Bradley 1036 about 16·3″ in 143·0°. Bradley, however, did not observe the declination of his No. 1036; the value, therefore, of the proper motion in that element assigned by Bailey and Mädler depends on a comparison of Piazzi (1800) and Taylor (1835). It is certainly far too large. Auwers gives for the proper motion in R.A. of Bradley 1036 + 0·0027s., and for that in declination – 0·01″, an almost insensible amount in the latter element. With these values the modern observations agree well with those made at the beginning of the century. In the Greenwich New Seven Year for 1864 the B.A.C. values are employed for Bradley 1036 (+ 0·007s. and – 0·13″). **H. Sadler.**

HERCULES.

[26968.]—THE faithful reproduction in current issue of my sketch representing sunrise on the lunar formations Atlas and Hercules prompts me to offer a drawing of the latter under higher illumination, and I do so the more readily because Hercules is one of the objects allotted for study this session by the lunar section of the L.A.S. A curious feature about Hercules is a series of bright points forming a species of circle just to the north of the large interior crater, unnoticed by Schmidt, but seen by Haeckel and corroborated by "our" able selenographer, Mr. Elger. On Feb. 6 I saw the spots noted in accompanying view to the N.W. of interior crater, but on March 6 I also glimpsed the spot figured on the N.E., and the whole space within the supposed "ring" seemed brighter than the rest of the interior of Hercules. Feb. 27 I noticed a bright spot just on the border of the shadow in Hercules: it is unmarked in the sketch already given in the MECHANIC; but I mentioned it to Mr. Elger, who happened to be observing at about the same hour, and am very pleased to learn that he also saw the spot which may probably be a formation more N. still than the "ring" above mentioned. But there was no sign of it either on the 6th of February or the same date in March under higher illumination. The N. rim of large interior crater is very bright, and next to it in brilliance comes the northern rim of Hercules itself. The S. boundary seems to disappear under a high sun. The accompanying sketch was made March 6th, 6—8 p.m., under tolerable definition, with power 60—400, on my 8½in. Calver. I wish some other observer would give us what he sees of Hercules. "North-east" in my last letter should read "south-east."



Llanelly, March 11. **Arthur Mee.**

SATURN.

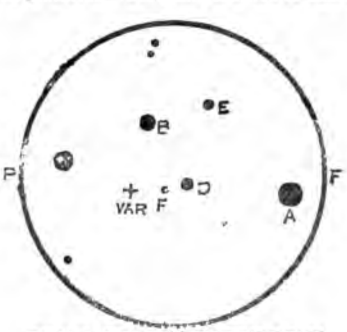
[26969.]—MAY I call your attention to the fact that the letter accompanying my sketch of Saturn made no mention that it was *half-size?* Since the sketch was drawn to no particular scale, such an expression may be misleading. I observe that the print is half the size of the sketch; hence, perhaps, the reason of the interpolation. Encke's division is shown too plainly in the foreground; it is scarcely, if at all, visible just there, owing to foreshortening. I believe it is my own fault; in striking out the ellipse I must have left the pencil line unobliterated. **A. Percy Smith.**

[We of course added the words "half size." The sketch as sent was too large for our pages.—ED.]

PUBLICATIONS OF THE L.A.S. OBSERVATORY, NO. 1—AN EXPLANATION—THE NEW VARIABLE V CASSIOPEIÆ—A MISSING STAR.

[26970.]—WILL you kindly allow me space to explain a most unfortunate misunderstanding, which is causing, as I hear, some friction? Law No. 23 of the L.A.S. states that "members shall be entitled to receive all publications of the society free by post." Members seem to have thought that the Observatory publications came under this law. May I therefore state that the Observatory Publication No. I. is not published at the expense of the society at all, and therefore does not come under law No. 23?

The new variable near *o* Cassiopeiæ, for which Mr. Baxendell suggests the letter V, has now dwindled down to an extremely small star. In case any of your readers are following it through its minimum, I give another drawing of the field, showing the comparison stars Mr. Baxendell and myself are using. The drawing was made on the night of Feb. 27th with a power of 200 on the 17¼in. Equatorial. The stars marked A and B are identical with those so marked in letter 26835, p. 541. The following are the magnitudes of the comparison stars—



STARS NEAR V CASSIOPEIÆ
1887 FEB 27TH 17¼ EQUATORIAL
POWER 200.

B	10·2
D	11·5
E	12·0
F	12·6

Mr. Baxendell's observations and my own are as follows—

1886	Nov. 30	8·5	E	1887	Feb. 18	11·0	B
1887	Feb. 6	9·9	E		20	11·0	E
	8	9·9	E		23	11·0	E
	10	10·6	E		27	11·3	E
	11	10·6	E		March 3	11·7	B
		10·7	B				

Mr. Baxendell, jun., finds that the star D.M. 47°, No. 192, which lies 11sec. *f.* the star C (let. 26835) is invisible in his telescope. On Feb. 27th not a trace of the star could be seen with the 17¼in.

T. E. Espin.

L.A.S. Observatory, 11th March, 1887.

DAY AND NIGHT IN NEBULÆ.

[26971.]—THERE is not a particle more ground for "F.R.A.S." to call the day of the body in the Andromeda Nebula "continual" than for us to have had day here while passing through the tail of the comet of July, 1861. Nearly from sunset to sunrise we then had, extending from us toward Capricorn, at least fifty million miles of something as luminous as all the outer regions of that nebula. Yet no one considered our state other than "night," though the astronomers complained of seeing fewer stars than usual. If the new body has "continual day," it must be of two very different sorts—a "day" that is day while the dense central nebula is in sight, and a "day" that is rather night when it has set under their horizon.

March 14. **E. L. G.**

COILS.

[26972.]—EVERY physicist must feel more or less with "R. G. P." (letter 26942) the desirability of producing a powerful induced current with a minimum battery power.

For the examination, mapping, and photographing of spectra of metals, alloys, amalgams, metalloids and gases, and also many of the metallic salts in the direction of physical and chemical research, a powerful coil is indispensable; but not in all cases does it advantageously supply the place of the Bunsen burner in ordinary qualitative chemical analysis. For such substances as are included in the two groups of the alkalies and alkaline earths, it is not advisable to go past the Bunsen burner; indeed, the spectrum of salts of K is incomparably better observed from the flame than from the spark, and doubtless much smaller traces of lithia could be detected in the same manner. The chlorides of manganese and copper, also boracic acid, give flame spectra, but as the two former give characteristic precipitates in the wet way, the flame is not necessarily resorted to. Thallium and other more rare elements also give characteristic and delicate reaction best examined by means of the flame.

In answering the question whether such a coil can be purchased from the philosophical instrument maker, I may say that 10in. coils are, I believe, in the market; but the makers themselves can only answer as to the required battery power.

Mechanical skill is highly desirable in the construction of machines of whatever kind; but the application of the principles of magnetism and electricity as elucidated by such men as Prof. Thomson, J. T. Sprague, &c., is of equal importance. In referring to a work by the latter, readers will call to mind a description of a four section coil in which the thickness of insulating material is made to vary in direct proportion to the strains. It would be interesting to know how in 50 to 80 section coils this principle is carried out; still, it must be evident that when the insulating discs are of uniform thickness, the loss of space must be enormous, and might as well be occupied with wire, particularly where the thinning is progressive towards the primary, the convolutions being necessarily of smaller diameter, and thereby concentrating the secondary as much as possible midway between the poles. Attention was called to this in my description referred to by "R. G. P."

The thickness is more a matter of convenience and space than that of resistance, to which it appears so much importance is attached by many. The difference of resistance between Nos. 35 and 36 is about 300 ohms per mile; this slight resistance in a 10-mile secondary is insignificant as compared with the resistance to the secondary discharge in air of such an instrument, which amounts to many million ohms, and may therefore be almost neglected.

It has been more than once stated in these columns that because a secondary discharge occurs at all, it is a sufficient proof that the secondary is therefore in one continuous length. Such is not the case; the extremely high E.M.F. is sufficient to bridge over a large number of breakages. The space between dischargers may be considered as one.

"Sigma" and others of high authority prescribe silk-covered primary; but there is probably a limiting diameter where the slight gain in this direction may be also neglected. A primary of a smaller diameter than 12 or 13 B.W.G. is, doubtless, preferably silk-covered; but in this, as in all other details, so much depends upon individual cases, and the purposes for which a machine is intended, that no strict lines need be laid down, and much after all must depend on the judgment and ability to grasp all the conditions of perfect harmony of parts composing the whole.

To those who are frightened at the idea of building on the tapering disc principle, I venture to say that the difficulties exist more in the imagination than in actual construction, and with a fair amount of manipulative skill practically vanish. The results referred to by "G. P. T." could, if desirable, be still further augmented by two very simple improvements—namely, by using hexagonal wire for the core and square wire for the primary, with corners somewhat rounded to prevent abrasion of the covering. **S. Higgs.**

HORIZONTAL v. VERTICAL WINDMILLS.

[26978.]—IN reading the letters on the above subject, and thinking over the action of the wind on the sails of a vertical mill, it occurred to me that all the force or energy contained in the wind as it strikes the sail is not utilised. Thus, suppose the sail to be set at an angle of 45°, and to be held at rest: as the wind strikes the sail it is deflected in a line at right angles to its course, and directly opposite to the direction in which the sail would move if allowed to. Now allow the sail to move at half-speed. The wind will still be deflected, but not so much, and still in a direction contrary to the revolution of the mill. Now place at the back of the first windmill (on the same spindle, but to run loose) another set of vanes, set to move in the direction opposite to the first. It seems evident that the wind when deflected from the sails of the front mill, will impinge upon those of the one at the back, *perpendicularly, or nearly so;* thus utilising some of the energy, or momentum, still remaining in the wind after it has passed the first mill. Has this experiment been tried? If so, with what result? If not, I throw it out for the consideration of our readers. **E. W. O.**

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61101.]—**Stars Visible from Bottom of Well.**—Some time ago I ventured to express a doubt whether stars could really be seen from the bottom of a well; and "B. A.," on 20th Jan., gave as proof that they could be seen a second-hand statement by Herschel, and several references of a similar nature in Arago's "Popular Astronomy." Having, with some trouble, found that work, I see that they are really of a similar nature—viz., worthless. 1. A statement from some unknown place in Aristotle's works. 2. A statement by Pliny, who, Arago says, is not to be trusted. 3. A statement by one Steiner, who says that a trustworthy Spaniard had told him that some students at Coimbra had so seen the stars! "B. A." should, in fairness, have mentioned that Arago himself is not convinced. I am more than ever—DUBITANS.

[61131.]—**Electric Cautery.**—In reply to last week's answer, I may say that though the needle of the Bottone ammeter is directed by the earth's magnetic field, still readings taken in two different rooms of same house with same current may vary considerably. That is the case here; and as an example, I was told by an electrician in the G.P.O. that the tangent galvanometer used for testing did not give two readings alike in different parts of the General Post Office. A gentleman well known here uses the Byng cautery battery of the General Electric Apparatus Company, and he says it does admirably. On short circuit, with a cautery, it gives 40 ampères. It is clean, handy, and portable. Six plates, 4in. by 6in., are used, and two cells in series.—IOTA.

[61402.]—**Electric Bath.**—TO "EOS."—I am much struck with your ingenious arrangement of the above, and having a zinc bath and 6-pint bichromate battery, would like to try its effects; but before doing so, may I submit the following queries:—1. What electrical conductors do you recommend? 2. Is the elastic tape and hook to be submerged or not? 3. Is not all that part of the body which is immersed affected by electric action? 4. What is the reason for two terminals to negative pole?—ELECTRA.

[61402.]—**Electric Bath.**—I quite agree with "Eos" as to the great value of above for many ailments; but I can see one objection to using salt water for exciting a Pulvermacher, and that is, the deliquescent nature of sea salt, which would waste the zincs. Surely "Eos" is mistaken in calling the zinc the positive pole. At least, I do not know any metal (commercial, I mean) positive to zinc. If zinc is positive to the yellow alloy, it must surely be the negative pole (positive electrode). That is to say, inside the battery zinc is positive to the other metal, and so the current flows from zinc to alloy, and, outside the battery, in the opposite direction, or from alloy (+ pole) to zinc (– pole).—ELECTRICIAN.

[61452.]—**Electrical Apparatus.**—I quite agree with Mr. Habgood as to there being several advantages in running lamps from accumulators charged by primary cells, as opposed to being run from the batteries direct. Of course, the resistance of the cells must be low; but, with large cells and small accumulators, this presents but few difficulties. Mind, I do not advocate batteries where dynamos are admissible. I myself have experimented in this line, and know that Mr. Conry is mistaken in saying that a week's charging is needed for a few hours' lighting; for I, for seventeen days in succession (Sundays excepted), have obtained from accumulators charged by batteries sufficient power to run four lamps of 12c.p. for two and a half hours a night, being at the rate of 8 ampères 22 volts for two and a half hours, without any perceptible fall of E.M.F. As to economy, I think the waste of energy in charging accumulators by primary batteries is, compared with direct lighting by primary batteries, about 15 per cent. This, however, is fully compensated for by the following advantages, viz.:—Economy of labour by having only a few cells to charge. Economy of first cost, as accumulators are cheaper than batteries giving an equal discharge. Absence of expensive switches, as the accumulators are self-regulating. Economy of lamps, as they cannot be over-run, since the E.M.F. is constant.—ELECTRICIAN.

[61452.]—**Electrical Apparatus.**—I am quite at one with Mr. Habgood so far as the use of secondary cells are necessary when primary batteries are employed for electric lighting; but in all but special cases the cost puts the use of primary batteries beyond reasonable reach, although the most economical way to use the latter (and, in fact, owing to the varying E.M.F. and internal resistance, the only way they could be worked in a practical manner) is in combination with secondary cells, when the latter can be charged in parallel and discharged in series. When I put the efficiency of accumulators at 60 per cent., I refer to the very latest forms, both E.P.S. and Elwell Parker's, and to the results of actual tests over some length of time in regular working. I am quite aware that if we take cells specially for testing purposes we may easily get 80 per cent., and I have even got higher results; but what we want is practical results, and upon this base our calculations of cost. I may say that the report of the Commissioners to the Colonial Exhibition bears me out. They put the efficiency of the accumulators at 63 per cent. in ampère hours, and a fall in E.M.F. of 6 volts in five hours. This was not due to the cells being too rapidly discharged, as the cells were stated as capable of discharging at 240 ampères, and the actual rate of discharge was only 169 ampères per hour. I said nothing about local action in the primary batteries, and this would certainly be considerable.—OHM.

[61456.]—**Caustic Soda Process.**—(Page 504, reply by Saml. Ray.)—Might I ask Saml. Ray if the 33lb. of acetate of soda is put in the footwarmer dry or with some water? and if with water, about how much? If it is put in dry, and simply melted by the heat, does it, in cooling, expand like ice, with a tendency to burst the vessel? If it is used with water, would a supersaturated solution (in boiling water) of, say, common soda (which is cheap) have a similar effect; that is, as it cooled, and the excess of soda crystallised, would it give out more heat than the same bulk of boiling water?—E. W. O.

[61530.]—**Ferrous Oxalate (U.Q.)**—I use ferrous oxalate to develop bromide paper both when enlarging with long exposure or printing by contact with short exposure. Why not try it? Personal experience is better than second-hand.—SM.

[61538.]—**Straightening Wire.**—I am obliged to "No Sig." for his answer to this query. He, however, has misunderstood it; and as this is perhaps due to my not having made it perfectly clear, I will say that by the best system of straightening wire I mean that which will produce perfectly straight wire from the most springy and irregularly annealed wire of different gauges, with the least adjustment and with the least power. I may say I have tried straining it straight; this I found answered admirably for soft or fully annealed, but not at all for half-annealed wire. I have also tried drawing it through a series of adjustable rollers fastened on a plate, which would perhaps be similar to the "drawing machine" referred to by "No Sig." This I found answered fairly well, but could not be relied upon to remove kinks, and required a lot of adjustment. The system of drawing it through a high-speed machine, referred to in my query, has, I believe, none of these objections. Unfortunately, at present it is not convenient to refer to the mill in which I saw it at work. I hope, however, that with these additional particulars, "No Sig.," or some other correspondent, will be able to put me on the right track.—H. C. C.

[61543.]—**G.W.R. Locos. (U.Q.)**—No. 378 (Sir Daniel) was built at Swindon, September 1866.—EAST ANGLIAN.

[61570.]—**Chemical (U.Q.)**—If your BaO_2 is pure, you can estimate the Ba as sulphate; the difference will give you the oxygen. You can test for nitric acid by the usual methods—*e.g.*, sulphuric acid and ferrous sulphate gives a brown colour. The ppt. of $BaSO_4$ will mask the reaction slightly, so if the HNO_3 is in small quantity, fuse your BaO with pure Na_2CO_3 extract with water, evaporate and apply the test.—SM.

[61576.]—**Chimes for Grandfather's Clock.**—If this querist is wise, he will buy the set of chimes—preferably bells—from one of the dealers in Clerkenwell, as he will have much trouble in making them himself from steel wire. The Cambridge or Westminster chimes are to be found in several books, and are well known to all the dealers. The order of the notes is thus: Key A, 1st quarter, C, B, A, E descending; 2nd quarter, A, C, B, E; A, B, C, A; 3rd quarter, C, A, B, E; E, B, C, A; C, B, A, E. The hour is chimed A, C, B, E; A, B, C, A; C, A, B, E; E, B, C, A—A. The semicolon indicates a note three times as long as the others; but the end notes of each phrase are semibreves, or what you like.—N. E. CHILD.

[61587.]—**Street Medical Coil and Phonograph.**—Directions for making these instruments have been given many times. The phonograph is no use in the street, and as to the coil, it is a very small affair, differing from the ordinary induction coil by having a brass tube sliding over the primary. It is padded out to an enormous size, and the drawing out of the tube is made to actuate the index finger on the dial.—PERIPATETIC.

[61590.] — **Electrical Foot-warmers.** — Are there any electrical foot-warmers in existence that Mr. Conry should ask for details? If so, where? —NUN. DOR.

[61592.]—**Tinned Steel Spiral Springs.**—If the springs are properly made, they retain their resilient powers more than "pretty well." Any maker accustomed to the manufacture will guarantee them.—N. E. CHILD.

[61593.]—**Electro-Deposition.**—Nobili's rings were produced by electrolysing a saturated solution of acetate of lead by means of a strong current and a steel platinum anode and platinum wire cathode, the rings being produced on the anode. Nowadays they are produced on a polished steel plate, laid in a shallow vessel containing the acetate solution. The steel is connected to the copper element of the battery, and a small disc of copper connected to the zinc element is brought close to the steel, when films of lead peroxide will be deposited.—NUN. DOR.

[61597.]—**Organ Scales.**—Mr. B. Bolt will find scales in back volumes, and he will also find, if he tries, that the lengths will vary within very narrow limits for any scale. An 8ft. pipe must have that speaking length—there or thereabouts, unless it is stopped, when 4ft. + will answer: it must have room for the stoppers. An open diapason is about 8ft. 7in., and a bourdon (16ft. tone) would be including foot and stopper 8ft. 6in. But the querist should always work with a margin, and leave something to cut off. This refers only to fine-work. Reed pipes have many scales.—N. E. CHILD.

[61598.]—**Hall Mark.**—It is doubtful whether even an expert can answer this query without seeing the cup, which is presumably of silver. The anchor is the Hall mark of Birmingham, and a lion passant would be the mark of the standard; but "Argent" writes "lion rampant," which is a standard mark for Glasgow. The head is probably the duty mark; but what "13 in Court Hand" can be is a puzzle—surely 13 is really some letter. I think the querist should allow some one to look at it who is acquainted with the intricacies of Hall marking.—SAML. RAY.

[61607.] — **Proportions of Locomotives.** — The proportions of locomotives, or, at all events, the proportion between the cylinders and boiler and heating surface depend on the work the engine is required to do, which work itself may perhaps be summed up in the one term "resistance." There is no simple rule, but if "Inquirer" will turn to p. 13, No. 885, he will find the data necessary for designing a locomotive worked into an example by Mr. Ed. Gobert, a contributor whose pen has been missed from these pages for some time. If the querist is really interested in the matter, and cannot procure the number, I will make a précis of the reply for him, as it will no doubt be useful to other readers.—NUN. DOR.

[61608.] — **Compound Engines.** — Surely "Loco." can do the sum himself, when he asks whether a goods engine makes as many revolutions per minute as the express. In round numbers, an express with 8ft. wheel makes 210 revolutions to cover a mile, a goods with a 5ft. about 350 revolutions. One accomplishes the distance in a minute, the other takes three minutes; therefore, the goods makes, say, 110 revolutions while the express makes 210, and as it is the last straw that breaks the camel's back, "Loco." will perhaps understand why compounds are more suited to goods traffic than to express.—NUN. DOR.

[61619.]—**Varnish.**—I think "Oilman" will find amber varnish or best pale copal withstand heat better than others; but how it will act when mixed with asbestos is rather a matter for experiment than for suggestion here.—I. J. M.

[61631.]—**Whiskey Distilling.**—This is really three queries in one. Call them *a*, *b*, *c*. (*a*) If for sale by distiller or merchant as whiskey, 25 over-proof. If for sale by a publican, cannot tell. The minimum is 25 under-proof. The law fixes no maximum; but you may safely say from 5 to 25 under-proof. (*b*) Taking this query to apply to distillers only, then whiskey from a patent still 65 to 68 over-proof, and from a pot still from 20 to 35 over-proof, according to the distillery and quality of spirit. (*c*) From a patent still from 68 to 70 over-proof; from a pot still about 40 over-proof.—C. H. O.

[61632.]—**Specific Gravity of Spirits.**—Proof spirit is defined by Act of Parliament 58 Geo. III. c. 28, as that which weighs at 51° Fahr. exactly $\frac{12}{13}$ths of an equal measure of distilled water. Practically, it may be said to be equal weights of water and absolute alcohol. Ten degrees O.P. means that 100 gallons contains as much alcohol as 110 gallons of proof spirit; 10 U.P. means that 100 gallons contains 10 gallons of water and 90 gallons of proof spirit.—NUN. DOR.

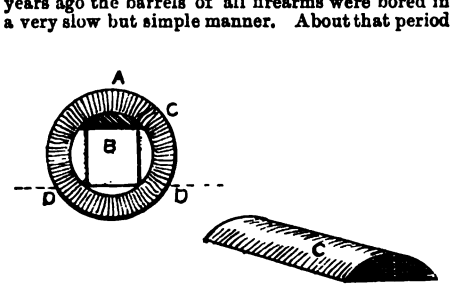
[61632.]—**Specific Gravity of Spirits.**—When 100 gallons of spirits contain $57\frac{1}{10}$ gallons of alcohol, it is called (by Act of Parliament) *proof spirit*, and at a temperature of 51°Fahr., weigh $\frac{12}{13}$ths of an equal quantity of distilled water. Should the proportion of alcohol be greater than stated, it is called over-proof; but, if less, it is under-proof—the letters O.P. standing for over-proof, and U.P. for under-proof. The strengths named are clear enough when similarly expressed, 30 O.P. and 3 O.P.; the former contains $74\frac{2}{10}$ of alcohol, and the latter $58\frac{8}{10}$ to the hundred. To find the strength O.P. and U.P. from the specific gravity as shown by a chemical balance (query: is this what you want to know?) is very lengthy, and scarcely necessary. Why not get a hydrometer? same as used by the Customs and Excise, and you would find the strength with far less trouble.—C. H. O.

[61637.] — **Dewing of Object-Glasses.** — I thank "M. A." for his reply; but I do not quite understand how his brass cap fits on to the cell so as to allow the dew cap to go on over it, and in a moderately large glass it is not always convenient to remove the dew cap when work is done. I am having made to fit on to the end of my dew cap a shallow cap of tin, in which is cut a circular aperture some three-fourths the area of the o g., and covered with very fine brass wire gauze. This will give ventilation to the o.g., and still keep out dust.—H. A.

[61645.] — **Portable Engine.** — First of all things, make a good fit of everything before putting in rivets; don't trust to them to pull up joints—if you do, you will find the rivet last put in will be slack when the next one is finished. As to getting out old box; if your outside plates are strong, get a sharp thin steel bar, and put in mud-doors, and cut off stays close to outside plate; if thin, drill them out. If you decide to put a new piece round the bottom, drill a row of holes round, and cut the parts left with round-nosed chisel, and let the box drop out. If your Z-iron is fairly good, be careful in getting out rivets, or you may spoil it. Drill or chip off rivet heads, and hold hammer against it when punching out rivets. Use $\frac{3}{8}$in. plates, and put on flush, with strap over joint inside, countersink outside, $\frac{11}{16}$in. rivets, 2in. pitch; fit and caulk up carefully, and you will make a neat, strong job of it. The corners as now.—T. N. C.

[61716.]—**Electric Lighting by Batteries.**—I did not notice this query; but having seen Mr. Bottone's reply last week, I would add a few remarks to his answer. In King and Mendham's Catalogue there is a note as to the uses of primary batteries, and it says: "Primary batteries are very convenient and economical where a strong light is wanted for a short time, as in lantern projections, or a very small light, either for a long time or for interrupted use." This explains the matter very well; but no primary battery is used for house-lighting continuously direct. The Upward and Lalande-Chaperon are often used to charge secondaries. The only battery the least like direct working is the Schanschieff; but, of course, as Mr. Bottone says, it is patented.—IOTA.

[61767.]—**Gun-barrel Boring.**—Forty or fifty years ago the barrels of all firearms were bored in a very slow but simple manner. About that period



A, bore of barrel; B, square bar; C, wooden chuck, blinding two corners; D D, cutting angles.

I was the possessor of a "Ginjal," or huge Indian wall piece—weight of barrel, 70 or 80lb.; calibre, $\frac{3}{4}$in. The metal was good, sound stuff, so I decided on turning the affair into a swivel duck gun. I had a neighbour who had served his time with a gunsmith, and he undertook to bore out the barrel for a consideration. He soon turned out a boring bar—that is, a square bar of very hard steel mounted in an iron rod 3 or 4ft. long (the barrel was about 7ft.) At the further end of the rod was an eye or ring, into which a cross handle of tough wood was inserted; the barrel was put in a sheet lead clamp, and then tightly fixed in a large vice. The piece of square steel on end of rod was only a few inches long, and made purposely a loose fit. Then a scrap of wooden hoop from a cement barrel was taken and driven into the muzzle, choking two out of the four cutting corners of the steel bar, so as to drive the edges of the other two into close contact with the inside of the bore. Oil was applied plentifully to the interior; then two men turned the cross staff slowly round with a twisting motion, gradually cutting all projecting metal. The rod was worked back and withdrawn when the loose motion proved that the cutter required a new wedge. A slightly thicker one was then inserted in the way before described, and the same operation repeated till the bore became enlarged to 1in. diameter. Then the gun-barrel was reversed in the vice, and the interior was treated in the same way, until on looking through it from end to end, the whole surface was smooth and free from specks. On removal from the vice came internal polishing; a rod of iron having a short cylinder at the end—just a trifle less than the calibre—is employed. This cylinder may be 2 or 3in. long. It is cast on the rod of tin alloy. Take off the back centre of your lathe and insert the opposite end of rod in a chuck, dress the cylinder with a paste of flour emery (the cutler's genuine article, not the stuff in packets), and olive oil. Revolve this tool half-way in the barrel, feeding it occasionally with the paste; then reverse your work, and do just the same thing again. Lastly, test the boring with a hard wood cylinder of very exact fit, and if it should run true from end to end all is right. The final dry polish is given by wiping out the barrel with a rag and boiling water, a little soda dissolved in same. When dry, run a wooden rod with a slit at the end, in which is secured a roll of fine emery cloth. This is best done in the lathe. In a few minutes hold your barrel to a lighted candle, or the sunshine—surprising you by the silvery whiteness of the newly-cut iron. If you want modern machinery, get "Harrison's Mechanics' Tool Book"; page 122, figure 28, will give you a boring bar for the lathe, easily made, and managed.—EOS.

[61768.]—**Battery for Lamp.**—Mr. Whittaker is right in saying that chromic acid attacks zinc; but so does bichromate of potash. Bichromate single fluid batteries are the most costly batteries in use, and have only one advantage, in that they are portable. Mr. Whittaker's form is not, however, nor is it lasting, as cheap earthenware cracks and leaks very often. Bichromates are said not to be troublesome to charge. Perhaps not, but they require recharging every two hours. Now, a two-cell chromic battery will outlive seven charges of a single-fluid bichromate, and the zincs are not in the chromic solution, so the balance is decidedly in their favour; both as regards cost of running and economy of labour, I think them unequalled.—ELECTRICIAN.

[61777.]—**Ferro - Chrome.** — Having obtained the chromium and manganese in solution by fusion with caustic soda and magnesia, and treatment with dilute sulphuric acid, add a few cc. of peroxide of hydrogen to decompose permanganic acid. On heating the solution for a few minutes, the excess of peroxide of hydrogen will suffer rapid decomposition, the chromic acid remaining unaffected. The analysis may then be completed in the usual way with standard ferrous ammonium sulphate.—NORMAN McCULLOCH.

[61787.] — **Indicator Diagrams.** — I cannot make the diagrams $\frac{1}{10}$ and $\frac{1}{30}$ scales. I presume these were the original scales you used; but they have evidently been reduced to something like half by the engraver. The area of the low-pressure cylinder = (say) 1,018 square inches, or 7·1 square feet nearly; the stroke being 5ft., the engine uses $7{\cdot}1 \times 2 \times 5 = 71$ cube feet steam per revolution, or $71 \times 45 \times 60 = 191{,}700$ cubic feet per hour at a pressure equal to that at end of stroke in diagram. As there appears to be a doubt as to actual scale, you can take this off for yourself; but you must measure from theoretical vacuum line = $1\frac{1}{2}$in. below atmospheric line, and divide by relative volume of steam to water at the pressure. Add 10 per cent. to result to allow for losses.—T. C., Bristol.

[61789.] —**Gas-Engine.** — Many thanks to Mr. J. Brown, Belfast, for his courteous reply to my query. I am well aware that the impulse is given to the flywheel. But the question is, is it given in an economical manner? I do not know the action of gas in the gas-engine. Is it sudden? I think, from the massive proportions of connecting rods, crank-shaft, &c., it is. It appears to me something like striking a blow with a heavy hammer. If so, the same amount of energy applied during a longer time would give much more available power. This is the point on which I seek information. I have also to thank "T. C., Bristol." But his reply is wide of the mark, as it deals with the invention, of which he can hardly form an opinion. I should be pleased to show him it in connection with an ordinary 7H.P. steam-engine.—T. N. C.

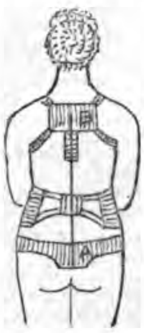
[61791.—**Pumps.**—About 28ft. of suction is the extreme, even with a straight suction pipe; for myself, I should not like to fix a pump with this length of suction, as I should not expect it to work well. The friction of a 1,000ft. of suction pipe would be much extra work for the atmospheric pressure. The amount of friction would much depend on the speed of the pump. If "H. H." decides to try his pump, he should be extra careful to have tight joints, a good foot valve and vacuum chamber on suction pipe, have good fitting buckets, a reflux valve on the delivery side, and a tap on suction pipe for charging it with water if it should fail to catch it; the larger the better, to save time. The speed of pumps would be limited by the rate the suction pipe would convey it—in this case uncertain. The speed is also limited to the design of pump, stroke, &c., which "H. H." does not state.—RIFLE.

[61798.]—**Condenser.**—I will give "T. C, Bristol," what information I can anent this query. Morton's ejector condenser consists essentially of two conoidal nozzles, one within the other, and pointing the same way. The inner nozzle brings injection water from the cold-water tank, and the sectional area of its outlet is, according to Rankine, $\frac{\text{net area of orifice}}{\text{area of piston}}$ = net volume of injection water per cubic foot swept through by piston × velocity of piston in feet per minute divided by 810. The outer nozzle receives the waste steam from the cylinder; the diameter of its throat, or narrowest part of its outlet, is a little greater than that of the cold-water nozzle. Beyond the throat it widens slowly into a trumpet-mouthed form, its diameter at the mouth being about three times the diameter at the throat. If there are two cylinders, there is an intermediate nozzle, so as to divide the steam coming from one from that coming from another. The condensation goes on in the space between the outlet of the cold-water nozzle and the throat of the outer nozzle. The vacuum is at least as good as in the common condenser. The momentum of the cold water and the waste steam carries the whole condensation water, together with the air it may contain, through the throat of the outer nozzle, and out at the trumpet mouthpiece, and the power required to work an air-pump is saved. For further particulars see *Transactions* Inst. Eng. Scot, 1868-69. Then there is the Macarter condenser, which consists of two chambers, one above the other. The top chamber is for condensing the steam. The bottom chamber has two tappet valves opening into it; its function is to remove the waste water. The exhaust steam from the engine passes into upper chamber, meets the injection water in form of spray, and is condensed, falling to bottom. To remove this water a vacuum is alternately created and destroyed in bottom chamber, by alternately raising the steam or water tappet valve. On vacuum being created in bottom chamber, the waste water which has collected above in top chamber is drawn down through a valve; and on vacuum being destroyed in bottom chamber the water falls out, through a foot valve, into waste water sewer. There is a starting wheel on tappet-shaft which is used at starting the engines. When thrown into gear this tappet-shaft is driven at seven revolutions per minute. The vapour used for destroying vacuum in bottom chamber is reduced to two or three pounds' pressure by valve. This condenser draws its own injection water from a depth not exceeding 27ft.; and maintains a vacuum of from 28in. to 29in.—J. Q. D.

[61810.]—**Spirit Lamp.**—I think the reason of your spirit burning so is the wick not being packed tight enough into the burner. Fill your lamp half full of spirit; fill the wick-holders with a compact mass of wick. If wick be too loose, spirit rises too rapidly, ignites, and overflows. I think this will cure disappointment.—F. C.

[61814.]—**Cleaning Gold and Silver Dials.**—There is no satisfactory method of cleaning gold and silver dials, with painted figures, except renewing them properly and repainting the figures, which "Getting On" would hardly care to attempt, especially as he can get them done at a very trifling cost in the trade. He can, however, clean gold and silver dials, without painted figures, thus: Heat silver dial gently on charcoal, or hold it over a gas flame, till covered with soot, then drop it instantly into weak sulphuric acid (1 part acid to 10 water), rinse in cold water. Dial should have a dead-white appearance, and, to be properly finished, should be scratch-brushed, and the figures reburnished. Good dials can be cleaned with ordinary cyanide solution, or in diluted nitric acid. I would advise "Getting On" to invest a few shillings in the purchase of Saunier's or Britten's "Watchmakers' Handbook"; he would save himself a deal of trouble, and "get on" much faster than at present.—X.

[61813.]—**Mechanical Support.**—In "The Surgery of Deformities," by E. Noble Smith, F.R.C.S. (Smith, Elder, and Co.), the author says: "When a spinal apparatus is necessary, it should allow freedom of action to all the muscles of the back, and, in fact, the whole trunk . . . afford support to the back, in a good position, directly the muscles become fatigued . . . Should be light, &c. The only apparatus which thoroughly fulfils the above desired objects is that invented by Mr. E. J. Chance. It is formed as follows:—A belt (A) surrounds the pelvis; a single upright rod passes from this belt as high as the shoulders; a pad (B) movable by a key is attached to the upright rod; shoulder straps proceed from this pad; an abdominal belt is attached by straps to a pad opposite the lumbar region, and this pad is affixed to the upright rod. The apparatus is so fitted that when the patient is seated the lower portion of the pelvic belt (A) comes in contact with the chair, so that the support in resting the back is complete."—SM.



[61817.]—**Battery.**—The green deposit is produced by the liberated ammonia gas from the battery acting on the copper. The best cure would be to use double cotton-covered wire, and heavily paraffin it. The paraffin stops the little game, for I had the same trouble, and now it is gone. All connections and clamps should be paraffined—it is far better than varnish.—IOTA.

[61817.]—**Battery.**—"Bell Wire's" trouble is doubtless caused by that peculiar creeping-up observed in various solutions of salts, and known as "osmose." The sal-ammoniac solution in Leclanché cells is very much given to this sort of thing. Painting over with tallow the tops of both the outside containing jar and porous pot I have found to entirely prevent this, especially if they are treated in this way when the cells are new and clean. Use guttapercha-covered wires for connecting the carbon and zinc poles.—J. T. N.

[61817.]—**Bunsen Battery.**—I see Mr. W. Holder's advice to "E. J. C." is to use commercial nitric acid over and over again. I should feel much obliged to him if he would favour me with any address at which I could obtain such acid, and also how often it can be used. I regret that hitherto I have been unfortunate in not discovering any nitric acid, either pure or commercial, that was regenerative. Would he kindly favour us with the reaction of his batteries?—ELECTRICIAN.

[61818.]—**Bunsen Battery.**—What size is the porous pot to be, and is it to be flat to hold carbon plate 8in. by 4in.? The nitric acid should be concentrated—in fact, must be. No, the E.M.F. with zinc sulphate would not be so high, and resistance would be greater. The plates, however, would not waste if no nitric acid percolated through the porous pot. Better use the battery as a granule or zinc chloride form.—IOTA.

[61826.]—**Block Signalling.**—In *Electrical Review*, a few weeks ago, there was a full and descriptive explanation of these instruments. The querist could hardly do better than get these Nos., and he will find what he wants.—IOTA.

[61829.]—**Resistance Coils.**—Dr. Fleming, in his book, gives the following:—Platinum silver wire—

1 ohm,	9ft. long,	No. 22 =	·036 dia.
10 „	42·5ft. „	„ 24 =	·025 „
100 „	133ft. „	„ 30 =	·014 „
1,000 „	675ft. „	„ 34 =	·010 „

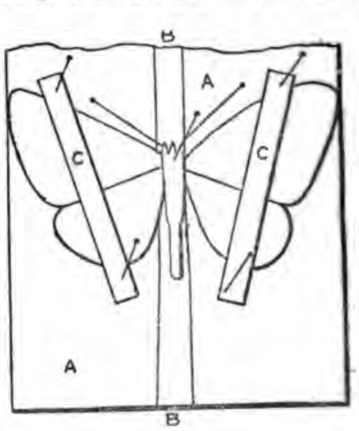
Platinum silver is the best wire to use; but platinoid or German silver would do. You don't need the 3,000 or 4,000 *w.* coils; let the Nos. be 1, 2, 2, 5, 10, 20, 20, 50, 100, 200, 200, 5,000, 1,000. 2,000 ohms gives a total of over 4,000. My detector has quantity coil of No. 22 wire and about 20 turns. A single Daniell on short circuit gives 25° deflection. The resistance is about ·2 ohm.—IOTA.

[61830.]—**Galvanometer Coils.**—If your detector coils are to be compound wound—viz., for large and small currents, proceed thus:—Wind on each coil, first, two layers of No. 20 B.W.G. silk-covered copper wire, and over this put on ten layers of No. 38 or 40 B.W.G. wire. Well varnish or boil in paraffin wax, to keep out dampness. If your needle and pointer are not too heavy, and the bearings for spindle are jewelled, or are at least free from undue friction, these coils will make a very effective instrument, and will answer admirably for bell work or ordinary line testing, and if you are likely to meet with heavy currents, you might make an arrangement in your galvanometer-case for shunting the larger coil.—J. T. N.

[61845.]—**Fluidity of Cast Iron.**—In answer to your querist on the fluidity of cast iron, I may say that the fluidity depends chiefly upon the amount of fuel and blast used, for even the one cupola working upon the same quality of metal can be made to give a thin, easily-flowing stream, followed by a thick, treacly metal, and vice versâ; such is often required by the founders For light, hollow casting, a very hot metal is used, obtained by a larger quantity of fuel per ton of pig; whereas for heavy casting a cooler metal will suffice, got by using only just sufficient fuel to melt the pig. As to heating cast iron in the lump to a white heat, I never heard of it being done, for it melts long before it can attain to that colour, as can easily be seen by looking through the tuyere (fitted with a glass eye-hole) into the furnace; the metal falls in beads from off the pig, like drops of perspiration from a puddler's forehead, and they are the same colour as the metal which subsequently flows from the tap hole; yet I never saw white fluid cast iron from a cupola, and I see cupolas melting nearly 2,000 tons of Nos. 1, 2, and 3 grey hematite per week. A casting can be annealed to a slight extent by heating to a red heat in a furnace or open fire, and then allowing the fire to die out, leaving the casting to cool gradually.—GRIS DE FER.

[61862.]—**Gherkins.**—In France, where these are highly esteemed, special varieties are grown called "Cornichons." They can be grown here as ridge cucumbers. Any seedsman having a French correspondent would supply them.—ELECTRICIAN.

[61864.]—**Butterflies.**—The best way to relax these will be to pin them on cork resting on damp sand in a tin vessel. If this is left in a cool place, the wings, &c., will relax sufficiently to allow of their being "set." The diagram will explain the manner of "setting" the insects better than any mere verbal description. A A is a block of cork of width to suit that of insect when extended, depth ¾in., and length to allow of three or four insects being set on it. It has a groove, B B, down the centre large enough to hold the body of the largest fly. C C are strips of thin card pinned to the board to keep the wings in position while drying when extended as in the cut. The fly, when thus arranged, should be left in a dry (not hot) place for as long a time as possible (the longer the better, but a fortnight at least is desirable), and when the strips are removed the wings will retain the position figured. Great care must be taken not to injure the wings in "setting." On no account must they be touched with the fingers, but should be got into position with the aid of a bodkin or needle. If when the insects are quite dry and set, they are saturated (wings and all) with benzine (which may be allowed to drip on to the upper surface until they are covered), they will be protected from the ravages of mites, and will regain their former appearance in a minute or two. This with feathery bodies should be set in a gentle draught, blowing from head to tail to prevent the feathers getting matted. I shall be pleased to give any further directions if these are not sufficiently explicit.—SEVERGA.



[61863.]—**Roses.**—The month for pruning roses must depend upon the time when it is wished the trees should bloom. Persons who are anxious to exhibit rose blooms early in June will prune their trees in February; whilst others who do not require blooms till the end of June or beginning of July will defer that operation until the middle or end of March. Those persons, however, who prune their trees so early as February incur the risk of losing the young shoots by the frosts which frequently occur in March and April; so that it is a good rule to follow not to prune your rose trees until there is a fair chance that the frosts are over. The pruning should be done with a sharp knife, not with scissors or sécateurs. The branch should be cut off just above an eye or young shoot, and the eye chosen should be one which is on the outside of the branch, so that the new shoot will grow outwards. A clean cut should be made from the inside to the outside, and as close above the eye as possible. Ordinary strong-growing hybrid perpetual roses, if dwarfs, should be cut back to the second, third, or fourth eye from the ground, always choosing the one which turns outwards, and standards at the same distance from the stock. More delicate roses should be more delicately treated; and the rule holds good that the more free growing a rose is, the more it should be pruned; and the more delicate it is, the less should it be treated to the knife. The shy-growing roses, therefore, should be cut off further up, at the sixth or seventh eye. In pruning care should be taken to cut out all the inside branches so as to leave the tree hollow, for by this means light and air penetrate among the branches and nourish the blooms. Tea roses may be pruned at the same time as the hybrid perpetuals, but they should be more gently treated. Instead of shortening the branches down to the third or fourth eye, they should be left almost intact, and the knife should be applied rather to the entire removal of such as are weak or of unripened wood. The same holds good with the noisette and climbing roses, which must be rather thinned out than pruned back. When the pruning is finished, the bed should be forked over and dressed with a good coat of manure. For this pig's manure is well adapted, and is considered by many rose growers to be preferable to stable manure.—T. K. W.

[61876.]—**Primary Battery for Lighting Billiard Table.**—I am sure the readers of "Ours" would all hail with pleasure a description of a battery to do what "Electrician" claims—viz., five farthings per hour for a *twenty* c.p. lamp. I trust we may have such from him.—OHM.

[61876.]—**Electrical.**—"W. E. F." seems to be under a wrong impression as to the amount of trouble attendant upon the manipulation of primary batteries, when he talks of the bother of paraffin lamps. Perhaps the following will give him some idea of the trouble and expense incurred in lighting the billiard table. Supposing it to be a full-sized one, it would take six 16c.p. lamps, or their equivalent, to light it well. Now £20 would be a low estimate for such an installation, and 2d. per lamp per hour a low price for the working expenses. The amount of attention the battery would require would vary according to the description used; but it would be a very good one which did not require on an average at least half an hour a day. If in the face of this he is determined to try the experiment, I shall be pleased to give him full particulars.—E. E. V.

[61878.]—**Electric Tramway Bell.**—Most likely there is a relay to work with a 100 per cent. current more than usual on circuit. The E.P.S. Company use that idea with accumulators. The back tension of the relay spring prevents working currents ringing the bell, but a short circuit attracts the relay armature.—IOTA.

[61881.]—**Tangent Galvanometer.**—The force (f) exerted on the pole of a magnet in its neighbourhood is proportional to the magnetic strength (m) of the pole of the magnet, and to the strength of the current (C); and if the conductor be at all points equi-distant from the pole, f is proportional to the length of the conductor (L), it is also inversely proportional to the square of the distance (r) of the pole from the conductor, $\therefore f = \frac{C L m}{r^2}$. The two poles of a short magnet hung in the centre of a circular coil, with its magnetic axis in the plane of the coil, will experience equal and opposite forces, each equal to $f m$ (where m is the strength of each pole of the magnet). If l is the distance between these two poles or forces, then the magnet is influenced by a couple, the moment of which is $f m l = \frac{C L m l}{r^2}$. N S is magnet in plane of coil, let $N_1 S_1$ be position of magnet under influence of current making angle θ with N S. Since poles of magnet (being small) remain sensibly in centre of the coil, f remains the same; but $N_1 C$ the perpendicular distance between the poles on which the equal and opposite forces are exerted $= l \cos. \theta$, and hence the couple is now $= \cos. \theta \frac{C L m l}{r^2}$. This couple is opposed by that due to the earth's magnetism; the force due to its action on each pole $= H m$; the perpendicular distance $S_1 C$ separating the two parallel forces $= l \sin. \theta$; the whole couple $\therefore = \sin. \theta H m l$. When magnet is in equilibrium, under the forces of the current and of the earth's magnetism, then—

$$\text{Cos.}\, \theta \frac{C L m l}{r^2} = \sin. \theta H m l$$

$$\therefore C = \frac{\sin. \theta}{\cos. \theta} \cdot \frac{H m l r^2}{L m l}$$

$$\therefore C = \tan. \theta \frac{H r^2}{L}$$

Example given H = ·17; tan. θ = ·700; L = 26 π; r = 13.

$$\therefore C = \frac{\cdot 700 \times \cdot 17 \times 169}{26 \times \pi} = \frac{20\cdot 111}{81\cdot 6816} = \cdot 246 \text{ C.G.S.}$$

units = 2·46 ampères.—W. E. H.

[61881.]—**Tangent Galvanometer.**—The formula for the solution of this question is as follows:—

$$C = \frac{H r \tan. \theta}{2 \pi n}$$

Where C = current in electro-magnetic units (10 ampères = 1 electro-magnetic unit), H = horizontal intensity of the earth's magnetism in dynes (C.G.S. units) at the place of observation, r = mean radius of the coils in centimètres, θ = angle of deflection, π = 3·1416, or the ratio of the circumference of a circle to its diameter, and n = number of convolutions on the coil. Working upon the given data, mean diameter 26 centimètres (mean radius 13 centimètres), mean horizontal force ·17, and number of convolutions 1, we have—

$$\frac{\cdot 17 \times 13 \times \cdot 7}{2 \times 3\cdot 1416 \times 1} = \cdot 246 \text{ electro-magnetic units}$$

= 2·46 ampères.—HOSEIN IMRU.

[61886.]—**Backlash in Slide-Rest.**—Saw nut in half and screw together with four screws. Cast-iron or steel nuts are better and more durable than gunmetal.—A. F. SHAKESPEAR, Lüttichaustr. 14, III., Dresden.

[61886.]—**Backlash in Slide-Rest.**—If in top slide this should not trouble you when screw-cutting, as you can tighten the slide until it is nearly a fixture. The greatest trouble is with bottom slide. This can also be tightened somewhat; but is very troublesome if slide is at all worn. The only effectual cure is new nuts and screws.—T. C., Bristol.

[61886.]—**Backlash in Slide-Rest Screws and Nuts.**—You can cure it by chambering your nut and running in (with the screw in place) some tin, zinc, or any other mixture, as antimony and tin, Babbit's metal, or even lead will do, but will not last long. The usual way in the shops is to set up the slide as tight as possible to be workable by the set screws for that purpose; but in some you cannot set them up, as they get worn beyond the limit for adjustment, and some cheap makers make no provision at all for adjustment. One I worked on was of this class, and it was so bad that when cutting I used to block it with piece of wood dropped in the hollow in slide, and bring carriage up to it by screw; so if you want to give tool little more bed, you can force the wood, as you are apt to smash tool if taking full cut of any size.—LUMSIE.

[61888.]—**Electric Lighting.**—The "incandescent lamp filled with carbonic acid, with a wire at each end," was most likely an ordinary vacuum tube filled with carbonic acid. These were used in France for miners, &c., attached to a small induction coil, and gave a soft glow. There are incandescent lamps made with a "carbonic-acid vacuum," but these have a carbon filament. A battery can be made as described, with a zinc and a carbon element immersed in brine. No porous cell is required, but the current is very small. Placing the zinc in a porous cell and using chromic acid with the carbon plate greatly improves matters. I do not know anything about Chaudron's thermopiles.—S. BOTTONE.

[61892.]—**Uncovered Wire.**—There is no advantage in using naked wire for coils, the object being cheapness.—H. AUSTIN.

[61892.]—**Uncovered Wire.**—TO MR. BOTTONE.—I believe there is no other reason but cheapness. The uncovered wire is quite as efficacious, as may be seen by the cheap French coils (also made of uncovered wire) which are really very effective.—S. BOTTONE.

[61893.]—**Gas Firing.**—There are several methods of gas firing in use—the Wilson gas producer, Siemens, Dowson, and others. I cannot tell you very well which is the best through this paper, as it would be as good as an advertisement; but if you will advertise your address, I shall be glad to send full particulars of the best known system at present in use.—GAS FIRER.

[61894.]—**Corrosion in Hot Water Cisterns.**—Wash over the inside of boiler or cistern with two coats of Portland cement of the consistency of lime-wash, and let it get quite hard before filling the cistern.—O. R.

[61895.]—**Moulding.**—The proportions we use in the foundry I am working at are these: For light and medium castings, 6 parts of old to 2 of fresh sand, adding 1 part of coal-dust; for heavy castings, 1½ part of coal-dust, and ½ part of sea or sharp sand. We always use plumbago for facing the moulds, and so prevent the metal burning the sand, and thus we obtain castings with a perfect skin. Our plumbago comes from Battersea, and the sand from Charlton. All facing sands should be ground.—W. W.

[61897.]—**Expansion Gear.**—They being old engines, I presume they are somewhat out of order. At any rate, the expansion valves are, as they do not act as such if steam is admitted throughout the stroke; and yet you say boiler pressure is 50lb. and pressure in cylinder (I presume average pressure) is 18lb., which looks as if you have expansion valves; so I suppose you mean they leak. (1) An efficient expansion valve will, of course, save fuel, and if automatic regulate the speed. (2) We should all differ as to the "best" expansion valve; but Corliss is perhaps the best. Then there is a good one of foreign design used by, I think, Robey. The plate on top of main valve is also good, especially if regulated by governor. Apply to engineers for estimated cost.—T. C., Bristol.

[61898.]—**Hard Water.**—Grains of carbonate of lime, &c., per gallon = degrees of hardness (Clark). To find degrees of hardness: Make a standard solution of soap, 10 grammes Castille soap, 1 litre of weak alcohol; 1cc. of this solution will precipitate ·0001 grammes carbonate of lime. Take 50cc. of sample water to be tested, add standard solution till lather forms on shaking, and remains for five minutes. The number of cc. of solution required to do this will give the grains of carbonate of lime, &c., per gallon or degrees total hardness. Lime water will only remove temporary hardness. To find temporary hardness, boil 50cc. of sample for half an hour, then make up to 50cc. with distilled water, and take hardness as above, which will be the permanent hardness which, subtracted from the total hardness first found, will give the temporary hardness. Then for every degree of temporary hardness add 1 per cent. of saturated limewater. To remove permanent hardness add 1 grain (per gallon per degree hardness) of commercial caustic soda of 60 per cent. strength. Thus, if a water is examined, and found to have 18° total hardness—permanent hardness, 8°; temporary hardness, 10°; every 100 gallons would require 10 gallons limewater, and 800 grains of caustic soda to render it soft.—ELAG.

[61898.]—**Hard Water.**—I quote Barff:—Hard water contains lime, and its degree of hardness can be determined by Clark's test, which consists in the addition to the water of a solution of soap in alcohol. The quantity of soap in solution is known, and, according to the quantity of soap used in producing the desired results (frothing), so the degree of hardness of the water is determined; each degree of hardness represents one part by weight of carbonate of lime in 100,000 parts of water. It is well known that soap curdles when used with hard water. This is because the lime in the water forms a chemical compound with one constituent of the soap, which is insoluble in water. When a measured quantity of Clark's solution is added to a measured quantity of water containing lime, on shaking them up in a bottle no permanent froth will be produced, because the soap is decomposed by the lime; but, on addition of more soap solution, when enough has been added to combine with the lime, then, on shaking the bottle strongly, a permanent froth lather will remain, and the quantity of soap solution to effect this tells the quantity of lime in the water, and therefore its hardness. The quantity of lime to be added to soften water depends on the amount of carbonic acid it contains, and this must be ascertained by trial.—S. BOTTONE.

[61900.]—**Resistance of Wire.**—I suppose the querist means pure copper wire, then he may take the resistance of 1ft. of such wire one mil. (the mil. = ·001in.) in diameter as 10·33 ohms at 60° Fahr. Now the resistance of any pure copper wire is $\frac{10\cdot 33}{d^2}$ per foot—e.g., No. 36 = ·0076in. diam., and $\frac{10\cdot 33}{7\cdot 6^2} = \frac{10\cdot 33}{57\cdot 76} = \cdot 1788$ ohms per foot, and $\frac{150}{\cdot 1788}$ = 838·72ft. in 150 ohms. Of course this is upon the supposition that your wire is pure copper; and you should have no difficulty in getting it = 98 per cent. conductivity.—OHM.

[61900.]—**Electrical Wire Resistance.**—Obtain a table of resistances from wire-maker. The resistance of pure copper-wire per mile at 15·5°C. equals the square of its diameter (mils.) divided into 53087·9. Or, in short—

$$R = \frac{53087\cdot 9}{d^2} \text{ ohms}$$

at 15·5° Centigrade per mile.—ELECTRICIAN.

[61900.]—**Electrical Wire Resistance.**—According to Dr. Matthiessen, one foot of pure copper wire, ·001in. diameter, at 60° Fahr., has

[illegible]

[illegible] Wire Resistance.

[illegible]

[illegible] Resistances of Wires

[illegible]

fore, at 60° Fahr. No. 36 [illegible] m. R. in the above means [illegible] is for each 1,000ft. For [illegible]ting resistances see Sprague [illegible] OTTONE.

[illegible]are Battery.—Would not a [illegible]nt, or a small oxide of copper?

[illegible]are Battery for Bell-work. [illegible]l be wound with suitable fine [illegible]h little current, you will have [illegible]ing it off and on for a year [illegible]lanché cell of the dimensions [illegible]ad one cell about 6in. by 3in. [illegible] two years without any atten[illegible]tion of a little water. I need [illegible]is carefully sealed with pitch, [illegible] funnels which serve to intro[illegible]ells.—S. BOTTONE.

[illegible]are Battery.—"Tor" should [illegible]orrugated carbon cells; a very [illegible]le from one of these. Get a [illegible]½in., put in a soft porous pot [illegible]he four sides, fill the corners [illegible]o peroxide, place the zinc rod [illegible] the whole cell with a nearly [illegible]sal-ammoniac. This will cost [illegible] and will give about as good [illegible]ery I can recommend.—H.

[illegible] Stylographic Pen.—Make [illegible]n water of aniline black. It [illegible], and an ounce will last for [illegible]ordinary pens. If it does not [illegible]op or two of spirits of wine.—

[illegible].—This substance is a double [illegible]n and potassium, having the [illegible] SiO₂. According to Cooke's [illegible] Acids," it may be considered [illegible]hth anhydride of hexasilicic [illegible]h sodium carbonate, it is de[illegible]tion of sodium silicate, and, [illegible] silicate.—WM. JOHN GREY, [illegible]on-Tyne.

[illegible].—To "S. R. C."—Felspar is [illegible] compound, and a good deal [illegible] amount of sodium carbonate [illegible] sufficient quantity added. [illegible] the following. The felspar [illegible] [illegible]

[illegible]

[illegible] Soles.—[illegible]

[illegible] not know if there is any [illegible] between them; I believe not.—[illegible]

[illegible] Lemon Soles.—The lemon sole, as [illegible] of the British Islands," [illegible] than the common sole. [illegible] are different, and the upper eye is [illegible] of the other, whereas in the [illegible] eyes are level. Brixham fisher[illegible] have caught lately in their [illegible] of the Eddystone, a good many [illegible] soles, as they also call them. [illegible] as "Sceptic" says, far below [illegible] common one. It is possible that they [illegible] confounded with another species, [illegible] or variegated sole.—W. M. B.

[illegible] Cleaning Indian Brass Salvers.—[illegible] into slices about an inch thick, [illegible] with one of the slices; then [illegible], and brush the lemon juice [illegible] interstices, put it under a tap and [illegible] with a clean linen cloth, and polish [illegible] with a [illegible] leather; if necessary, repeat [illegible]. I have two small Benares ewers, [illegible] gold.—W. A. S.

[illegible]—Cleaning Indian Brass Salvers.—[illegible] certainly tarnish if not polished and [illegible] lacquered. Some of the high-class [illegible] beautiful after eight years' ex[illegible] to the air and coal smoke. The more [illegible] specimens are easily renovated by immer[illegible] boiling water, then scrubbed with a hard [illegible], and rinsed in cold water: afterwards a [illegible] is cut in pieces, and well rubbed into the engraved parts, the juice and pieces of lemon are spread over the salver, and left for some hours. Boiling water is again poured on to cleanse them; they are dried before the fire. Finally, they are polished with any powder or paste used for household brass. Lacquering is a very cheap process, and the brass finishers will do it for you. The above mode of cleaning dirty brass is practised by the Indian workmen who make the goods.—EOS.

[61920.]—Screw-Cutting.—Although not addressed to me, "One Deeply Interested" will probably have noticed Niblett's apparatus illustrated in same No. in which his query appears. My object in writing is to tell him that Holtzapffel describes one somewhat similar as regards tool and bar; but instead of the swash plate the mandrel carries a few guide screws on it. The bar being fitted with a suitable comb to fit the required guide screw, the tool is used as in Niblett's; but at end of stroke is drawn clear of guide screw, moved endways for a fresh start by hand, and then pushed forward for cutting.—T. C., Bristol.

[61921.]—Soldering Lamp.—A very good soldering lamp is one of the following description:—In a case similar to an ordinary small bull's-eye lantern (with the lens and front removed), a spirit lamp is placed at the bottom, over which is fixed a round or cylindrical copper vessel, the only outlet from which is a small copper tube, bent in such a way as to form a blowpipe. The action is this: the spirit lamp heats the air inside the copper vessel, which expands and blows out of the tube against the flame, thus blowing it out on to the joint. This forms a very light and handy lamp; the most suitable spirit is ordinary methylated spirits of wine.—W. E. H.

[61922.] — Cement. — Plaster of Paris is generally used. Perhaps stucco (i.e., putty made with plaster of Paris in place of whiting) might answer.—ELECTRICIAN.

[61925.]—Screw Taps.—Friend Shakespear, I am also very unbelieving. They are certainly stronger, if that is a recommendation; but then you require stronger muscles to use them, and then perhaps burst the job in hand. They are better for under ¼in.—T. C., Bristol.

[61929.]—Double Star near Castor.—If Mr. Holmes will locate his star with more precision, I may be able to help him. There are so many small stars in the neighbourhood, and I have not time to search. I looked but could not see a 4 star. Can he give R.A. and Dec.? Castor is 7h. 27m., and 32° N. Or a sketch might suffice.—SM.

[61931.]—Expansion Valve.—An expansion valve to a compound acts the same as in a simple engine—viz., cuts off the steam in the cylinder to which it is fitted. Set the main valves in the ordinary way, and as to cut-off, you can bar the engine round to the point at which you desire to cut off, and [illegible] eccentric of cut-off valve to suit this [illegible]. Now bar round until in [illegible] [illegible] in the other stroke, and see if [illegible] [illegible] the same; if not, alteration is required in [illegible]. Repeat until correct.—[illegible]

[illegible]—Logarithms.—[illegible] Chambers's Mathe[illegible] [illegible] are the best I [illegible] [illegible]—SM.

[illegible]—Logarithms.—The best that I [illegible] [illegible] for all ordinary purposes is that published at 3s. 6d., by the Messrs. Chambers, of Edinburgh.—S. FORD.

[61933.] — Logarithms. — For multiplication, find the log. of the Nos., and prefix the proper index and add. Find natural No. of log. so found. For division, subtract instead of adding. Of course the book of tables gives an explanation of how to use them, and as to prefixing the proper index.—T. C., Bristol.

[61933.]—Logarithms.—I think the book that you want is Bottomley's "Mathematical Tables" (price, I think, 1s.). It is a very useful little book to have, especially if you have much calculation to do, as it is arranged in a very simple and convenient manner; all the logarithms, from 1 to 10,000, are seen at a glance, and on the next two pages are the corresponding antilogarithms. This is preceded by a very clear explanation of their manipulation, which is very simple. I can thoroughly recommend this little book to those who have many calculations to work out, and are content with four places of decimals. I have used it myself for several years now with great satisfaction.—W. E. H.

[61933.]—Book of Logarithms.—Buy or borrow Chambers's "Mathematical Tables"; this will give you all you require.—OHM.

[61934.]—Modelling.—The following will, I think, suit C. North; but I cannot positively say whether it stands water well or not. Steep glue in water and then dissolve it; melted rosin and linseed oil are then poured into it; the whole is then incorporated with pounded whiting till of the consistency of putty. It can then be easily moulded, and sets hard in a few hours.—A. R.

[61935.]—Valves of Air-pump.—Leather is generally used, stiffened by metal plates.—ELAG.

[61940.]—Rear-driving Safety Bicycles.—In my opinion there are very few disadvantages over the ordinary bicycle. The chief disadvantage is, perhaps, the little extra friction incurred by the use of the chain, instead of direct action. To one accustomed to the ordinary, the steering of the safety at first is a peculiarity, but is easily mastered with a little practice. I have not yet heard of a "self-steering" cycle. If you mean an "automatic" steerer, that is, one which will run in a straight line without the rider steering, I should not recommend that arrangement on a rear-driving safety. The loose steering is just the right thing for it, as it is not beneficial to the rider's comfort to let the machine go without steering. I have had some practice in this respect, and find it is not expedient to ride much without steering. The saddle is placed so that the maximum of power may be obtained for driving, that is, right over the pedals. The rider's whole weight and strength, consequently, are both gained, and more power secured than on the ordinary. In riding up-hill this will very soon be discovered, and an ascent is more easily ridden on account of the driving and steering wheels being separate. On account of the small wheels, a chain allows the machine to be "geared up" or "down," if "Quis Est" understands the terms, and were the pedals and cranks direct-acting, the machine would not be what it is, neither as regards speed, nor safety, nor comfort. The "true tangent wheel" is certainly the best driving wheel for any kind of cycle. Much of the strain essential to "direct-spoked" wheels is saved the spokes of the tangent wheel. There is, of course, less friction on chainless machines, but the extra friction of a chain is not a great matter. With regard to saddles, I may say about four years ago, when I purchased a machine—not my first one by any means—I was recommended to have one of Lamplugh and Brown's long-distance suspension saddles, which I have used, and am now using on a safety. I have ridden on it over [illegible] miles on all kinds and conditions of roads, and have not felt the slightest inconvenience from its use. I might also say that my wife uses, always, a saddle similar in construction, either on her single tricycle or when accompanied on the tandem, and she can confidently recommend its use after [illegible] years' experience.—SARDONYX.

[illegible]—Steam.—[illegible] his textbook [illegible]. His first formula should stand [illegible] = twice the thickness. This will make it [illegible] give the same results.—[illegible]

[illegible]—Steam.—[illegible] formula taken from [illegible] — [illegible] = [illegible] [illegible] stress = [illegible] = [illegible] [illegible] = [illegible]

[illegible]—Steam.—The [illegible] for a [illegible] diameter [illegible] pressure.

is ·304in. You may depend upon the following rule being correct: $T = \frac{D \times P}{10,000}$. Where T = thickness; D = diameter in inches; P = pressure in pounds per square inch.—J. F. W.

[61943.]—**Steam.**—Never mind about the books, but take the question as it stands in the examination paper. The whole pressure on a ring of the boiler 1in. wide tending to burst it is 76 × 40 = 3,040lb., and if you require not to strain the metal beyond 5,000lb. the thickness contained in the two sides must equal $\frac{3040}{5000}$, or, say, ⅝ in full. Half of this will be in each side, so the plate would require to be $\frac{5}{16}$in. thick. This neglects all consideration as to joints, which are supposed not to exist. If single riveted, ¾ bare would have to be used, and I should say so.—T. C., Bristol.

[61944.]—**Piston for Gas Engine.**—I fear your packing rings, if of harder metal than your cylinder, which you say is brass, would cut it about very much. That is the only objection I see to them.—ELECTRICIAN.

[61946.] — **Niaudet's Battery.** — TO MR. BOTTONE OR MR. CONRY.—The strength of the salt solution should be: Water, 4oz., by weight; salt, 1oz., by weight. The usual form given to the zinc is that of a plate, but a rod would do just as well. Yes; the carbon is a plate in a porous cell, stuffed in with coarse fragments of carbon and chloride of lime. The battery will run for bell-work — say, six months—without attention; but there is much smell at the beginning, and the chlorine given off attacks metals, &c. E.M.F. at start, 1·65; after some months, 1·5. R., for the ordinary size, 6in. by 3in. by 3in., about 5 ohms.—S. BOTTONE.

[61946.]—**Niaudet's Battery.**—This cell is constructed as follows:—Make a zinc cylinder, and leave a narrow strip on for connection; put a retort carbon plate in a porous cell, and fill in with broken pieces of carbon. Place an indiarubber ring nearly at the top, and one near the bottom of porous cell; make the zinc cylinder to fit tight on these, so that it will keep it from falling to the bottom of outer cell. Fill the porous cell with a saturated solution of chloride of lime, made by scalding ordinary bleaching powder, and then seal up with a paraffined cork; place these in a glass cell, which fill with a saturated solution of common salt. Seal this up also; but make a small hole for the escape of any gases that may be generated. The E.M.F. of this battery is 1·6 volt, and it will ring a bell a long time under ordinary circumstances. But why not use a Leclanché, which will give far more satisfaction in the end?—H. AUSTIN.

USEFUL AND SCIENTIFIC NOTES.

An Electric Light Installation.—The Edison Electric Illuminating Company, Lawrence, Mass., runs a plant of a capacity of 5,40010 c.p. lamps including 1,000 municipal lamps. The power plant includes two 120H.P., two 80H.P., and one 35H.P. engines; 65 miles of wire are used in the street circuits. The underground system embraces over six miles of tubes, aggregating 18 miles of single conductor. Current is also supplied for 23 electric motors, ranging from ⅛H.P. to 6H.P., and running printing presses, elevators, lathes, &c., in various parts of the city. There are the following isolated lighting plants in Lawrence: Pemberton mills, 650 lamps; Arlington mills, 425 lamps; Russell paper mills, 200 lamps; Naumkeag mills, 550 lamps; Upton's Glue Works, 150 lamps.

MR. BURCHARD, American Consul in Honduras, reports that the pita plant, which has never been cultivated, grows spontaneously and in apparently inexhaustible quantities by the margin of every river and lagoon, and, indeed, anywhere below the altitude of 2,000ft. It can be had for the cost of cutting. The fibre is susceptible of a thousand uses. The people of Honduras convert it into thread for sewing boots and shoes, and into nets, fish-lines, and cordage. The finest hammocks and most costly are also made of it. The small quantities which have been sent to the market have been manufactured into handkerchiefs, laces, ribbons, false hair, and wigs. The difficulty is to decorticate the plant without rotting or otherwise injuring the fibre.

Castings, Filling for. — An alloy named Mock Iron is used for filling blow-holes in castings. It is made of one part of bismuth, two parts of antimony, and nine parts of lead. It is claimed that this alloy will expand in cooling. A hole filled with melted alloy will not show any cracks, and the plug will be tight.

Coal in New South Wales.—A diamond drill boring for coal on the Holt-Sutherland estate, fifteen miles from Sydney, struck a seam at 2,227ft. This, in connection with other bores, proves the continuity of the main coal seam from Wollongong to Newcastle, right under Sydney and its suburbs.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Sm." has replied to 61530, 61570; "East Anglian," 61543.

61337. Brazing Copper Water Tuyeres, p. 420.
61343. Milling Machine, 420.
61344. Lathe Matters, 420.
61359. Engine Brasses, 420.
61361. Orthographic Lens by Ross, 420.
61364. Driving Lathe, 420.
61369. Gedge's Railway Coupling, 420.
61371. Tempering and Doctoring Steel, 420.

61578. Walnut Plank, p. 508.
61580. Helical Spring, 508.
61582. Chloride of Mercury for Battery, 508.
61584. Stamping, 508.
61591. Lifeboats, 508.
61596. Goniostat, 509.
61602. Pile Driving, 509.
61605. Jerusalem, 509.
61611. Improving Clay for Pottery, 509.
61618. Variable Pitch Propeller, 509.
61621. Dividing a Circle, 509.
61625. Chemical—Ozonic Æther, 509.
61628. Lard Oil, 509.
61629. To Analysts, 509.
61631. Whiskey Distilling, 509.
61636. Feed Wick for Paraffin Lamp, 509.

QUERIES.

[61947.]—**Electrical Query.**—In static or frictional electricity we find two kinds of electricity, plus and minus, either of which can be collected and stored (though not produced) irrespective of the other. True, you can do nothing with it when stored but let it go. In current electricity, on the other hand, we seem to be concerned with electricity of one kind only. A current flows in a certain direction, whether from battery or dynamo, and the signs plus and minus are now used to indicate direction only—for instance, plus would be marked at the terminal of a lamp by which the current enters, and minus at that by which it leaves the lamp. We are told it is impossible to produce one kind of electricity without the other. Which kind is produced in a battery, and what becomes of the other?—AJAX.

[61948.]—**Induction Coil.**—I have an induction coil, and will be glad if one of your friends will render me a little information upon one which, when the battery connections are fixed, will not act. The battery is composed of zinc and carbon plates. I tried ¼lb. of bichromate of potash, and put three-quarters of a pint of boiling water in a glass cell, to which, when cold, I added ¼lb. of sulphuric acid, and placed the two plates in. I then had the spark at the contact breaker, but no shock or anything else. If my adviser thinks fit I should change the battery for different plates, &c., I will instantly do so. Also, if he will give me the right recipe for chemicals enough for one battery I will be much obliged.—IGNORAMUS.

[61949.]—**Boiler Gauge Glass.**—Can any of "ours" explain the following phenomena? Most observant practical engineers know that a water gauge glass in work has a tendency to become dirty; and they also know that if any attempt be made to clean the glass with an iron wire probe and waste, fracture usually takes place soon after; but experience has shown that fracture does not take place when a piece of cane or other wooden material has been used as the probe. I have heard it said the fracture is because the glass has been scratched by the iron wire; but I know it will happen when the glass has not been scratched. Again, what is the cause of the corrosion and wasting away of these tubes? I recently took one out of a boiler that had been in some three months, and I found it completely guttered inside longitudinally, and the ends where the indiarubber packing rings had encased it were reduced to the thickness of tissue paper, so that the greatest care had to be taken to prevent the glass falling to shreds. I may say that the boiler is a marine one, and the practice has been to fill with fresh water, and not let them exceed a maximum density of 3-32. I have heard it stated that if an iron wire be passed two or three times freely through a thick barometer tube, and the tube be then laid aside, fracture nearly always takes place within an hour or so. I have heard the following explanation offered for this, but it does not seem satisfactory to me: In cooling, the outside obtains prior strength to resist compression, and compels the portions yet soft to shrink to its own standard of dimensions; therefore, in the subsequent mutual contractions, while cooling down, constrain them to contract among the particles in a more rapid rate than itself. Consequently the outside is in a state of compression, and the inside in a state of extension, the one reciprocally inducing the other. This antagonism sometimes so closely approaches the limit of strength of the material, that the slightest shock or injury to the inside of tube is sufficient to cause fracture. However true this explanation may be as regards barometer tubes, it will not hold water as regards gauge glass tubes, for they are subjected to shocks in their daily work infinitely greater than the passage of iron wire freely through them could effect. As to the corrosion, is there anything in the decomposition of the rubber packing rings to account for it. Pure rubber is, I believe, carbon 87·2 and hydrogen 12·8 in 100 parts; but vulcanised rubber will at least contain sulphur in addition, and possibly other sophistications. —GIL BLAS.

[61950.]—**Photo. Enlargement in Crayon.**—Since my query (No. 61663, p. 531), and which is still unanswered, appeared in the "E. M.," I have seen a circular with a friend of mine from a gentleman in Southampton who offers an apparatus and outfit at 10s. 6d. for enlarging any photo. to life-size in crayon, and he further guarantees to pay 2s. for each picture finished for him; but as there are so many impositions practised nowadays, I would like to know, before investing in the apparatus, if any kind reader knows anything about this process, or is it genuine, and if it is easily learned, as if it would be easy to learn, it would suit my purpose just as well as the apparatus referred to in my former query. Replies to both queries will oblige.—D. J. KEEGAN.

[61951.]—**Legal.**—Will one who knows kindly answer me the following question? I am a dental assistant (operating and mechanical), but was unable to get registered because I did not begin learning dentistry until a few weeks after the passing of Act, which is very hard, as I have served my time with a good man, and am morally more qualified than many on the register. I am in a good berth, but have a deal of spare time, and want to do a little on my own account, and if I have a few cards with my name, and put "dental mechanician," will it be infringing the Act? I only want the cards for a few friends, &c. Of course, I am able to do both mechanical and surgical dentistry, and am not an amateur. If somebody who knows will kindly answer the above they will be doing a good turn. Or perhaps I could put something else on the card. Will someone suggest?—DENS, Peckham, S.W.

[61952.]—**Hot-air Engines.**—As the subject of hot-air engines has been discussed very much of late years, I should like to ask if any of our readers can give any particulars as to the success or failure of an experiment with hot-air engines on a large scale, which was tried some years ago. I quote the following extracts from an old magazine (1853), which I came across lately, and which had copied them from the *New York Literary World*: "On Tuesday, the 11th day of January, in the year 1853, the caloric ship *Ericsson* made its first public essay. The *Ericsson* got under way from her anchorage off the Battery at half-past nine o'clock, and, proceeding out of the harbour through the Narrows into the lower bay to a distance of about 12 miles, returned at half-past twelve, having accomplished the trip without a stoppage or hindrance, or any untoward result. The invited guests on board were principally members of the press of New York. . . . The single fireman and the single engineer on duty had nothing to do but to answer questions. . . . The caloric ship is over two thousand tons, has an engine of six hundred horse-power, a speed of eight or nine knots, and consumes only six tons of coal in twenty-four hours, and will pay." I will not trespass on your space by quoting more, but should like to ask what became of the vessel, and how the experiment succeeded?—E. W. O.

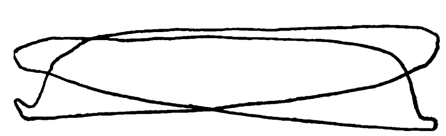
[61953.] — **Loco. Engines — Narrow Gauge.** — Can any reader give a description of the locomotives of the North Wales Narrow-gauge Railway? Also the weight and coal consumption per train mile, and what speed can be obtained from them?—G. D. H.

[61954.]—**Lamp and Bellows for Glass Blowing.**—Will any reader be so kind as to give me sketches and dimensions of an oil lamp (not gas) and bellows, suitable for glass blowing, or blowpipe suitable for using with an oil lamp?—A TWO YEARS' SUBSCRIBER.

[61955.]—**Science and Art Exams.**—I wish to compete at these exams. next year. Will some reader who has passed kindly advise what books I should use for the Elementary Theoretical Mechanics and Elementary Applied Mechanics? There are three books in the market by Goodeve, I see—"Manual of Mechanics," "Principles of Mechanics," and "Elements of Mechanism." Do these all treat of the same subject, only at different stages? Are any of them suitable for either of above exams.? I should also be glad of advice as to reading up for the Elementary Machine Construction Exam.—EL.

[61956.] — **Physical.** — I read the other day of "Guthrie's conducting cones." Can any reader inform me where I can find a description, or will they give one, as I can find no mention of the apparatus in textbooks? —EL.

[61957.]—**Engine Query.**—Diagram annexed of high-pressure cylinder of compound engine; cylinder, 12in. diam. Will be pleased to hear how I can improve it.



What part of valve should be altered, or how to alter it from eccentric?—ENGINEMAN S.

[61958.] — **Photographic.** — Will some subscriber kindly inform me how to put gold paint on to the back of glass to show up crystoleum photo. painting? Also how to apply gold leaf to same purpose; also silver paint? What is the best size for sticking photos. on to glass? At present I use starch. What is the best way of making photo. transparent before applying paint? In rubbing down, I experience some little difficulty through breaking the paper. Also, I should be glad to know how the photos. are coloured by the chemical process.—J. T.

[61959.]—**Clearing and Cultivation of Forest Land.**—A missionary abroad has written to his friends for books giving information as to the foregoing. Would one of "ours" kindly give the titles and publishers of books treating on the above, and thus enable querist to send him one?—ROMEO.

[61960.]—**Boiled Oils.** — Will someone oblige with recipes and instructions for making good quick-drying boiled linseed oils, the same as used for varnish making? I should also be glad to know whether there are any books published on it, and who by.—PITCH BOILER.

[61961.]—**Blue Brick.**—Will any reader be kind enough to tell me what kind of material to obtain and how to mix to repaint a hard red Leicester shear brick to imitate a blue band across the front of a house, as the builder did this instead of laying a course of blue bricks when the house was built, 12 months back, and the blue colour is now turned to a very (nasty-looking) light appearance, and I should like to repaint it?—WOODCROFT.

[illegible]

[illegible]

Balancing Fast Running [illegible]

[illegible]

Pressure Gauge [illegible]

[illegible]

Woodward's Spongy Lead [illegible]

[illegible]

40 Candle Power Dynamos. [illegible]

[illegible]

[illegible] **Casting Zinc.**—[illegible]—A. ARD.

[61971.]—**Gramme Dynamo.** [illegible] —I am [illegible] is wound [illegible] No. 22 wire [illegible] core of [illegible] are each 5¼in. long [illegible] ¾in. thick, of wrought iron. What quantity and size of wire should fields be wound with for shunt and series respectively, and which would probably give best results? —JOHN [illegible].

[61972.]—**Safes.**—I am thinking of making a safe, fire and thief proof, and a few practical hints would be of great service to me, especially regarding the following points: How is it made burglar proof? The door may be strong enough; but what is to hinder anyone so inclined to enter by the side, either by springing the rivets and taking off the whole side, or cutting a hole in it, somewhat after the way meat tins are opened? Is there any unpickable lock? What is the best fireproof material, and in what proportions? What gauge of iron would be suitable for a safe, say, 3ft. high? What part is put together last, and how?

[illegible]

Peroxide of Hydrogen.—This is now [illegible]

[illegible] **Calculating Speed of Launches.**—[illegible]

[illegible] **Turret Clock.**—[illegible]—ESSEX.

[illegible] **Hair.**—[illegible]

[illegible]—**Mushet's Steel.**—[illegible]

[illegible] **Cotton Belting.**—[illegible] enough to inform me how to [illegible] driving a machine? Have [illegible] and stitched it together in the same manner [illegible] I bought recently, but I do not know what [illegible] to be soaked in or covered with [illegible] McGILLIGAN.

[61994.]—**Prof. Rowland's Water Battery.**—How does the power of this battery vary with the number of the elements, and the size of them? What is the best solder to use? About what is the power of the size described (no electrical language)?—BOY.

[61995.]—**Casts.**—What are the casts used in schools [illegible] What is the cost of the material about, [illegible] of the same kind of material, [illegible]?—BOY.

[illegible]—**Legal.**—Will some of your legal correspondents [illegible] answer these questions? A market gardener [illegible] as yearly tenant, without [illegible] agreement. Does he come under the Agricultural Holdings Act which requires 12 months' notice [illegible] notice do? Also, can he remove [illegible], which he has planted on [illegible]

[illegible] **Moulding.**—Can any reader tell me what [illegible], so as to determine in what [illegible] be cast? Are steam [illegible] vertical? Also, what is the [illegible] and what are its advantages and [illegible]

[illegible]—**Reversions.**—Will any contributor enlighten me as to the present value of two reversions? (1) [illegible] years, rent £1[illegible], to revert to [illegible] male aged 56 years, a female aged [illegible] Two freehold houses, with shops, [illegible] years at a peppercorn.—[illegible]

[illegible]—**Force Pump.**—Will anyone inform me [illegible] of air into a cylinder 24in. [illegible] with a hand force-pump? If so, [illegible] force-pump requisite for the purpose [illegible] it would take me to fill the [illegible]

[illegible]—**Oleograph Pictures.**—Can any reader [illegible] oleograph pictures on canvas? The great difficulty that I have experienced is [illegible] rising on the picture about [illegible] pasted on to the canvas.—G. [illegible]

[illegible]—**Hydraulic Machinery.**—In a press the [illegible] the ram 9½in. dia. The plunger is [illegible]. The distance from the pump to the [illegible] from the fulcrum to the power [illegible] W = 2[illegible]2 P, and prove it on the [illegible]—STUDENT.

[illegible]—**Centrifugal Pump.**—Can such a pump be [illegible] a vacuum in a vacuum pan, and, if not, why not and could one, by reversing the direction of [illegible] be made to draw water in through discharge [illegible] discharge at the centre? Further, how are such pumps started, charged, cleared of air, &c., and in what way does the presence of air affect them? Any information on these pumps and their general application will be much appreciated by—SHINY BOOTS.

[illegible] — **Irregularity of Watch.** — I have a [illegible] with compensating balance, of first-class [illegible] after going regularly for some time, suddenly gains more than a minute a day. Will any correspondent say the reason and remedy? I think I have seen a reply to a similar query in the "E. M." before; but [illegible] and have all the vols. except the first five I cannot find it.—CROYDON.

[62004.]—**Comets' Orbits.**—In "Annuaire par le Bureau des Longitudes" (for 1877, for instance), and in that part devoted to comets, they give what is called the new method of stating a comet's orbit. That is, for a retrograde comet they use the supplement of the inclination, and also make—

$$\pi_{11} = 2☊ - \pi$$

where π_{11} is the tabulated value. Would someone inform me who proposed this method, and when it first came into general use, and also the reason why $\pi_{11} = 2☊ - \pi$ should have been fixed upon as the tabulated value? Also, has a table ever been formed for comet's elliptic motion similar to that for parabolic motion called "the table of the [illegible]." Pratt, in his "Mechanical Philosophy," 1836, p. 253, gives a method of forming such a table by tabulating the value $\frac{n}{1-e}$ found from the formula—

$$\frac{n}{1-e} = \frac{1}{15}\tan.\tfrac{1}{2}V\left\{4 - 3\cos.^2\tfrac{1}{2}V - 6\cos.^4\tfrac{1}{2}V\right\}$$

Can this formula be simplified by reducing it to logarithmic computation? Where to find such a table (if one has been found) will greatly oblige.—COMET.

[62005.]—**Battery with Non-conducting Elements.**—Can any one tell me anything about the battery? It consisted of iodine and phosphorus in nitrogen. When, and by whom, was it devised? What chemical action takes place?—LONDINIENSIS.

[62006.]—**Daniell Battery.**—What chemical action takes place in this battery when water is used with the zinc (equations)?—LONDINIENSIS.

[62007.]—**Plaster Trusses.**—I want to cast a number of trusses in plaster. They will have to be run in a mould which divides in order to get all the members perfect. What composition should the mould be made of, and how am I to proceed?—O. R.

[62008.]—**Bright Parts of Machinery.**—I have some machinery in hand now that requires to be brightened, and some parts of the cast iron are full of air-holes. I have heard there is a composition used which is used to fill these holes, so that when the iron is finished they cannot be seen. Can anyone tell me anything of this composition, or kindly help me out of the difficulty?—J. C. C.

[62009.]—**Legal.**—I live in the country in a house of my own, and on one side of my garden I have a wall which is gradually falling over towards land belonging to a neighbouring landowner, in consequence of a ditch not being properly levelled, so as to allow the water to drain off as it used formerly to do, said ditch belonging to my neighbour and being on his land. Can I compel my neighbour to remedy this state of affairs, as if not remedied my wall will in all probability eventually fall over through the foundations being undermined by the water in the ditch? My neighbour is a solicitor, and he and I are not upon friendly terms.—P. Q.

[62010.]—**The New Herz Telephone.**—Can any of your readers give me any information about a new Herz telephone, which I find referred to in the following paragraph in the *Weekly Times and Echo*:—"Experiments have been made between Paris and Brussels, a distance of over 200 miles, with a new telephone, invented by an American. Dr. Cornelius Herz. The entire apparatus is remarkably compact, and though scarcely bigger than an ordinary electric push button, transmits the human voice as efficiently as the best microphones in general use at present. Every word of a conversation which lasted over an hour was rendered with remarkable distinctness, and throughout the experiment there was not a single hitch. It appears that this tiny apparatus can be produced for less than half a crown."—TELEPHONER.

[62011.] — **Earthquake Predictions.** — Would "Eos" ("E.M., 4th March), or "A Fellow of the Royal Society" ("E.M.," 11th March), kindly quote the words, and give the date, of Prof. Falb's (query Fabl) prediction of the late earthquake in the Riviera? It is pleasant to have at least got hold of a real genuine prophet, and a scientific one to boot.—TRITON.

[62012.]—**Horizontal Sundial.**—Would any of your readers kindly inform me as to the most practical method (not involving trigonometry) for a country amateur of making the above, square shape? Also material and instruments used. A sketch would be valued.—AQUA.

[62013.]—**Silica and Alumina.**—Will some chemical friend kindly say how I could test a lump of ordinary clay to find out the relative quantity of each in any given lump of clay; and also how to analyse lime, to find out what it contains? Are there any simple works relating to the same?—CONSTANT READER.

[62014.]—**Guttapercha.**—Can guttapercha by any process be made to resist heat (i.e., not to melt when exposed to heat), and still retain its other characters of toughness, pliability, &c.? If not, is there any substance known that can be so treated, that would have the above qualities (excepting indiarubber)? It is necessary that it is capable of being liquefied in the first instance. The formula will be greatly esteemed by—ONE IN A FIX.

[62015.] — **Engine and Boiler Power.** — To "T. C., Bristol"—Kindly favour with the following information. I have an engine, horizontal, and vertical boiler, 9in. stroke, and 5in. bore. Boiler is 30in. from firebox, and 21in. diameter, 10 tubes. Please say if the boiler is powerful enough for engine. When I start it at 70lb. steam, and only work a small planing machine, it runs back to 20lb. in about 30 minutes, and as soon as I apply the pump it stops altogether. Engine is 60ft. from boiler.—AMATEUR.

[62016.]—**Preserving Food in Tins, &c.**—Although I know there is a good deal of information in back numbers concerning various methods of preserving food, I would ask those of your readers who fully understand the various processes to describe them in detail. For instance, how are mutton, salmon, lobster preserved in tins? How are fruit and vegetables preserved in bottles and tins with liquor? It seems to me that if it pays Americans to preserve greengages and send them over here, our fruit-growers ought to be able to take advantage of so abundant a crop as they had last year of plums, and at least dry them into prunes. So with peas and beans, which are preserved green—the latter being called "haricots verts à l'Anglais," and largely imported from France. Why not preserve them here?—T. J. M.

[62017.]—**Odic Force.**—Would "Odometer" (letter 26946) kindly give further particulars as to how he carried out his experiments? I, too, saw the magazine article he alludes to; I, too, made an odometer (gold ring and silk thread); but to my disappointment I could not verify Mr. Maye's assertions. If the odometer was at rest, no manipulation of mine (putting metals under it, taking a lady's hand, &c.), would start it. It will undoubtedly swing backwards and forwards, or rotate; but this, in my opinion, is due to unsteadiness in holding it, combined, perhaps, with unconscious muscular action. Nor could any manipulation of mine (as above) change one kind of motion for another—i.e., cause it to rotate, when it had been swinging, or vice versâ.—TRITON.

Brazing Compound.—A new method of preparing solder for brazing consists in mixing suitable proportions of pulverised brass solder and pulverised borax, then grinding the two together until the borax will set or harden, and the mixture is wholly free from lumps, and slowly adding water to make a paste. The moisture is then dried from the paste, whereby cakes are formed which will keep any length of time.

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⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 16, and unacknowledged elsewhere:—

OTTWAY AND SON. — B. Wheeler.—Maj.-Gen. Cunningham.—A. J. P.—Norman Bros.—L. Walton.—A Fellow of the Royal Astronomical Society.—H. J. Hardy.—H. C.—Student.—Orthochromatic.—H. D.—John Currie.—Excelsior.—J. W.—P. H. Kempthorne.—R. Dobson.—G. H., Bristol.—H. H.—Old Subscriber of 20 Years.—Gerard Smith.—C. M. Gaudibert.—One Interested in Mines.—H. P. Slade.—Eos.—Jason.—S. Bottone.—Dr. F. Terby.

F. S. W. (You should have stated in what point you failed to obtain satisfaction, as the method of making camera bellows has been frequently described. There are two illustrated methods in No. 894, p. 224.)—COUNTY DURHAM. (Any turner having a suitable lathe could make them; but he would find a great difficulty in procuring wood properly seasoned. It is better to buy a set, and they can be had of any of the dealers who sell such things as cricket bats.)—AMATEUR, Malton. (A large Leclanché battery will be required, and the connections must be so arranged that the persons stand on metal while attempting to touch the other metallic surface. Rather troublesome and expensive to carry out efficiently, and then it might lead to awkward results occasionally.) — PRIMUS. (Chloralum is an impure aqueous solution of chloride of aluminium, which any of the dealers in chemicals advertising in our pages can supply.)—A CONSTANT READER, Norwich. (If you mixed a bronze powder with the varnish as directed, you obtained a bronze paint. What effect did you expect?)—AMATEUR. (Try what effect a weak solution of chloride of lime has. See No. 912, p. 44, and No. 917, p. 169, for methods of cleaning soiled engravings. Many plans have been described in back volumes.)—E. C. M. (Your idea is a good one, except that so long a "tunnel" would be disadvantageous. We think you will find mention of something similar in this number.)—J. R. (A similar query inserted on p. 43.)—M. (You will find several methods in back volumes. See pp. 330, 354, 422, Vol. XXXIX., for instance. The simplest plan is to clean off all flesh and immerse in cold water, preferably running, for some weeks; then expose to sun under glass.)—ELECTRICAL. (The answer given was an answer to the question, and you were referred to the lists in the books, so that you could adopt which you please, for they vary, much depending on the comparative purity of the metals. The question is of no special interest.)—G. C., Clapham. (How can any one answer such a question? It is purely a matter for experiment. If you mean has it ever been tried?—we do not think it has—at all events, with success; for cooking seems to be essential.)—R. AMPSON. (We believe we answered you last week; but, however, for several recipes for luminous paint, see No. 1063, p. 467; but see also No. 774, p. 471, where you will find a description of Balmain's, which is the best.)—SANITAS. (For an article on the physiological effects of massage, see p. 273, No. 1105; for electro-massage, see p. 519, No. 854.)—JUBILEE. (What do you mean? "Emery" is usually "red brown" or dark brown in colour. The better qualities are, however, blue and greyish-blue; but they are known as corundum. It is the common brown emery that is used for the purpose mentioned.)—GAMMA SIGMA. (Should you not procure a handbook of the game? Considerations of space prevent the setting out of the solutions in full; but as a matter of fact problem solvers do not require them. The key-move is all they need. The problem in question (1031) seems quite sound, and you have correctly made the key move; but the mating move depends on which piece Black moves. The solution says a Queen, a Rook, a Knight, or a Bishop mates; but there is another alternative, for a pawn may be enabled to move and so "discover check." If you select as Black's move advancing the pawn to the square from which the W. Queen has just moved, mate is given by the Queen taking that pawn. In problems the pieces are, as you suggest, often in positions not generally seen in games; but if pieces are put on the board merely to confuse, then the problem is not considered a good one. Half an hour with a chess-player would teach you more than a dozen columns in our Replies.)—C. W. F. (You want a slip of wood over the back ends, or a little rail to enter the slot in the ends if they are so made. In No. 662, p. 290, both methods are illustrated.)—A LABOURER. (The query is just as incomprehensible as before. In fact, it is the same. Read some textbook of electricity—say, Mr. Sprague's work.)—A. SOUTHGATE. (See the diagram and table for the identification of Saturn's satellites in No. 1130, p. 381.)—TERBOT. (They are salted more or less and smoked. See p. 310, last volume.)—STUDENT. (The usual method is to press the oil out by means of hydraulic machines, putting the nuts into bags. See any cyclopædia for a general description, and then put queries on any points not understood.)—A FOREIGNER. (We believe scraping was done in 1863 to a certain extent; but it is not done periodically. M. Taine is not exactly an authority on such matters. 2. It means investigation, inquiry, from Greek *zeteo*, to seek.)—VICTIM OF FASHION. (Brush well and iron on a block.)—YOUNG HAND. (Procure Michael Reynolds's "Stationary Engine Driving." Crosby Lockwood and Co., Stationers' Hall-court, E.C., 4s. 6d.)—OUIDA. (Official information can now be obtained from the Emigration Office; but there are many hints in back numbers.)—FESTINA LENTE, Bath. (A query on the subject appears this week. If it were as wonderful as the *Times* correspondent announced, you would have heard something about it before now. If it is worth anything, you may be sure it is patented, and you will not get it for half a crown. 2. No one can suggest the cause; but you can varnish over the putty. 3. Most likely it would kill the fish, unless the tank were sunk in the ground.)—TRAVELLING EXHIBITOR. (See the letters on "Ethoxo Limelight," which appeared a few years ago, and especially a reply in No. 1,072, p. 128, in which Mr. Pumphrey offers to send directions for making it safe and simple. See the indices of Vols. XXXIV., XXXV., XXXVI.)—C. H. G. (It is public property. The ascent is dangerous at times; but you will find full information in the guidebooks. 2. Carbolic acid will generally induce them to quit; but a mixture of red lead, dry flour, and a little sugar will clear them off, if placed in their haunts.)—A. S. (By "salol" you no doubt refer to salicylic acid, which has, we believe, been used with advantage in cases of acute rheumatism; but amateur "physicians" had better leave it alone. See "Salicin," p. 244, No. 1,103, and the indices.)—B. LONNEN. (Send the question to the editor of the *Phonographic Reporter*, London. All sorts of extraordinary speeds have been claimed; but you, we presume, want well-authenticated instances.)—HARDMAN, South Australia. (There are none that we know of; but several papers often have articles on the subject, and you will find a few in our columns. Chadwick's "Magic Lantern Manual," London: F. Warne and Co., Bedford-street, Strand, 1s. 6d., would be useful. Also Wood's "Magic Lanterns," E. G. Wood, 74, Cheapside, E.C., 1s. Have you Vols. XXXII. and XXXIII., containing Mr. L. Wright's articles on "Optics with the Lantern," and Vols. XVIII. and XIX., containing Mr. Woodbury's "Science at Home"?—TYRO. (Hatto was Archbishop of Mentz, and was devoured by mice or rats in the Mouse-tower erected on an island in the Rhine, near Bingen. Southey, not Wordsworth, tells the story in a ballad entitled "God's Judgment on a Wicked Bishop." The story is told in many forms. Other query inserted.)—AQUA. (The storm-glass referred to is made thus: A clean glass tube, 12in. long and ¾in. diameter, is three-parts filled with a solution made up in the following proportions. Camphor 2 drachms, nitre 1½ drachm, sal-ammoniac 1 drachm, proof spirit 2¼oz. The open end of the tube is closed with a brass cap, having a very minute hole in it, or covered with a piece of bladder. The indications are not trustworthy.)—A GREAT DRAWBACK. (Read the medical column in the *Weekly Times and Echo.*)—HEREWARD. (Replies to such a query might come from those interested in the machines. See what has been said in back volumes about them, and judge for yourself. 2. An article on pastes and gums appeared in the No. for Feb. 18, and there are many recipes in back volumes.)—IGNORANCE. (Tar is used, water-glass, and silicate paints; but particulars should be given if useful advice is required.)—E. HOLMES. (Impossible to reproduce drawing sent.)—PROFESSIONAL ETIQUETTE. (No. It refers to the medical editor of the *Weekly Times and Echo*, a fully-qualified practitioner whom his confrères are, as usual, trying to boycott.)—L. W. D. (Only for three years.)

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 25, 1887.

NOTES ON THE CHURCH ORGAN.

VI.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

IN my remarks on the tonal scheme of the Great organ in the preceding Article I omitted to again dwell on the importance of the introduction of a stop of 16ft. pitch. But after what I have said in Article IV., it is, perhaps, unnecessary to do more than refer the reader to the three opening paragraphs of that article, just remarking here that no Great department of any pretension towards completeness and dignity should be schemed without a *Double* of appropriate character.

Swell Organ.

From all my preceding Notes it will have been gathered that I lay more stress on the proper appointment and location of the Swell department of the Church Organ than, perhaps, any other writer upon the subject has hitherto done. The Swell certainly has, ever since its inception in the year 1712, undergone a gradual but very decided development; but it would be rash to say that it has reached at the present time its highest point of excellence. In mere matters of construction and mechanical adjuncts it has become fairly satisfactory. With the construction of the swell-box, however, I have nothing to do at present; but I have a few very decided words to say relative to its position in the instrument, and with reference to the stop appointment or tonal structure of the department.

In an instrument specially designed for accompaniment, like the Church Organ, it must be obvious that its most important and effective division should be rendered capable of the greatest possible gradation of tone, and be endowed with the highest possible powers of expression. Unless such is the case, I hold that both the beauty and utility of the whole instrument are seriously impaired. As a rule, the Swell organ is hardly accorded its true dignity and importance by our organ builders in any class of instrument constructed by them; and even when it is fairly well appointed, it is too often relegated to a position in the depths of a chamber or some other objectionable locality which is fatal to its effectiveness. Serious complaints are levelled against the swell, because the stops placed within the box are believed to suffer a species of annihilation. There may be some reason in such complaints in certain cases, for, unquestionably, swell-boxes are frequently sorry affairs, constructed with insufficient means for the free emission of sound when their shutters are fully open. Under such circumstances a general inefficiency obtains, and nothing but an undefined *crescendo* and *diminuendo* can be produced. Great care should always be exercised in the construction of the swell-box, and it is highly desirable that a better arrangement and a far greater area of shutters should be adopted than is generally the practice. It is argued that a swell with a large area devoted to shutters fails to produce a very soft or distant effect. Granted; but do we want in a Church Organ anything approaching that mile-away sound annihilation? Certainly not. We want pure, distinct tone when the shutters are both closed and open, with a well-marked gradation from a perfectly dead *piano* to a brilliant *forte*. This can only be secured, firstly, by properly constructing the swell, and, secondly, by locating it in a position where it will not be surrounded or hemmed in with obstructions to the free egress of its sound. Want of space prevents my enlarging upon this most important subject here; and I must turn to the consideration of the stop appointment or tonal structure of the Swell organ.

As the Swell organ is an *expressive* department, it is obvious that the considerations which obtained with so much force in relation to the Great have no direct bearing in regard to its tonal structure; nevertheless, the important elements of dignity, purity of tone, and proper harmonic structure must be fully acknowledged. It will be remembered that, in my illustration of the divided orchestra, I ventured to believe that a musician would decide that the *unexpressive* section should be composed of those instruments which produce the purest, roundest, and quietest tones; and that the *expressive* section or sections should embrace all those pungent, loud, and assertive instruments, as well as the greatest number and variety of instruments, which must be played with expression to be tolerated by the musical ear or to reach the musical sense. From these words it will be gathered that I hold that the *expressive* section of an organ should contain louder and more assertive stops, and also a greater number and variety of stops than any other (*unexpressive*) department. Such is my firm conviction. It is not too much to say that, while the Great organ, in its dignity and refinement, is of immense importance, the Swell department should be chiefly resorted to for the highest class of accompaniment: and were Swell organs properly schemed and appointed, few organists would question this statement. If the vocal music is required to be expressive, surely the accompaniment should be equally so. This, I think, may go without saying.

In advocating the introduction of louder and more assertive stops in the Swell than in the Great department, it must not be understood that I mean coarse, screaming affairs, such as one only too frequently hears in Church Organs. I merely require stops which are of sufficient power and clearness of intonation to be thoroughly effective under the conditions in which they are placed and used. A Great organ, such as I have endeavoured to describe in the preceding article, would be altogether ineffective if inclosed in a swell-box and treated as a Swell organ.

To secure the brilliancy of tone desirable in the Swell department, stops of medium scales, specially voiced, with copious windage at a pressure slightly higher than that of the Great—say 3in. or 3¼in.—should be adopted.

In scheming the tonal structure of the Swell department, care must be taken to secure the preponderance of true organ quality, by the introduction of the full complement of foundation and chorus work. It is even more important here than in the Great that the full harmonic structure should be present and assertive; for that ringing brilliancy which is so desirable in a Swell organ can only be attained by the development of a true harmonic scheme, based on prime tones of great fulness, and justly tempered throughout. To this may be added, according to the size of the organ, as many imitative and solo stops, of 8ft. and 4ft. pitch, as can be accommodated or afforded, and one or two stops of 16ft. tone. It must be realised, once for all, that the resources of this important department cannot be overdone. The more varied and flexible the resources are, the more efficient the entire instrument will prove in all classes of accompanimental music. In speaking of imitative and solo stops, I allude to those which impart a refined and characteristic tone colouring to the combinations in which they enter, or which are satisfactory and effective when used with some soft accompaniment—stops which, in short, throw an orchestral reflection on the solid background of true organ tone, varying it without destroying it. Such fancy stops as the *Vox Humana* and *Voix Célestes* I lay no stress upon. They may be adopted or not according to taste; but I do say they are not necessary in a Church Organ, and should never be introduced to the exclusion of important and infinitely more valuable stops. After having devoted so much space, in Articles III. and IV., to the consideration of the speaking stops suitable for the Church Organ, it is unnecessary for me to give here anything in the nature of a list of those suitable for the Swell department. With what I have just said, and with reference to my remarks on the speaking stops and the appointment of the Great organ, the intelligent reader can easily develop a satisfactory scheme for the Swell department of an instrument of any dimensions.

Choir Organ.

I now come to the consideration of the third and least important manual department of the Church Organ. As the so-called Choir organ is commonly met with, it is open to grave question if it is not a mistake. That a third department, properly schemed and presenting a decided individuality, is of considerable importance in itself and a great convenience to the organist, cannot be doubted. All that can be said against its insertion is that in a Church instrument, provided with a Great and Swell such as I have sketched, it is not a *necessity*.

Seeing that both the Great and Swell organs are based on and furnished with true harmonic structures, it may be taken for granted that the third department may be schemed on freer lines, and partake partly of the nature of a soft accompanimental organ and partly of a solo organ. This dual character at once ushers in the question—should the choir department be *expressive* or not? My answer is simple, and, I venture to think, logical—its soft accompanimental part need not be *expressive*, any more than the normal Great organ; but its solo part must be inclosed in a swell-box. The too common practice of placing imitative stops—notably *Clarinets*—in the Choir, without any means of controlling or imparting light and shade to their tones, is to be condemned from every musical and commonsense point of view. When it is decided that the choir organ is to be *unexpressive* throughout, let all imitative and essentially solo stops be omitted. The great advantage to be gained by inclosing the Choir, partly or wholly, in an independent swell-box has been altogether overlooked in this country; but on the other side of the Atlantic a different state of affairs exists. The late Hilborne L. Roosevelt has, in all his important Church Organs, introduced the Choir as an *expressive* department. The following are the specification of the fine Choir organ of the instrument built by him in the Church of the Incarnation, New York, and his remarks thereon:—

"CHOIR ORGAN

"(Inclosed in a separate Swell-box).

1.	Contra Gamba	16ft.
2.	Geigen Principal	8
3.	Dulciana	8
4.	Voix Célestes	8
5.	Concert Flute	8
6.	Rohr Flöte	8
7.	Quintadena	8
8.	Fugara	4
9.	Flute d'Amour	4
10.	Piccolo Harmonique	2.
11.	Dolce Cornet	V. Ranks.
12.	Clarinet	8ft.

"The pipes of the Choir organ are placed in an independent swell-box, an expedient which more than doubles their intrinsic value, and admits of such telling effect, when coupled to the Swell, produced by gradually opening one box while closing the other. The two swell pedals are assigned a position to the right of the organist, their elevation or depression being governed by a ratchet mechanism, controlled by the position of the foot upon the pedal." *

In the builder's organ in the First Congregational Church, at Great Barrington, Mass. (the case for which I had the pleasure of designing in 1883), the whole of the stops of the Swell and Choir departments and seven stops of the Great organ are inclosed in swell-boxes. Speaking of this instrument Mr. Roosevelt says :—"From the above it will be readily seen that, with such an unprecedented proportion of the whole instrument placed within swell-boxes—viz., 38 stops out of 55 (exclusive of the Echo), a *crescendo* or *diminuendo* of startling intensity becomes feasible to an extent impossible under other circumstances; besides which, a beautiful and novel effect is produced by gradually closing one swell while opening the other." †

Considerable freedom, as I have already hinted, may be exercised in the appointment of the Choir department. As it is not necessary to construct its tonal scheme on the same scientific lines as are imperative in regard to the Great and Swell organs, individual taste may have free scope in the selection of the stops to be inserted. It may be made partly a soft accompanimental and partly an effective solo organ; it may be schemed as a solo organ only, in which case it must be *expressive* throughout; or it may be entirely planted with string-toned stops, producing an effect corresponding to the collective stringed instruments of the orchestra—again it must be *expressive* throughout. In the last case it becomes a very valuable and effective accompanimental department. I think it should always be borne in mind, in scheming the Choir department, that it is more useful as an auxiliary to the Great and Swell organs than as a free and independent department.

Pedal Organ.

It is quite safe to say that of all the departments of the Church Organ, as it is commonly constructed in this country, the Pedal is the most deficient and radically imperfect. The lamentable shortcomings of this department are attributable to several causes—viz., shortness of funds, deficiency of space, want of a proper conception of the true office of the Pedal department, &c. Now, it is not too much to say that, without an adequate Pedal organ, it is hopeless to construct a well-balanced and satisfactory instrument. Judging by the generality of Church Organs constructed in England, it is obvious that the true office of the Pedal department is altogether misunderstood or ignored, and that it is sacrificed or denuded of its true glory for the sake of the manual departments. Nothing could be more short-sighted than such a method of procedure.

The true office of the Pedal organ is to provide a perfectly suitable bass for all the important stops and combinations of stops of the several manual departments. To fulfil this office in a satisfactory manner, it is necessary that the Pedal organ should be furnished with well-selected stops, numbering about the fifth part of the entire list of stops contained in the instrument. In many Continental organs the proportion is greater than this, as will be seen by the following list :—

	Manual stops.	Pedal stops.
Cathedral Church, Ulm	69	31
SS. Peter and Paul, Goerlitz	36	19
St. Bavon, Haarlem	45	15
Cathedral, Antwerp	34	10
St. Maria, Cologne	30	10
St. Ursula, Cologne	19	6
St. Paul, Frankfort	52	22
Parish Church, Muhlhausen	42	18
Cathedral Church, Merseburg	61	20
Christ Church, Hirschberg	46	16
Catholic Church, Trebniz	22	11
St. Catherine, Salzwedel	28	14
St. Mary, Wismar	39	17
Holy Cross. Dresden	40	16
Cathedral Church, Breslau	42	18
St. Vincent, Breslau	30	15
Lutheran Church, Warsaw	18	9
St. Stephen, Vienna	28	13
Lutheran Church, Vienna	15	8
St. Emmeran, Ratisbon	18	8
Parish Church, Botzen	22	8

An examination of the above list will clearly show the importance attributed to the Pedal organ by the great masters of organ-building in Germany and elsewhere. And it is not too much to say that we need never hope to have satisfactory Church Organs in this country until we follow the lines laid down by these old artists in this direction.

I am perfectly aware that the large-sized pipes necessary for the stops of the Pedal organ are both costly and cumbersome affairs, and that deficiency of funds and the blunders of architects generally militate against a more liberal introduction of them. But, in the name of art and common sense, it is surely more advisable to scheme an organ with all its departments properly balanced and fitted for each other, however circumscribed they may be, than to have the manual departments enlarged at the expense, if not to the total ruin, of the Pedal organ. Where is there an English Church Organ schemed on such lines as those followed in the appointment of the moderately-sized instruments in the Lutheran churches of Warsaw and Vienna? The former organ has 18 manual stops and 9 pedal stops; while the latter has 15 manual stops and 8 pedal stops. Eight or nine pedal stops are considered by English organ builders to be ample for an instrument of four manuals and forty-five or fifty manual stops. By far the greater number of Church Organs, at present in existence in this country, have only one, two, or three pedal stops. I have already commented on the absurdity of depending on one master-of-all-work, "deep booming" 16ft. *Open Diapason*, or, what is still worse, a "tubby" *Bourdon*, to supply an appropriate bass for fifteen or twenty manual stops, and need not enlarge on the subject again. But I may just say that it is truly melancholy to note the shifts organists are commonly put to in performing on instruments with totally inadequate Pedal organs: and the expedients they resort to, in doing their utmost, by a timid, *staccato* style of pedalling, to make their solitary booming 16ft. stop serve for the bass of some soft combination, just, as a moment before, it served for the bass of the full organ, are worthy of all praise.

Will the day ever come when the true nature and the proper appointment of the organ will be generally understood; and the present absurd style of building become a thing of the past? There certainly is, at the present time, a growing interest in matters relating to the "king of instruments"; but I am afraid the day of complete knowledge and reformation is still far distant.

In scheming a Pedal department on proper and scientific lines, the fact that it must provide proper basses for all the manual departments, and, indeed, for all the more important manual stops and combinations, must be held steadily in view. In addition to this, it must within itself have a true harmonic structure, and certain of its stops should be made *expressive* by being inclosed in one or other of the swell-boxes. These considerations bring me, of necessity, to the system of organ building introduced by my friend, Mr. Thomas Casson, of Denbigh, and I cannot do better than conclude the present series of Notes with a few remarks on it; indeed, no article on the Church Organ would now be complete without some allusion to this most ingenious and useful invention.

Whether all Mr. Casson's theories be accepted or not, it must be admitted that some of them are bound to exercise a great influence on the art of organ building in the near future. The system is based on the necessity, musically, of having each of the departments which go to form a perfect organ complete in itself. Mr. Casson says :—"Since it is necessary to have separate manual organs, and since the pedal stops are or should be the basses of the manual stops, it follows that there should be as many Pedal organs as manual departments—one for each—together with a coupler to unite each manual organ to its Pedal organ. Each such Pedal organ and coupler is called a *Pedalier;* and its draw-stops must be grouped with those of its corresponding manual organ. Since it is impossible or impracticable to have more than one convenient pedal clavier, the *Pedalier* required must be readily attachable to it to the exclusion of the *Pedaliers* not required. This is conveniently done by a pneumatic stud, placed under each manual, and called a *Pedal Help.* On touching this the *Pedalier* belonging to the manual is at once brought on to the exclusion of all others. When two manual organs are coupled, the *Pedal Help* of the controlling manual brings on the *Pedaliers* of both.

"Couplers must, for the purposes of combination, be regarded as *mechanical stops,* adding to the resources of certain manual or pedal departments. They are, therefore, grouped with the stops of the department which they augment. Thus, Swell to Great must be treated as a stop of the Great organ; Choir to Pedal as a stop of the Choir *Pedalier.*

"Combination actions govern the entire stop-group of each separate organ—i.e., manual and pedal stops and couplers. Thus, for ordinary combinations the pedal stops are always ready. Pedal obbligato or solo combinations may be readily prepared by hand.

"By these methods of preparation, the freedom and versatility hitherto confined to the manual stops are imparted to those of the Pedal organ, entirely abolishing the usual worry with the pedal stops and couplers. The pedal clavier, under such conditions, becomes a *great mechanical hand,* applicable at will to any of the Pedal organs.

"If several manual departments are attachable to one manual clavier (as in the ventil system), each organ must have its separate *Pedalier,* couplers, and combination actions. The changes of these are effected by *Manual Helps.* Thus, in a two-manualled organ, the upper clavier may have Swell and Echo, and the lower Great and Choir, the one coupling action drawing and moving separately with both Great and Choir, being thus equal to four. The two Pedal couplers draw and work separately, becoming equal to four. A simple contrivance enables two departments on the same manual to be coupled, so that, for instance, the Choir can be governed by the Great, though the Great cannot be governed by the Choir, and the [illegible] holds good as regards the Swell and [illegible]. Thus, with only three coupling actions the work of ten are secured, with an enormous simplification of mechanism.

"Since the pedal stops are the basses of the manual stops, it is permissible (although it is no part of the *principle*) to borrow their upper range from the corresponding manual stops. For instance, the upper range of a pedal *Trombone*, 16ft., from the manual *Trumpet*, 8ft. And since the pedal stops are the basses of the manual stops, it is imperative that the pedal basses of all stops in a swell-box be in that swell-box."

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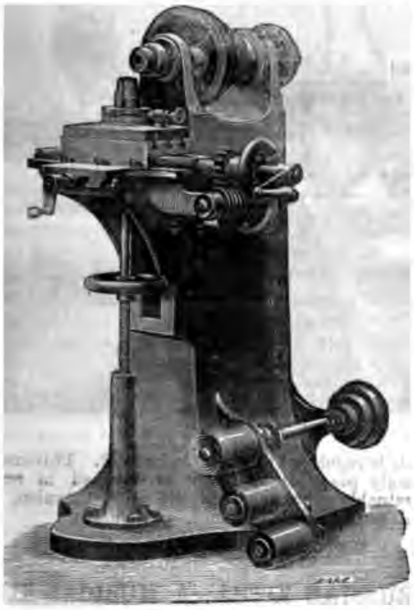
* It is right to remark that Mr. Roosevelt subsequently favoured the central position and balanced swell pedals.

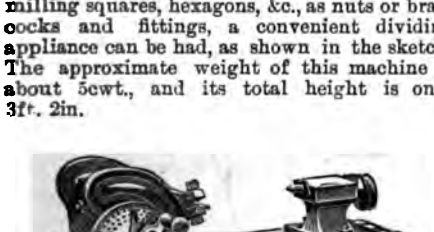
† This was in 1883; but in the year 1870 I had anticipated the novel effect here commented on by placing portions of the Great department of my own Chamber Organ in two independent swell-boxes, and the Choir department also in a swell-box. As I have already pointed out, my organ still remains unique in the respect that its oneG reat department has two distinct *expressive* sections and one *unexpressive* section, all commanded from its one keyboard. By this arrangement, the crossing effect of *three* swells is obtained while the hands are performing on the *two* keyboards, and the feet are operating *two* levers only.

Such is a short *résumé* of Mr. Casson's admirable system; and I seriously recommend it to the careful consideration of all interested in economical and efficient organ building.

NEW MILLING MACHINE, DIVIDING APPLIANCE, AND MACHINIST'S VICE.

IN the engravings annexed we illustrate three new appliances recently brought out by the Britannia Company, of Colchester. The milling machine is especially suited to the work of makers of small machines, the slides traversing longitudinally 11½in., transversely 4½in., and vertically 12in. The work table is 8in. by 6in. with T-grooves. The spindle is of steel, and has a conical neck; the nose is screwed and coned for chucks, and the machine is self-acting longitudinally by means of improved worm and wheel feed, while the vertical movement is effected by the wheel and screw seen in front. When required for milling squares, hexagons, &c., as nuts or brass cocks and fittings, a convenient dividing appliance can be had, as shown in the sketch. The approximate weight of this machine is about 5cwt., and its total height is only 3ft. 2in.





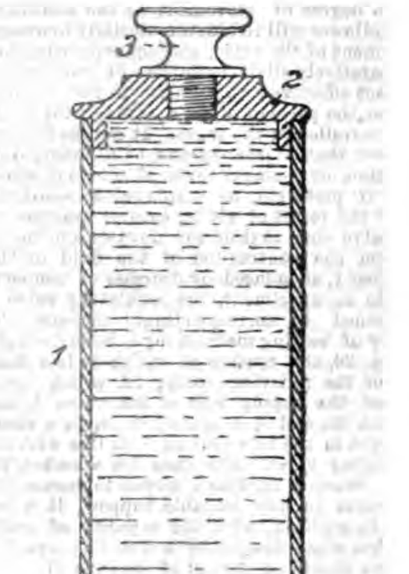
The dividing head shown in the annexed engraving is especially adapted for shaping, milling, and similar machines, and is a strong pattern for engineers' work. The bed is planed, and has T-slots so that it can be bolted to the machine table, while the quadrant slots allow of adjustment to any desired angle for cutting worm wheels, angled-tooth cutters, &c. The fast head is constructed for the spindle to be elevated and locked at either the horizontal or vertical, or any intermediate angle, and it has a graduated quadrant. A steel worm and wheel moves the spindle for dividing, and the worm shaft carries a division plate with five rows of holes capable of dividing, with the worm gearing, up to 3·600 to an inch. A piston stop and sextant finger are provided, and the main spindle is hollow, and coned so that different mandrels may be used.

The improved engineer's or machinist's vice shown in the engraving is sufficiently explained thereby. It is of a strong pattern, with swivel bottom, and is adapted for use with milling machines, planers, and shapers. It is made with jaws of 5½in., opening to 4in., but is constructed in other sizes to order. Like the dividing appliance above described, it is in use at Woolwich Arsenal, a sufficient guarantee of its value.

WESTINGHOUSE AND MOORE'S IMPROVED THERMOSTAT.

THERMOSTATS are so useful in many of the arts that any simple apparatus which can be relied upon is of great interest, and we accordingly illustrate one form of the improved thermostats recently patented by G. Westinghouse, jun., and F. Moore, of Pittsburg, Pennsylvania. The object of the invention is to provide an apparatus of small compass and simple and inexpensive construction whereby the temperature of an apartment may be maintained at a substantially uniform temperature by the automatic regulation of the supply of heating medium coincidently with and proportionately to variations of temperature above or below the desired and determined degree. To this end the invention, generally stated, consists in the combination of a closed case or chamber for the reception of a readily expansive liquid, the chamber being connected to the chest or body of a regulating valve, a movable abutment closing one end, and a follower adapted to bear against the movable abutment, and to transmit pressure therefrom to the regulating valve. The figure is a vertical central section through a thermostat constructed according to the invention. A thin metallic chamber or receptacle, 1, is designed to be filled with any suitable liquid having a high degree of expansibility, as, for example, alcohol, benzine, or other liquid, which vaporises at a low temperature, which chamber is most conveniently made, as shown, of cylindrical form, and is closed at one end by a cap, 2, having an opening fitted with a suitable plug, 3, through which the liquid may be introduced. The opposite end of the chamber 1 is fitted with a movable abutment adapted to be moved outwardly by the pressure of the contained liquid when expanded, and to be returned to position upon the contraction of the liquid, a desirable form of such abutment being a flexible diaphragm, 4, soldered at its edges to the end piece, 5, of the chamber 1. The end-piece 5 is connected to a follower chamber, 6, which is formed integral with or connected to the body or casing, 7, of a regulating valve, 8, controlling the passage of a heating medium, as gas, to the apparatus by which heat is imparted to the apartment in which the apparatus is located. The end-piece 5 of the liquid chamber may be connected adjustably to the follower chamber, as by a screw thread on the periphery of the former engaging an internal thread in the latter in order to enable the distance between the flexible diaphragm and regulating valve to be increased or diminished as desired. The movable abutment 4 bears against a follower which moves freely in the chamber 6, and which, as shown, is composed of a section, 9, having one of its ends abutting against the movable abutment 4, and a section, 10, connected to the section 9 by a nut, 11, engaging a thread on a central stem on the section 9, which passes freely through the adjacent end of the section 10. A helical relieving spring, 12, interposed between the sections 9 and 10, and of sufficient tension to resist compression under the pressure of the movable abutment during such period as the regulating valve is raised from its seat, maintains the outer faces of the sections 9 and 10 at the maximum distance apart permitted by the adjustment of the nut 11. To prevent leakage of fluid from the valve casing 7 past the follower, a flexible diaphragm, 13, may be inteposed between the central opening of the follower chamber 6 and the movable abutment 4, said diaphragm being secured centrally by a nut, 14, to the follower section 9, and its periphery by a nut, 15, to the chamber 6.

In certain modifications the liquid chamber is fixed without adjustment to the follower chamber, the follower is formed in a single piece having a broad head or upper face bearing against the movable abutment, and the relieving spring is located at the opposite end of the liquid chamber, and bears against a seat on the inside of the cap 2, and against a supplemental follower abutting against a flexible diaphragm, closing the upper end of the liquid chamber, and confined at its periphery between the same and the cap 2.



The pressure of the movable abutment 4, when moved outwardly by the expansion of the liquid contained in the chamber 1, is transmitted by the follower 9, 10 to the regulating valve 8, to wholly or partially close the same as may be required to maintain the desired temperature, and, for the purpose of increasing the cumference. These screws control an inner ring, into which the objective is screwed, and which may be moved laterally by means of the steel screws. This inner ring, and also the outer ring which supports it, may be made of any suitable length, and by this means the accurate adjustment for focus is effected; while the inner ring being, as already mentioned, capable of a lateral movement, the adjustment for 'centre' may also be accurately made."

Mr. W. Watson exhibited and described the Watson-Draper Microscope, a new instrument which he had made on the designs of Mr. E. T. Draper. The microscope is an elaboration of the Watson-Crossley form, and the idea of the designer is "that when the object is on the stage either it may be made to rotate in any direction, horizontal or vertical, round a fixed beam of light, without the light even leaving the spot, or the stage may be kept fixed while the light is revolving round it in any direction, horizontal or vertical, always however, remaining upon the spot."

Mr. J. Mayall, jun., described the "Nelson Model Microscope," exhibited by Mr. Baker (see ENGLISH MECHANIC, Vol. XLIV., p. 497).

Mr. G. Massee gave a *résumé* of his paper "On the Differentiation of Tissues in Fungi."

Mr. A. W. Bennett spoke of the interest attaching to Mr. Massee's paper, inasmuch as so much attention had not been paid to the differentiation of tissues in fungi as in the higher algæ, where we often get distinct tissues adapted for assimilation, for conduction, and for strengthening. He did not think, however, that this affected the primary classification of the vegetable kingdom into cellular and vascular plants, since it is doubtful whether any true vessels exist in thallophytes. The cystidia of the basidiomycetes he did not regard as having any sexual function whatever. They frequently contain large crystals of calcium oxalate.

Prof. Stewart said that, although the interest of any structure is naturally greatly enhanced when we are able to recognise the function it performs, we must bear in mind the fact that it may have no duty to accomplish, but be only the result of certain forces acting on the organism, or be but the remains of something of use in past times. Might not the cystidia be produced by the more abundant ascent of fluids through the laticiferous tubes at certain periods, causing an expansion of their free, unsupported extremities; the fluid contents finally escaping either by exuding through the thin walls of the cystidia or producing their rupture?

Drs. H. J. Johnston-Lavis and G. C. J. Vosmaer's paper "On Cutting Sections of Sponges, and other similar structures with soft and hard tissues," was read by Prof. Bell.

Mr. B. B. Woodward gave some further explanations as to the specimens exhibited in illustration of the paper, which were of exceptionally large size.

Prof. Stewart said that large and thin sections of sponges were often of great use by enabling one to determine the natural relationship of distant parts to one another, so that the method described would probably be of chief use in making such sections of the harder sponges. He thought, however, that the simpler freezing method would suffice in most cases. For investigations into the more minute structure, he had obtained the best results by hardening in osmic acid and alcohol, freezing, and cutting with a microtome, and mounting in a solution of acetate of potash, without further staining, or staining with carmine or logwood, and mounting in Canada balsam.

Prof. Bell considered that large sections would be found useful in the systematic examination of sponges, as an assistant to classification.

Mr. F. Kitton's note on "Styrax and Canada Balsam" was read:—"For the last few months I have been using a mixture (equal parts) of styrax and Canada balsam. The latter was pure, but hardened by exposure to a gentle heat. The styrax ('strained styrax of commerce'), dissolved in benzol and filtered, should be of the consistence of olive oil or a trifle thicker. The refractive index is of course less than that of pure styrax, but higher than that of Canada balsam; it is admirably suited for all the more robust diatoms, from *Eupodiscus argus* to *Pleurosigma angulatum*. It can be hardened over a Bunsen burner without the formation of air-bubbles until it becomes brittle, which, however, is not desirable. Hardening does not materially alter its colour. For the delicately-marked diatoms I have found nothing better than tolu. Preparations made two years ago are still free from crystals of cinnamic acid. Prof. H. L. Smith, in the beginning of 1886, kindly sent me some of his own preparations of bromide of antimony in boro-glyceride, together with a score of slides in various other media; many of them were beginning to show crystals; and at this date (December 13th, 1886) the diatoms are obscured by dense crystals. The slides prepared by myself with his bromide of antimony and boro-glyceride, the covers cemented with litharge and red-lead mixed with gold size (the most durable of all cements—I have some insect preparations, mounted in cells $\frac{1}{12}$in. deep filled with dilute glycerine and spirit, as perfect as they were when first mounted twenty-five years ago), are all full of crystals and perfectly useless. This is much to be regretted, as in every other respect this medium left nothing to be desired. With a dry $\frac{1}{6}$in. of Ross the lines on *Surirella gemma* were easily resolved into dots, and those on *P. angulatum* could be seen with an old Ross $\frac{1}{4}$in. of 74°. I have several of Dr. Meates' sulphide of arsenic mounts, but they are spoilt by crystallisation."

M. L. Chabry's capillary tube slide and perforator of cell elements was exhibited and described.

At the annual meeting the by-laws were suspended for the purpose of re-electing Dr. Dallinger as President for another year, his re-election being proposed by Mr. Carruthers, President of the Linnean Society.

The following were elected Council and officers for the ensuing year:—Vice-presidents: Robert Braithwaite, M.D., M.R.C.S., F.L.S.; J. William Groves, John Mayall, jun., F.Z.S.; William Thomas Suffolk. Treasurer: Lionel S. Beale, M.B., F.R.C.P., F.R.S. Secretaries: Frank Crisp, LL.B., B.A., V.P., and Treas. L.S.; Prof. F. Jeffrey Bell, M.A., F.Z.S. Twelve other members of Council: Joseph Beck, F.R.A.S.; Rev. Edmund Carr, M.A.; Frank R. Cheshire, F.L.S.; Edgar M. Crookshank, M.B.; Julian Deby, G. F. Dowdeswell, M.A.; James Glaisher, F.R.S., F.R.A.S.; Albert D. Michael, F.L.S.; John Millar, L.R.C.P., F.L.S.; Urban Pritchard, M.D.; Prof. Charles Stewart, M.R.C.S., F.L.S.; Charles Tyler, F.L.S.

The report of the Council for 1886 was as follows:—

Fellows.—During the year forty-four Fellows have been elected, a number which is a little below the average of preceding years; the deaths, however, have been somewhat exceptional, so that these, added to the resignations and removals, have reduced the list by thirty-three Fellows. Of the Honorary Fellows, one vacancy has occurred during the year through the lamented decease of Mr. Busk, whose death was noticed by the President at the October meeting. This vacancy has not yet been filled. The list at the end of last year stood as follows:—617 Ordinary Fellows, 49 Honorary Fellows, and 82 Ex-officio Fellows, or 748 in all.

Finances.—The revenue of the year for interest, admission fees, and annual subscriptions, exceeded £1,000. The net increase of annual subscriptions, due to elections of new Fellows, during the year, amounts to £24 3s., the invested funds standing at the same amount as last year. The arrears of subscriptions are small, and the Council believe that this Society will compare favourably in this respect with any other society in London. The compositions received during the year have been applied in part towards payment of the costs of the portraits of the presidents, which it had been intended to defray out of the invested funds.

Library and Cabinet.—The Council are glad to be able to report that the catalogue of the library is in the hands of the printers, and will be issued during the present session. In going through the books, it was found that there are many which, whilst valuable in themselves, are not, in the opinion of the Council, sufficiently useful or interesting to Fellows of the Society to make it desirable to retain them, having regard to the fact that the space in the library is rapidly being exhausted, and there is but little room to provide for the necessary books to be purchased in future years. Under these circumstances the Council recommend that they should be authorised to dispose of such books as they may consider it undesirable to retain. The examination of the cabinet has been continued, and is still in progress. An exhaustive inspection has been made of the slides, and a considerable number have been repaired and otherwise put in order. For this work the Society are largely indebted to Mr. W. H. T. Suffolk, who has been unremitting in the attention which he has paid to this matter.

Journal.—It having been found practically impossible to compress the Journal within narrower limits, the Council have consented to an enlargement of the page, so as to give more matter within the same number of pages, and it is hoped that by this means any necessity for an increase in the latter may be obviated. Arrangements have also been made for providing a somewhat thinner paper, so that the bulk of the Journal as a whole will be reduced. The Fellows will understand, however, that the volumes, although apparently smaller than hitherto, will contain in reality more matter. The subdivision of the summary has been carried still further by subordinate headings being given to the anatomy and physiology of the botany section, and also to both divisions of microscopy, thus facilitating a reference to the notes relating to any given subject.

Meetings.—The interest in the evening meetings has been extremely well sustained during the year, the attendance having been larger than in any previous year. The Society are much indebted to the indefatigable exertions of the secretaries for the subjects brought before the Society, the varied character of which has contributed largely to the interest of the meetings.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE sixth meeting of the session was held on Monday evening, the 14th March, Mr. W. D. H. Deane, M.A., in the chair. The election of 23 members was confirmed, and 10 candidates were nominated. Mr. Thos. Gwyn Elger formally proposed that the annual general meeting be this year held in London. The Society, though nominally associated with the city of Liverpool, had assumed a national character, inasmuch as it included members from all parts of Great Britain and Ireland, and, consequently, ceased in any way to remain a local institution. For the future welfare of a society constituted on this basis it was desirable that an annual conference of members be held at some place conveniently situated for such an assembly. A large proportion of the members resided within a radius of 80 miles from the metropolis, and it was in every way desirable that the annual meeting for 1887 be held there.

Mr. C. A. Defieux seconded, and he was sure it would receive the support of all local members. (Applause.) The annual meetings had hitherto been anything but representative. A few members had met in a friendly way to pass the accounts, and, after a few mutual compliments, the annual meeting of that year was a thing of the past. No doubt all this was very pleasant, but it tended to make things run too much in one groove, and a little outside criticism would be beneficial in every way.

Mr. S. M. Baird Gemmill opposed the resolution. He thought it would be quite out of keeping for the annual general meeting of the Liverpool Astronomical Society to be held in London. It could not promote the intercourse of members, since it would only be those residing in the metropolis who would benefit. It would, he thought, be detrimental to the Society to do anything which could interfere with the continuity of its history. The imaginary difficulty of its being supposed to be a mere local affair had not prevented its rising in the past, and was not likely to do so in the future.

Mr. James Gill, a vice-president, heartily supported the resolution. Whatever benefit there was ought to be shared equally, and London had certainly the first claim. It was impossible for non-residents to appreciate the difficulties presented by the supposition that it was a mere local affair, or they would see they were far from imaginary.

Mr. Walter Sang thought it might be as well next session to hold ordinary meetings in different towns on the lines of the British Association, the preference to be given to those towns which contain most members.

A paper was read on the "Absolute Dimensions of a Star Cluster" by Mr. J. E. Gore. The globular star clusters, consisting of thousands of minute stars, were some of the most interesting objects. It was not easy to understand on what dynamical principles such an immense assemblage of bodies could exist without interfering with each other. They could not be at rest, and it was possible that each of the components described an ellipse about the centre of gravity, which would probably be situated near the centre of the sphere. One of the most remarkable of these objects was 13 Messier, which lay between η and ζ Herculis. The number of stars in this cluster was estimated by Sir W. Herschel at 14,000, and Admiral Smyth stated that its central condensation must be subject to no known law of aggregation. This might convey the impression that the component stars near the centre were almost in contact. If, however, they considered the cluster as a sphere filled with stars, the apparent condensation at the centre was easily accounted for. Mr. Proctor was of opinion that the whole cluster need not exceed in mass an average first-magnitude star. If they assumed the total mass as equal to twice the sun's, it would give an average diameter of 45,218 miles for each component, and a very simple calculation on the above assumption would show, that so far from the closeness of their positions being real, each star in this wonderful cluster might be separated from the next by a distance of 9,000 million miles!

In a paper on the "Temperature of Stars," Mr. W. H. S. Monck included all bodies in space whether luminous or not. That there were dark bodies in stellar space the existence of meteors afforded conclusive proof, since many of them described parabolic, or even hyperbolic, orbits. Again, there was a class of variables, known as the Algol type, which strongly suggested the periodical transit of a dark satellite across its face. Further, the immense body of telescopic stars offered strong indications either that the entire stellar system was confined within a measurable distance from wide, and have a draught of 25½ft. The engines will be of 2[illegible] horse-power, and be supplied by twenty boilers, the estimated speed being 22 knots an hour. The vessel will not carry cargo, and only a few express packages, and altogether she will have 1,060 watertight compartments.

High pressures and multiplied expansion of steam are not to be confined to steam vessels. The North-eastern Marine Engineering Company, Sunderland, are making for the Wandsworth pumping station of the Southwark and Vauxhall Water Company engines of the vertical marine type having cylinders of 13½in., 19in., [illegible]in., and 32in. diameter respectively, with a stroke of 3ft. Steam is to be admitted to the smallest cylinder at a pressure of about [illegible]lb. per square inch, and will pass through the others consecutively to the condenser. There are several novel features about these engines, and their performance will be looked forward to with interest.

Two proposals have been submitted to the Minister of Works, New South Wales, for tunnelling under Port Jackson, in order to connect Sydney with North Shore—one a double tubular tunnel for road and railway purposes.

Fish-hatching at the National Fish Culture Association's establishment, Delaford Park, is being carried on with gratifying success, special attention being devoted at present to the American whitefish, *Coregonus albus*, the ova of which were forwarded by the United States Government. Some fry of this species turned into the water at Burghley Park last year have thriven well, and are now about eight inches long. At Delaford Park the Californian or rainbow trout, *Salmo irideus*, have grown more rapidly than any other fish, and the land-locked salmon, *S. sebago*, which is of especial value for stocking lakes, have proved worth the attention bestowed upon them. The land-locked salmon is practically the same as *Salmo salar*, except that it rarely, if ever, migrates to the sea. The white fish is, however, the most promising, as it is described as being sweet and juicy, and equal to salmon.

There is at present no proof that the efforts to acclimatise the sole and the turbot in American waters have succeeded, as the U.S. Fish Commission dredging last October failed to catch any flat fish. In 1880 five soles reached New York alive, and were deposited outside Sandy Hook; in 1881 three soles and six turbots survived the voyage, and were turned into the sea at Sheep's Head Bay.

At a recent meeting of the Paris Academy of Sciences, M. Frémy read a paper describing the successful researches made by him, with M. Verneuil's assistance, for obtaining artificial rubies. Some years ago he discovered a method of producing rubies, but all the specimens obtained were pasty, and wore away in scales. He adopted another process, and by letting alumina dissolve in fluoride of calcium he obtained crystals of alumina—that is to say, perfect rubies defying the closest scrutiny, and even higher in value than natural stones. They can be made of large size.

The fifteenth annual meeting of the San Francisco Microscopical Society was held on Feb. 9, when mounted slides were presented by Mr. Howard and Mr. Breckenfeld showing the general character of the diatomaceous deposits, samples of which had been received from the State Mining Bureau. The deposits proved to be rich, but not equal to the famous Santa Monica fragment, which contained upwards of a hundred perfectly distinct species. The fragment was found on the beach in March, 1876, and although many efforts have been made to discover the deposit from which it was detached, they have been unsuccessful. The retiring president, Dr. Mouser, delivered his address, in the course of which he congratulated the members on the position of the society, and referred to the great value of the microscope in the everyday purposes of life.

An improved battery, for which a patent has been recently granted to Mr. G. F. Rose, consists of any number of containers and porous vessels, one containing an acid solution of bichromate of potash and a set of electrodes, the other containing water and the opposite set of electrodes.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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ERRATUM — THE OCCULTATION OF ALDEBARAN, 1887, MARCH 2 — MEASURING OCCULTATION ANGLES ROUND THE MOON'S LIMB — CONJUNCTION OF THE PLANETS — DRIVING AN EQUATOREAL FOR THE PURPOSE OF DRAWING — ENCKE'S DIVISION IN SATURN'S RING—INK FOR STYLOGRAPHIC PEN—LEMON SOLES — DOUBLE STAR NEAR CASTOR — VELOCITY OF PROPAGATION OF AN EARTHQUAKE WAVE— HIGGINS'S "ANACALYPSIS" — THE CATASTROPHE OF FIFTY CENTURIES AGO (?)—DAY AND NIGHT IN NEBULÆ — LATITUDE — EARTHQUAKE PREDICTIONS—HORIZONTAL DIAL.

[26974.]—SEEING letter 26923 in print, I notice a slight typographical error in the penultimate paragraph, where "E O N = 38° 30′" should, quite obviously, be E O S = 38° 30′.

I am certainly not concerned to defend the *Nautical Almanac*, and *in limine* will say that the fixing of 54° as the northern of the limiting latitudes between which Aldebaran would be occulted by the moon on the 2nd instant, on p. 409 of that work, must have been the simple result of a very perfunctory piece of computation. But having made this admission, I feel a little surprise that the very sensible and measurable amount of the lunar parallax seems to be so unfamiliar to so many amateur astronomers; in fact, that they have quite failed to notice how the separation of any two given stations on the earth's surface, even by a few miles, suffices to alter her apparent position in the sky. Of course, as the occultation occurred so close to the true north point of the moon's limb, an observer at Southampton like "A. H. S." (letter 26924, p. 32), who would see her higher up than a man at Greenwich, would for the same reason witness the disappearance of the star, and its reappearance, both further from the north point than the Greenwich observer, and, of necessity, the chord described by the star being longer, it would remain longer behind the moon at the southern station.

If "F. B. A." (letter 26925, p. 32) will turn to p. 388 of your last volume, he will find a diagram and description of the manner in which angles are reckoned round the moon's limb for the calculation of occultations, and will ascertain that "south" means north, and "north" south, in the remarkable nomenclature of our national ephemeris. I have more than once protested against this senseless technical inversion of familiar words, and asked why the universally employed method of reckoning angles in the measurement of double stars cannot be applied to the angular division of the moon's limb too?—though without any result. But the editors of that excellent little shilling annual, the *Companion to the Observatory*, do give the angles of disappearance and reappearance of occulted stars from the true north point of the moon round by E. S. and W. It moreover contains much that renders the *American Nautical Almanac* of such great value to the observer, but which is wholly absent from our own, and I strongly advise "F. B. A." (and every other observer) forthwith to invest the very limited amount of capital needed for its purchase in the work referred to.

I do not know which edition of Chambers's "Descriptive Astronomy," "E.E.M." (letter 26930, p. 32) possesses; but certainly the conjunction of Mercury, Venus, Mars, Jupiter, and Saturn between Spica Virginis and Libra on Sept. 15th, 1186, is referred to on the top of p. 49 of the Third Edition now lying before me. The whole subject is an attractive one to those who have at once ample leisure and an aptitude for monotonous calculation. Dr. Ideler, the German chronologist, in his "Handbuch," alleged that of three conjunctions of Jupiter and Saturn, which occurred in the year B.C. 7, the planets were so close together during the third that they must have been seen as a single star; and that in that and other respects they fulfilled the conditions of the phenomena of the Star of the Magi (Matthew ii. 2, 7, 9, and 10). Professor Pritchard, however, in the year 1856, undertook the computation of all three of these conjunctions, with the result of showing that during none of them were the planets so close as to appear as anything like a single star to the naked eye; and that, hence, Ideler's hypothesis broke down. Prof. Pritchard's paper will be found on p. 215 of Vol. XVI. of the R.A.S. *Monthly Notices*.

If "Jason's" stand (letter 26934, page 33) is merely an altazimuth one; there is nothing for him but to set his telescope in advance of the object to be delineated, and make the best of the time it occupies in crossing the field of view. If, however, the telescope be mounted equatorially, however rudely, then he may drive it by the very simple means described by Mr. Vallance in these columns one-and-twenty years ago (ENGLISH MECHANIC, Vol. II. p. 394), and so, keeping the object in the field, sketch it at his leisure.

Are we really to understand that Mr. A. Percy Smith sees Encke's division *right round* Saturn's ring A, as delineated in letter 26937 on p. 34?

"Suaor" (query 61908, p. 42) does not need any special ink for a stylographic pen. I always use common writing-ink in mine, the sole precaution needed being that of seeing that it is quite free from dust.

In reply to "Sceptic" (query 61918, p. 43), the Lemon sole (or, as the Channel fishermen sometimes call it, the French sole) only differs from the ordinary variety in being *not* larger, but actually smaller than the common sole; albeit it is wider, and its skin is orange and drab, with dark-brown spots. It is taken in the trawl with the common sole. For sole *au gratin* they are quite equal to the ordinary kind.

The only star *n.f.* Castor which at all answers the description by Mr. Holmes (in query 61929, p. 43) is Σ 1123; but that is more than 1° off. Struve gave as its position angle 162·73°; the distance of its components 3·66″, and their magnitudes 8·8 and 9·5.

I see, from a statement of M. Lancaster, of the Brussels Observatory, that the shock of the earthquake which did such damage on the Riviera on the 23rd ult., took about 35 minutes to travel to Brussels, and affect the instruments there. As the distance between Nice and Brussels is somewhere between 497 and 528 miles, the undulation must have been propagated through the earth at an approximate rate of 1,313ft. per second.

"E. L. G." (letter 26953, p. 55) knows perfectly well that the reason why I referred one of your correspondents to Higgins's "Anacalypsis" was that he might get some inkling of the story about Khrishna and the rock sculptures, without entering into a discussion at once unprofitable and singularly unsuited to these columns. I no more believe in Higgins's fads than I do in the crazes of "E. L. G." himself; and it is as fair and legitimate to allege that I regard Higgins as "one whose whole sweepings should be read," as it would be to assert that I endorsed "E. L. G.'s" wild notions about watery comets and the like, were I to recommend anyone to consult some of his replies on mathematical subjects. I really do not feel called upon to discuss so utterly preposterous a notion as that advanced in the letter on which I am commenting—that all the gravels to which reference is made are coeval! Why, they may well differ in date by fifty or a hundred thousand years; while some may be water-borne, and some ice-borne, and so on. I should really like to be present at Burlington House, if "E. L. G." were to propound so baseless an hypothesis before the Geological Society, and hear what such indubitable authorities as Geikie, Ramsey, Bonney, Judd, &c., had to say about the contemporaneity and identity of mode of deposition of the various gravel patches referred to. One would also be curious to know what became of the absolutely innumerable billions of tons of water which filled every water-course and stream "once for a few days . . . many thousand fold"? "E. L. G." is a mathematician. Has it ever occurred to him to attempt to calculate the dynamical effect of the sudden addition to the earth's mass of a volume of water covering the entire globe to the depth of 600ft.? "E. L. G.'s" letter is, however, *more suo*, a simple mass of absolutely unsupported assertion from beginning to end. I do not feel called upon to reply to the personal claim of quasi-infallibility which he advances in that sentence in the concluding paragraph where he asserts that because practically every competent living geologist and astronomer differs with him, that hence "nobody but fools are alive to-day." But it is the old, old story. If all facts are against him—so much the worse for the facts.

"E. L. G." (in letter 26971, p. 61) again quietly ignores a few elementary considerations. The Nova in Andromeda appeared in the midst of the brightest part of the Nebula, which—according to his original contention—formed its sun. I should myself have thought that a "world" *surrounded* by a sun would have had perpetual daylight. His comparison of the condition of things during the passage of the earth through a tenuous mass millions of times less luminous than the body lighting only one side of our own globe is utterly irrelevant and misleading.

"Eos" (query 61985, p. 68) will find the explanation he requires on pp. 509 and 510 of this year's *Nautical Almanac.* It is too long to extract here.

In reply to "Triton" (query 62011, p. 69), the statement I made in letter 26923 (p. 31) was founded on this paragraph, which appeared in a London morning newspaper of the 24th ult.:—

"(From our Correspondent.)

"Vienna, Wednesday night.

"Several of the Vienna papers draw attention to the fact that Herr Rudolph Fabl (a misprint for Falb) predicted to an hour the earthquakes which have just occurred in France and Italy. Several days ago he published a statement to the effect that the annular eclipse of the sun, which commenced yesterday evening at forty-seven minutes past seven, and lasted till twenty-eight minutes to two this morning, and which was visible only in Eastern Asia, Australia, and Western South America, would be accompanied by extremely strong atmospheric and seismic disturbances owing to the coincident influence of the sun and the moon on the earth."

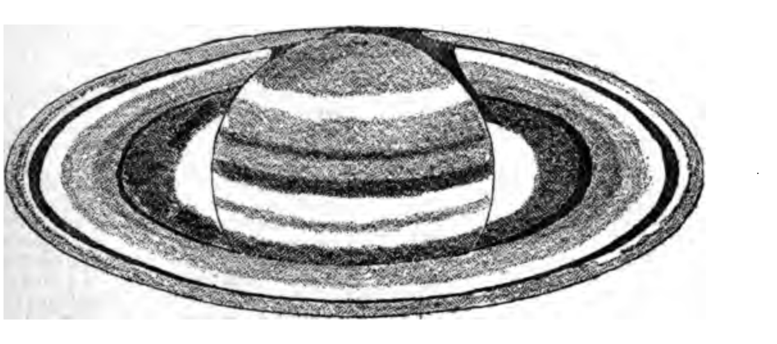
I cannot for the moment lay my hands on that in which Herr Falb is alleged to have predicted future "critical days"; but I copied those words at the time. I possess no further details.

"Aqua" (query 62012, p. 69) will find his query fully answered on p. 316 of your XXXVIth Volume. A typographical error in the reply there is subsequently corrected on p. 356. The numbers are 924 and 926 of the ENGLISH MECHANIC.

A Fellow of the Royal Astronomical Society.

SATURN.

[26975.]—J'AI le plaisir de vous adresser à inclus un dessin de Saturne, d'après mes observations avec un huit pouces de Grubb (réfracteur), monté équatorialement et avec des grossissements de 150 to 650 fois; ce dessin a été fait en Février, 1887. Il montre notamment: la division d'Encke, le trait brillant de MM. Henry dans l'anneau A, la division de Struve entre les anneaux B et C, des masses sombres dans l'anneau obscur, surtout à l'Occident, la dentelure de l'ombre du globe sur la division Cassiniènne, une dentelure grise isolée également sur la division Cassiniènne, à l'Ouest; l'ombre du globe sur l'anneau obscur, la transparence de l'anneau obscur qui lait le voir le globe à travers sa masse.



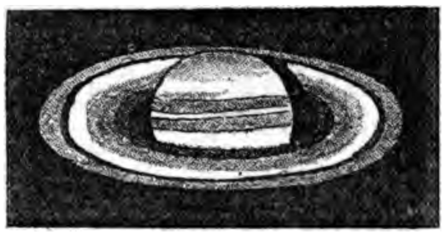
Dr. F. Terby, F.R.A.S., A.L.A.S.

[26976.]—MR. PERCY SMITH'S letter encourages me to say that I saw clearly on March 2nd what I often thought I saw before, a division in the exterior ring of Saturn. It was quite distinct on the following, less so on the preceding ansa. It seemed to me, however, nearer to the outer than the inner edge of the ring, not as represented in the sketch. If there is any notch in the shadow now it is not visible in my mirror (with 8½in.), for I have seldom seen a clearer line than that which bounds it. The boundary is slightly but quite distinctly convex at present. The belt nearest the bright equatorial region of the planet appears to me more definite and conspicuous than it was last year, and of a deeper brown. It shades off rapidly towards the south.

Would Mr. Watson be so kind as to refer me to the recent observations of the notch, and the concavity of the shadow to which he alludes?

March 15. P. H. Kempthorne.

[26977.]—WHILST observing with a friend, on the night of the 12th inst., we turned the 6in. refractor on to Saturn. We noticed that the outline of the shadow of the planet on the ring was decidedly "notched," or, as described by Webb, "curved the wrong way for its perspective." It appeared to follow close to the line of Cassini's division and then suddenly curve inward on touching ring B, then continued its line of perspective on that ring to and through ring C. This was confirmed by my friend a few evenings afterwards.



Powers used 215 and 260; definition good. I venture to inclose a rough sketch, as the two last drawings of Saturn in "E. M." do not note this peculiarity. **T. R. Clapham.**

COMETS 1887, D AND B.

[26978.]—1887 D (Barnard).—I obtained my first view of this very faint object last night. I had several times swept for it previously, with both a 3in. and a 4½in. refractor, in the positions indicated in the Dun Echt Circulars, which I receive direct from Dun Echt, but never could pick it up before; however, its position for last night, according to the ephemeris, was so near to the 4th magnitude star *o* (Omicron) Persei, that I knew it would be in the same low-power field, so I prepared for another search, and immediately on bringing that star into the field of the 4½in., and settling down for a steady look, I detected the comet a short distance from it about due north, and I afterwards picked it up with the 3in. in the same way.

It was very small and faint, with no perceptible tail, but a slight condensation of light to the centre. Its brightness is stated to be decreasing daily, a rather unusual circumstance, seeing that it does not pass its perihelion until the 28th of this month, at which time it will be situated about 5° south of Algol. The cause of its apparent decrease of brightness being, I presume, that although it is approaching the sun it is receding from the earth.

1887. B (Brooks).—I have observed this comet many times since its discovery, never having experienced any difficulty in seeing it with either the 3in. or 4½in., although it is also a faint object. Its brightness is also stated to be decreasing as it approaches perihelion, no doubt from the same cause I have given in the case of the other one; yet, observing it last night with my 3in., I thought it seemed brighter than I had ever seen it before; but this might be owing to the state of the atmosphere, which was exceptionally transparent here, a very keen frost prevailing, an unusually large number of stars being visible, and all remarkably brilliant; a night such as we rarely see here. This comet has a very decided stellar nucleus, but no perceptible tail. Its position last night was in a blank space between ϵ and μ Persei, about half-way on a straight line joining these two stars. It passes its perihelion on the 17th inst., at which time it will be situated about half a degree north-west of the fifth-magnitude star 52 Persei.

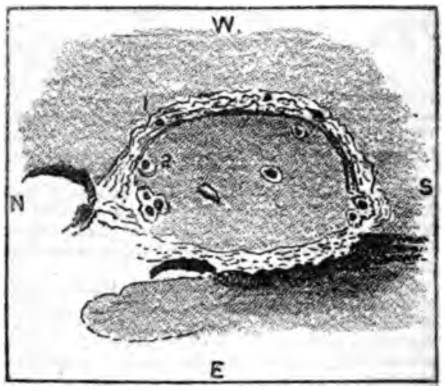
In the case of both of these comets the point of perihelion is apparently situated at a great distance from the sun, which no doubt accounts, in a great measure, for them being such faint objects when really at their brightest, though probably the relative smallness of the substance of the comets, if such a word is admissible in connection with them, may have something to do with it; but these are points in connection with comets about which very little is really known.

Huddersfield, March 14. **Excelsior.**

ATLAS AND HERCULES—CLEOMEDES.

[26979.]—IN reply to Mr. Mee (letter 26938, page 34), the small craters referred to on north-east (? south-east) borders of Atlas and Hercules, are not delineated in Neison's "Moon"; and I cannot say at present, from personal observation, if they are correctly represented in Mr. Mee's drawing. In Neison's map there is a crater on the extreme south wall of each of these ring-plains.

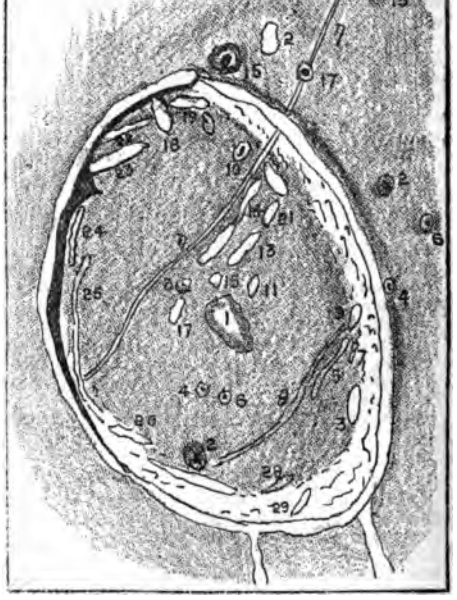
On the 26th and 28th February I spent a short time in examining the beautiful walled-plain Cleomedes—moon four to six days old—and the inclosed drawing is a fair representation of the scene as it appeared in my small reflector, powers 150 to 300. On the 26th the terraced walls of this plain to west, and north, and east, were grandly defined, those to north and east being very bright, that on the west rather dull. All the details were not clear on 26th. For instance, only one crater was defined on the south, and two on the north. On the 28th they were plainly visible, and the formations, which I have numbered 1 and 2 on the sketch, were glimpsed on this night; but I am uncertain as to their true character. Number 1 is either a small crater on the wall, or the shadow of some prominent mountain mass; and 2, either a small crater or crater-like depression on the floor.



Unfortunately, the moon, from my look-out, sinks down too soon into the smoke of London; I was, therefore, unable to make a satisfactory examination of these formations, which do not appear decidedly in Neison's "Moon." Perhaps Mr. Mee, or other friends, will report on this at a convenient season. **Jason.**

SELENOGRAPHICAL. — ATLAS — MERCATOR—ALMANON—ENCKE.

[26980.]—IN answer to Mr. Arthur Mee's question (letter 26938) about the existence of a crater on the S.E. wall of Atlas, I am induced to send you a sketch of this formation I made on February 23, 1882. My crater 10 is the nearest to



the place he assigns; but it is too far, and it lies on the floor itself. Schmidt has a small crater almost at the very place, but it is not likely Arthur Mee's eye has been attracted by so very small an object, almost lost among the terraces of the wall, while other markings on the floor far more likely to attract attention, do not seem to have been noticed by him, with the exception of the central mountain. If Arthur Mee makes Atlas the object of his study, will he try to identify the objects represented in my sketch and seek to add others, as details are what is really needful at present in order to increase our knowledge of our satellite? Will he specially observe the cleft η and its prolongation S.E. of the ring-plain, and also the cleft θ, which is not a valley as Neison suggests, but a true cleft, though there is a ridge at 5, but quite distinct from the cleft. 4 and 6 are two small craters, one of which is doubtless the one suspected by Schröter. As the rest of the objects speak for themselves, I shall not take space to describe them.

Mercator.—Just N. of peak ζ of B. and M.'s map on the E. wall, I saw an easy white crater not on the Mappa Selenographica, nor on Schmidt's map. It seems almost impossible that such a close and careful observer as Schmidt could have missed it. Will any one say if it is represented by Schröter or Lohrmann?

On March 1, 1887, I found a cleft W. of Almanon about as long as the diameter of the formation, and about as far from its W. wall. It is not shown by Schmidt. I was observing the same region on January 1, but no cleft was seen then.

On March 3, Pictet, Pictet *a*, Sasserides, and the N. and N.W. region of Tycho, were seen pierced by minute craterlets like a sieve, and on March 5 the region between Encke and Kepler A was seen covered with minute hillocks, seen once before as craterlets.

March 12. **C. M. Gaudibert.**

HERCULES.

[26981.]—On Feb. 27 I was observing Hercules, and I also saw the spot just outside the shadow (referred to in letter 26968, p. 61), whilst another spot appeared in the midst of the shadow.

There also appeared to be *two* craterlets, contiguous to one another, on the S.E. wall of Hercules. Mr. Elger says that no one, to his knowledge, except Schmidt, records the smaller of these objects. It would be interesting to know if any other observer has seen it. These observations were made with powers 210, 300 on a 6½in. Calver.

G. B. H.

MERCURY—NAKED-EYE OBSERVATIONS.

[26982.]—I find my record of observations of this planet for the past fortnight to be the best I ever made—viz., eight consecutive nights, on which it was not only visible, but brilliant, beginning Feb. 26th and ending March 5th; also observed it on 7th and 11th. On a former occasion I observed it on seven nights; but only four consecutive.

On Thursday, March 3rd, there was a rather bright afterglow, but it was of brief duration. Is there anything of the nature of the Aurora about this? When these afterglows were at their brightest, I have at different times distinctly seen rose-coloured streamers shooting up from the bank of crimson below.

While writing of the Aurora, one of "ours" some time ago doubted if anyone ever heard the noises said to be made by them at times. I can assure our correspondent that, though rarely, they are yet occasionally heard. It is a peculiar rushing, crackling noise, like the rustling of new silk when quickly moved about. It gives one a peculiar creeping sensation, which is difficult to describe.

When that brilliant and ever-memorable display of 31st August, 1881, took place, it seemed as if a million goddesses of the air, clothed in silk raiment, and with trains 1,000 miles in length, were rushing from every quarter of the heavens to keep an appointment somewhere overhead. I can compare the noise to nothing else.

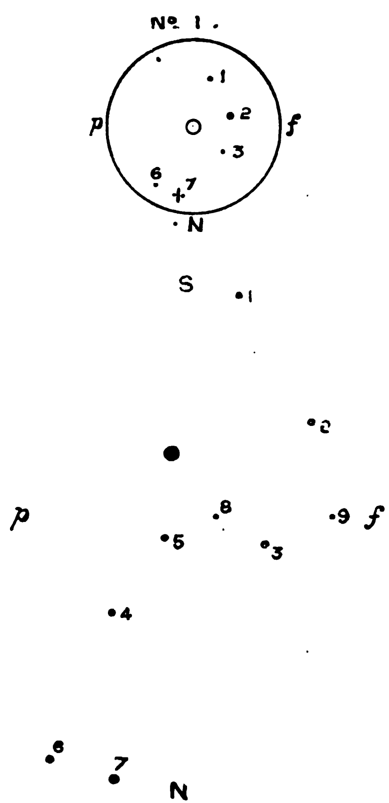
Definition during the first week in March was superb; the views of the moon and Saturn I never saw better; but it has been followed by severe frosts, and a heavy fall of snow.

Perthshire, March 16. **J. D.**

ALPHA ARIETIS.

[26983.]—In the English Mechanic for November 10th, 1886 (Vol. XLIV. p. 323), Mr. Gaudibert published a drawing of the stars near Alpha Arietis (made, I presume, with his 8½in. reflector), and remarked that if it was compared with the MS. one of Admiral Smyth's, given by myself on page 222 of the same volume, it would be seen that the stars had changed their places considerably since the date of the "Cycle" drawing. Comparison, however, with the diagrams in the "Cycle" or the Bedford MSS. should never be relied on as evidence of change. As I believe that Dr. De La Rue and others stated this publicly in January, 1874, some time before I had ventured to question the accuracy of the "Cycle" measures, it is to be hoped that none of Smyth's cousins or aunts will take offence at this statement. On seeing, however, that if the stars lettered C, F, and D in Mr. Gaudibert's diagram were identical with the three shown by Smyth (as I presume Mr. Gaudibert supposed), the change since 1835 in the position of F, as also in its magnitude, was very large indeed, I asked several friends who possessed telescopes of considerable size to look the matter up. Meanwhile I had found a sketch of Alpha and the stars near by Bianchi, made with the Modena circle about 1839, which seemed not at all unlike Smyth's of 1835, due allowance being made for the fact that both Smyth's and Bianchi's were rough attempts only, and not finished sketches. Owing to the prevalent bad weather and other causes, only Mr. Hunt seems to have been able to examine Alpha, and then under not very favourable atmospheric conditions. With very great kindness, however, he sent me numerous notes on the stars in question, and three sketches, the last of which, and the one which he considers to be the best, is reproduced in the accompanying diagram. It is evident at first sight that Mr. Gaudibert has not shown the southern one of Smyth's stars (numbered 1, 2, and 3 on the diagram) at all; but only 2 and 3, lettered by him C and D. F would have been far too faint an object to have been noticed by Smyth. "6" and "7" are too near Alpha in Bianchi's diagram; "5" on Mr. Hunt's diagram is evidently Mr. Gaudibert's G, and "9" his F, if the modification of Mr. Gaudibert's sketch, given in letter 26594, p. 345, be borne in mind. "8," the nearest *comes* of all to Alpha, was discovered by Mr. Hunt in full moonlight with his 8in. refractor. Of "9" (Mr. Gaudibert's F.) Mr. Hunt writes:—"I am not certain about its position, as the powers necessary to show it *at all* had fields *too small* to take in it and '2' and '3' at the same time; but I made out that it is nearer to '3' than to '2.' . . . At the telescope I estimated the position angle from '3' at 135°, whereas in my diagram it is about 112°." Mr. Hunt considers it the faintest object in the whole group, and "7" as much the brightest. A set of measures of the angle of Smyth's *comes* (Mr. Gaudibert's C., Mr. Hunt's "2"), made by Mr. Hunt under very unfavourable circumstances, gave $\theta = 99{\cdot}2^\circ$. Epoch 1887·13. The change in angle since 1835 is probably owing to the proper motion of Alpha. Bianchi's diagram was made with a power of 72 on 4¼in. aperture. Evidently the smaller stars have undergone no change in their relations to each other since 1835.

H. Sadler.



α ARIETIS AND COMITES

CONSERVATION OF SUN'S ENERGY.

[26984.]—Letter 26929, "E. M.," page 32, by "F. G. Ll.," exactly represents my idea of "force." It cannot exist per se in vacuo: force leaving one body must be received or absorbed by another body; or, speaking in general terms, force must reside in matter, and pass from matter to matter. Force or matter, separated from each other, represent themselves to my mind as nonentities.

"F. A.," letter 26952, "E. M.," page 36, considers my ideas of "heat" rather loose, by contesting not "my" ideas, but the theory of Büchner, from whom I quoted. I gave this quotation verbatim, "quod valeat." I think "F. A." should rather excuse me, if I say he read my letter somewhat loosely.

I should myself object to say that "heat" is separation, &c. I would define "heat" as a mode of motion, this particular mode of motion acting in matter as a separating force; whilst cold, being the opposite mode of motion, I should call a concentrating force. Prof. Huxley, I think, as quoted by "F. A.," seems to go further than can be demonstrated by experiment, in my humble judgement—viz., that "force" is the "cause" of motion. "F. A." will see what I mean when I say that by experiment we can only demonstrate that there are various modes of motion, and that there is matter which moves in various ways; but what is the ultimate "cause" or "reason" why particular modes of motion take place in matter we cannot demonstrate.

In conclusion, I wish to protest against matter being considered inert, if thereby is meant, devoid of force: we have no such thing existing to our knowledge. All matter we know of moves, and is therefore possessed of force. Neither can I comprehend of either force or matter being externally—i.e., existing independently of each other, even if in practically empty space.

Your able correspondent "Sigma" (letter 26962, "E. M.," page 59), proceeds to demolish a school of philosophy which ignores the soul, &c. As he includes therein my humble self, I wish to tell "Sigma," with your permission, that I know not one German philosopher, materialists pure or impure, ultra or supra, who does ignore the "soul" of the humblest living organisation. All "Sigma's" elegant arguments are therefore wasted in fighting a phantom, a creation of his own fertile brain. What these materialistic professors hold, and as far as I am able to interpret them, is simply this, and I believe it cannot, all the clamour of spiritualists and theologians notwithstanding, be disproved:

1. What is called spirit, soul volition, &c., does not manifest itself except by and through "matter."

2. That spirit or volition, *per se* is a nonentity, does not exist, at all events cannot be experimentally proved to exist "outside" or independent of a material organisation.

3. That whatever proof we have of its existence tends to show that it is a "force" or "property" attached to all "living matter in a more or less developed state of perfection or complexity."

4. That what is called "soul" follows the laws of evolution—i.e., that it is developed in close resemblance to the development of material organisations: Like in man, from the brute-like instincts of savages up to the highest intelligence of civilised races. Or in each individual, from the mere animal instincts of infants, rising in a gradual almost insensible ascent, up to the astounding intelligence of a Newton, Spinoza, or Kant, who no doubt once sucked their bottles like any other infants.

5. That its rise and decay corresponds exactly with the rise and decay of our bodily organs.

I therefore cannot resist the logical conclusion that if there is no longer "senses" existing, what is called "soul" must vanish also. If I have no brain to think, no eyes to see, no ears to hear, no nerves to feel, taste or smell, my "soul," if it should still exist, would have something to do of which at present I can form no conception. But perhaps "Sigma" can enlighten me thereon.

Considering "heat" as a mode of motion, I will give in to "Sigma" if he considers that "matter" on being moved or moving, has something "super"-added thereto not previously existing elsewhere in matter. **F. W. H.**

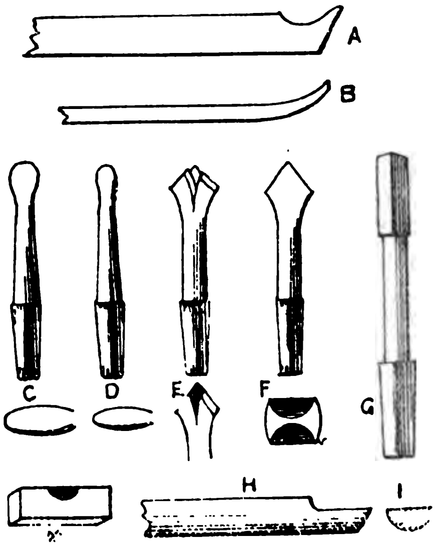
THE CATASTROPHE OF FIFTY CENTURIES AGO.

[28985.]—Your correspondent "E. L. G." (26953) fights very hard to prove the reality of the Deluge, but, as usual, wholly in vain. The history of no ancient civilised people permits us to suppose that the population of the earth was reduced to a single family 5,000 years ago; but, on the other hand, we know that several ancient States, such as Egypt and Babylonia, were then flourishing and populous; indeed, the greatest monuments of Egypt were erected about that time. As "E. L. G." insists that his elaborate calculations prove that the whole world was then under water, he puts the public in the painful position of having to ilth untouched. We trust more now to sanitary arrangements. But we know so little of individual cases of illness that many still trust more to prayer than to remedies. But even if this too comes ultimately under the realm of law, there will, as in the first case, remain a realm which science cannot touch.

F. G. S.

DRILLS AND BITS—LATHE TOOLS FOR AMATEURS.

[26991.]—To "bore a hole" seems to have been a primary object with manufacturing man even in the "Stone Age," judging by my collection of prehistoric heads, a strikingly hard variety of onyx, sufficiently refractory to the modern lapidary. However, as we may call this the "Iron Age," we will stick to our subject of perforation on a small scale. Here the necessity of genuine steel is very soon taught to the amateur, and the art of tempering the same forced upon him, unless he be a townsman with a full purse who can throw away his breakages and buy anew. This I call but being half a workman. I have an unusually large stock of drills and bits, chiefly home made. A small forge, besides revolving wheels, both emery and stone, render me independent of tool-shops, occasional Morse drills and twisted augers excepted. From my youth upwards, books, workshops, and manual practice have put me well up in drilling nearly every substance besides metals and wood. I will now communicate some of my favourite forms such as I use daily on iron and soft steel. Square steel I employ preferably to rod. Forging down the angles of the former produces a tougher tool, and as I use gauges, I always have a good fit, the lathe and the file soon reducing all inequalities of surface. Having marked off the end of the bar to length of cutting part, I hammer steadily along the shank, leaving the further end square for an inch or two, C; this holds better in a "Beach chuck," as it does also if worked by feed of the back centre. I then beat the point end into rough shape, finishing with the file. Having got a lot together, I proceed to tempering, from ¼in. to the least sizes. I plunge them at cherry red heat into a one pound jar of cold tallow, occasionally examining the colour, and moving rapidly into the cooler parts of the grease.



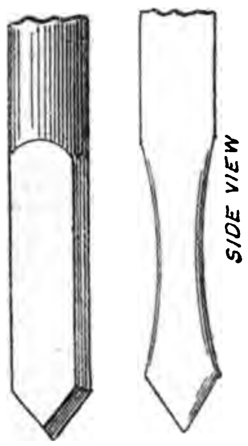
I must now explain my "universal drill," which can be made by a schoolboy at a parlour fire. No levels or facets here. C is the abovoid form for ¼ in. holes; D, more elongated, for $\frac{3}{16}$th ditto. I am continually boring pieces of metal ⅛in. thick; breakage very rare; a little rubbing on an oil stone the only sharpening; it even works fairly on brass. A gradual slope of the blade from heel to point forms the cutting part. The lubricant I lately mentioned must be used abundantly—as with every known drill, moreover—as a "round nose" will "wobble," and quit the centre of your work. You will first with a centre punch make a deep indent on this mark, with a hand drill make a small circular depression to hold the curved point*; this I always do with a rose-bit. Next on my list of favourites come the hollow drills. E is the usual blacksmith's drill of 90° (try them in the angle of your workshop square), to forge and file into shape is an easy matter: it has the usual cutting bevels on opposite sides, but from heel to point runs a deep triangular notch; when very correctly made it will throw spiral shavings like the T-drills. I prefer this to any other for enlarging holes of small size—⅛th or so. Another good one is an entirely hollow head, difficult to draw correctly; but the section of some is very intelligible, F—two sloping segments of a sphere. To do this figure correctly with a round file is a slow job, so I have made a cutter with round outline to work on a spindle in the lathe, which will polish off half a dozen in the same time; hardness and strength are absolutely necessary as a combination in these two last boring tools. I seldom have a crack in any kind of steel work, for I use leather shavings (old boots and shoes), and if your bit of work is the product of much labour heat it in a muffle—i.e., a wrapper of tin-plate or thin sheet-iron full of leather. Lately, a very old drill of the renowned Indian sword steel was becoming edgeless and dilapidated—it has been about the world with me 20 years or more. I reforged it, and to my surprise it stubbornly refused to harden; I was about to throw it into a scrap-box when I resolved to try an experiment. I brought it to a heat, nearly scaling point, and plunged it with a slow circular downward movement in a saline liquor I keep for heavy dips. On withdrawal, though covered with numerous cracks, the metal is hard and strong. Lastly, for boring smooth, deep holes in solid metal come the D-bits. I keep them from 1in. diameter, with crook necks for making chucks, down to $\frac{1}{16}$th umbrella rib wire for hollowing stems and mouthpieces of smoking pipes in the lathe. I only use "silver steel" for the intermediate gauges, though expensive. The amateur has only to anneal the rod, then with a centre punch and square mark the half circle. Secure in a leather clamp on your parallel vice, and having measured 2½ diameters from the end, file down to the punch dent and no further. Finish the curve part with a "rat-tail"; then cut a square and make taper-centre hole at other end, all which is easily and quickly done. Now for tempering. Extreme hardness combined with elasticity is necessary, so you have to be cautious. At a cherry-red, harden nearly throughout in a saline dip. Get a wrought-iron crucible, rub it with fireclay inside and out, put half a pound or so of lead therein, and put on any clear fire. After covering the lead with charcoal dust, melt the lead to redness. Put a piece of hoop-iron with a hole in the centre across mouth of iron pot. Put the square end of the new bit through this hole till it settles down in the molten lead. Now look sharp for colours. Violet-brown at the foot of the curve will give you warning to lift and quench that end in a saline bath if your piece be heavy; if light, in the cold tallow pot. For very straight shining holes in solid metal nothing can equal the cutting power of these bits, as long as you keep the edge square and sharp to the 3° angle of clearance. In using the oilstone, move the entire tool surface so as to preserve the same. If too hard the square edge will crumble away by pressure; if too soft the corners are worn off, and cutting action ceases. I wipe out the shavings constantly with a dry wing-feather of a duck, and apply the lubricant in the same way. I have just bored a 1¼in. deep hole in the centre of a revolving steel chuck with a ⅜in. D bit, being the chamber to receive a self-centring arrangement of spring point. A few rubs on the stone, and the tool is fit to do the same again. These bits must not be rotated; they must always be worked by back-feed. I have always found the "American Screw Augers" fine things for boring tubes in hard wood, and the shavings sent out from them are pleasant to see. I like the "Morse Drills" when *very sharp*, but I did so much work before they were invented that, not being a machinist, I still do much without them.

The "hooked chisels" (I am uncertain of their technical appellation) are prime favourites with me as hand tools; they are so easy of manufacture and of repair, too, that I keep them of all sizes in my workshop, only requiring some practice in their use, the cutting edge being very susceptible of fracture. 1st. The tool rest must be very carefully adjusted to line of centres. 2nd. The cutting part must be tempered very hard. 3rd. The steel must be well annealed, of the work to be cut. 4th. The work must be previously reduced with a roughing tool—within ⅛in. of the final size. Under all these conditions the operator will derive great pleasure and much profit in seeing the cylinder or rod become very smooth with a silvery gloss. I have made a large stock of these indispensable tools from 1½in. broad, forged from carriage-spring, grease tempered, to a tiny 1-16in. thick, ¼in. broad, for turning out small screw blanks. I even face discs of metal with the same. The rest cannot be too near the revolving work, or there may be a "catch in" and then a breakage. For brass or other soft stuff it is unsuitable—it will dig into them. I have given you a small sketch showing an angle of 3° clearance from the outer edge. They are sharpened on a slowly-revolving emery wheel. I have a shifting handle with a thumb-screw, three or four sizes, to suit these chisels. My best lot are of choice Sheffield flat bar steel, 1in. by ¼in.; thus I avoid much heating, and shape out with the file. Of course, very careful tempering is necessary, some old leather surrounding the cutting end when I am bringing it to "cherry red." Another hook ch
I use for lighter work usually (is here figu
marked B), still easier to make than the above.
keep this also in many sizes, and employ th
mostly in reducing rods of iron or steel. Th
must be carefully managed under the rules befo
described. The file is the chief tool necessar
the inside curve is made the whole way to t
edge; the outside one has a bevel of 3° to meet
I need hardly remark that any steel without
trade mark should be rejected. Bad stuff spoi
your temper, its own, and your work, with loss
time to be added.

Eos.

ANOTHER GOOD DRILL.

[26993.]—I accidentally omitted, in my la
communication, an excellent drill, which not on



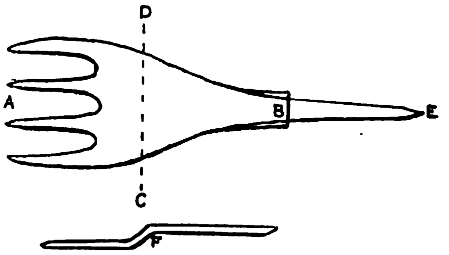
cuts well, but clears its own shavings. I particularly recommend this one to a "Country Parson," as no bad substitute for the "Twisted." The hammer and half-round file will soon set him up with many sizes. Herewith a sketch of same. Point angles, 90°; edge bevels, 3°.

Note.—All tools with a hollow or curve should be whetted on their inside edges with a taper gouge slip. I keep these in three sizes.

Eos.

THE CLAW WEEDER.

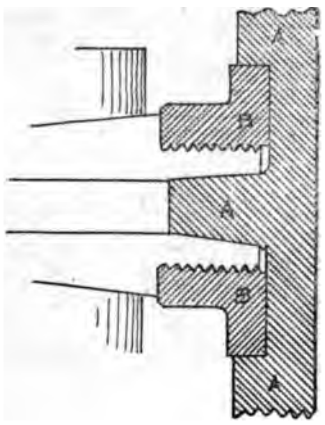
[26994.]—Very long ago I came across an old Hindoo gardener weeding a bed of seedling plants with a piece of flat iron cut into rude points. I watched its effect in loosening the soil without injuring the fibrous roots of the flowers. I admired the action of this rough implement, and at once manufactured one of good steel and better shape. I have ever since employed it in my gardens at home and abroad. A piece of old carriage spring is suitable metal for the purpose, only the prongs moderately hardened. Grease tempering is the best. The steel should be forged, so as to taper from ½in. thick at square shoulder, B, to ¼in. at prongs, A; 6in. or 7in. long, the tang or point to enter handle about 3in. more. Having forged the piece, give it a curved bend at the point C to D, as represented by the side view F. Mount in a hard wood handle, with iron ferrule. This I carry in my tool-bag, for hand weeding and loosening soil in tubs and pots. I have a similar claw weeder mounted on a light ash pole to reach far into the borders, where my foot would do damage. This one eradicates old thistles, docks, nettles, and dandelions in fine style. When the earth is soft from rain, I drive in the prongs with a hard thrust; then, with the arm pressing on the pole as a lever, the obnoxious weed is lifted from the ground. It also did some duty as a *snake destroyer* when I lived in sunny lands, for it is the gardener who has generally the first interview with those pests! I have also another useful auxiliary in my bag—an old carving fork (minus the cross guard) for weeding delicate subjects, and stirring the soil in very small pots previous to giving plant food; thus it is carried down



to their roots. In spring I have to give peat dust to my Himalayan primulas, when the loosening operation is of much importance. **Eos.**

LATHE MATTERS.

[26995.]—WITH reference to "F. A. M.'s" invitation for contributions towards a model lathe, as I see that my idea of the single I form of bed is proposed, I venture to offer the following notion regarding the fitting of chucks which is adapted to the generally approved form of standard mandrel noses (see diagram). The chuck A A A is turned up with a recess and taper pin to fit accurately the plug hole; the female screw portion and flange B B is separately fitted and finished on the mandrel to fit the recess on back of the chuck, thus combining the cone centring with the large flange bearing checking the concentricity of the ordinary screw connection, and providing a perfect protection to the cone.



I take this opportunity to point out that for those who wish to do occasional ornamental work on a lathe that is not specially built as a first class ornamental lathe, that in lieu of piling up complicated chucks and appliances on the mandrel, a long spindle at the back of the lathe in the plane of the screw of the lower side of the slide-rest, and capable of being driven from the mandrel by the change wheels, will, with the aid of a pair of mitre wheels, do surfacing and surface spiral work—fitted with eccentric right cone, rosettes or suitable cams acting on one of the slide-rest slides, and with suitable speeding between mandrel and spindle, all sorts of oval, cycloidal, rosette pattern and pump-motion work can be turned out. With a drilling mandrel and eccentric cutting frame on the slide-rest, the change wheels can be used with link connecting bars between the drill mandrel and the back spindle for geometric chuck work; the back spindle, moreover, can be used in many cases to take the place of the overhead. This is the arrangement in my own lathe, and although there are some constructive defects, it answers very fairly all round. **J. A. Armstrong.**

[26996.]—I WAS glad to see the letter from "F. A. M." in the ENGLISH MECHANIC for January 14th, and I hope that his remarks may elicit some, further contributions from correspondents on lathes and lathe work.

I would be very glad to see Mr. Hartley's book published, and would willingly become a subscriber.

I think it is very probable that there are many amateurs who have never heard of the manuscript, but who would be willing to subscribe if they knew of its existence. I knew nothing about it till I saw "F. A. M.'s" letter, and I did not know where to apply for information. Could not Mr. Hartley's executors advertise, and make some effort to have the work published? It ought to be of interest and value to amateurs.

I had Mr. Evans' new book before I saw the review of it in the ENGLISH MECHANIC.

One feature in the book that will recommend it to amateurs is, that Mr. Evans, in many cases, describes not only the apparatus, but the construction of the apparatus.

The plan, however, of drilling the zero line of holes in the division plate on an arc, instead of on a radial line, is by no means new.

Mr. Holtzapffel in Vol. V. page 11, if his work refers to this, and says that the terminal holes of all the circles to be correctly arranged should fall "upon an arc, and not in a radial line upon the division plate, which latter has been gravely, but erroneously recommended."

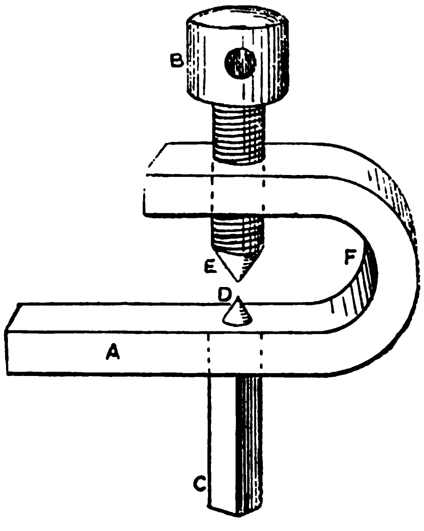
In the *Journal* of the Amateur Mechanical Society Vol. I., there is an article on the division plate by Mr. Sebastian Bazley. In the engraving of a segment of a division plate on page 202, the arrangement of the final holes of each circle on an arc is very clearly shown.

I have always understood of late years that it is the custom of lathe makers to arrange the holes the division plate in this way.

With reference to the letter from A. Gray, on Jan. 21st, about the Edmunds mandrel, has A. Gray seen the last number of the *Journal* of the Amateur Mechanical Society, published in December? In it there is the report of the sub-committee appointed to look into the question of a Standard screw thread, &c; but I regret to see that it does not appear as if anything were likely to be done in the matter. **E. B. F.**

SELF-CENTRING SLIDE PUNCH.

[26997.]—I SEND you a sketch of a little tool I contrived to facilitate a correct line of drilling metal. In making chucks I disliked the tedious measurement with dividers and compasses—especially in boring the heads of screw bolts—of the description like B in this tool. It may be constructed of any desired size; but I find this one suits most of my requirements. A bar of steel 6 or 7in. long, by ⅝in. broad, and ⅓in. thick, is bent into above shape. The upper hole is drilled first for a ⅜th Whitworth screw tap, and the internal screw cut accordingly. The bolt B is next turned from good steel rod in the lathe and then tapped to fit; the point E is then turned to an angle of 60°, and the piece grease-hardened at the tip. On working it round downwards to the bar till quite tight, this pressure will leave a true mark for drilling the lower screw hole. Get a small bar of ¼in. square steel, turn one end in the lathe to screw and sharp point. Having drilled the hole, tap it with thread, and then fit this bar till the point D (previously hardened) projects ¼in.; width of bend at I is 1in. It will be seen that any rod, bar, or sheet of metal of 1in. thick can be inserted. First with a common indent punch stamp a small hole in the desired position, insert the mark on the point D very steadily, the bar C and projection A resting tightly in the jaws of a vice; then screw down the bolt slowly till it stops hard, unscrew and withdraw your work, when you will find both centres in a truly straight line, by which you can bore half way and insure an accurate hole in your metal. I have had this little tool in my workshop for more than twelve months.



Eos.

RADIATION AND REFLECTORS.

[26998.]—MANY users of reflecting telescopes complain of their bad performance in cold, dry, east winds. Can alteration of figure, produced by the cold from radiation from front surface when pointed to clear sky, be the cause? Mr. Madsen, of Sydney, see "E.M." Feb. 18, 1887, describes clearly the alteration of surface of 5in. glass planes by the application of the point of finger to centre of plane: result was the parallel diffraction straight bands became circular. Mr. Madsen remarks that this shows the necessity of keeping both sides of a mirror at same temperature.

Tyndall on Hind Head, "E.M.," May 11, 1883, found a difference of temperature of 10° to 17° between a thermometer lying on a cotton-wool pad on the ground and a thermometer suspended 4ft. above in air—this on clear, cold, dry-air nights—the lower always the colder on such nights; on warm, moist-air, clear nights, no such difference.

When we point our telescopes to stars, does not the face of mirror radiate its warmth to space, and glass being a bad conductor, the back of mirror remains warmer than the face, and alteration of figure must ensue. I have many times in last two dry months found fair definition just at first alter for the worse in ten minutes and remain worse for an hour or two.

Herschel and Kitchener both assert that a reflector should be exposed a quarter or half an hour before beginning, to equalise mirror temperature, &c. Their mirrors were of metal, and the conducting power being so much greater than that of glass, they might find the advantage.

Rev. Mr. Godfrey, of Southsea, told me that he had a 7in. hole in back of his 12¼ mirror, and it performed admirably in good air. Mr. Calver often, if not always, sends out ring cells to his telescopes. Rev. Mr. Webb told me that one cause of the ill-shaped star rings was the unequal temperature of different parts of the mirror.

Will any users of large reflectors tell us their experience of the advantage or disadvantage of cells with openings at back? Till now my 12¼ mirrors have not had openings. In fine air they divide δ Cygni, θ Aurigæ well. **Bramley.**

ELECTRIC CAUTERY AND AMMETERS.

[26999.]—THE tests given by Mr. Bottone in last week's issue are very interesting, and especially the result from them of half an ampère for each foot-grain. The only objection at present to trying to calculate the current required for a cautery is that most makers flatten or file their cautery points so that the actual current is very different from the calculated amount. It will be curious if Dr. A. D. Stewart takes the hint that Mr. Bottone gave him about the resistance coils; certainly the results come out concordant as to the conductor resistance, and the question naturally follows: Why is the resistance marked on the base of the ammeter as ·00034, when it really is ·0041w.? I was very pleased to see the testimonial to Mr. Bottone from such a far-away place as Calcutta as to the accuracy of his instruments, and must say they have a very good appearance for the money. Also referring to Mr. Bottone and "Ohm" in Reply Columns, might I ask Mr. B. why he uses a "rough affair" to calibrate instruments to be sold to the public? As to the moment of magnet changing, I may thank Mr. Bottone and "Ohm" for their kindness in enlightening me, but I knew the fact they gave before: it is mentioned in nearly all the textbooks I have, and a full description is given in "Culley's Telegraphy." When I first got a 5s. ammeter I saw that, according to that, the readings should remain constant; but where the couple acting on the needle is small friction comes into play and spoils the readings. I have just checked the ammeter I used for my experiments, and find it correct; besides, I may tell Mr. "Ohm" that it was not a Bottone. I use the Bottone ammeter often, and at present it is quite correct; but I do not use it for tests to be made public in the columns of the "E.M." I then use an Ayrton and Perry or a Sir W. Thomson current-meter, which I am using to repeat my tests given last week, and find no difference. As several correspondents have given a lot of time and labour to Dr. Stewart's query, I think the least he can do in return is to tell us how he has got over his difficulty. **Iota.**

A VERY SIMPLE HYGROMETER.

[27000.]—PROCURE a small paper or chip box not less than 1½in. deep; also a piece of fiddle string, middle size, well twisted; with a drop of sealing-wax fasten one end of the string to the middle of the inside of the lid; pass the other end through a hole in inside of the bottom; with another drop of wax fix a neat paper or cardboard pointer; this pointer will nearly travel round the box in extremes of moist or dry atmosphere, which seldom occur; but if well placed it will be found continually on the move. Do not place it in a sitting-room with a fire; in the entrance hall or passage will do. A few holes pricked in box will assist its action. This simple instrument will, in my opinion, give much better indication than a wet and dry bulb thermometer, as it is not affected by wind. Do not expect it always truly to predict the weather; a correct forecast can only be found by observing the hygrometer, barometer, and the part the wind is in; if the wind is not in the east or north-east, and the two former are favourable, you may safely leave your umbrella at home.

If our Editor has not put the "closure" on windmills, I should like to add a few words. Over fifty years ago I made several small-power windmills. Experimenting with them some time, I came to the conclusion that wind-power in whatever way applied is very unsatisfactory. The wind never blows steadily even in the finest weather, which is a great drawback to its usefulness, although my mills all struck their sails automatically. Windmills, although very troublesome, have succeeded, to some extent, for pumping water to drain land. Water is as rigid as iron. The wind being unsteady, every pipe should be as large as the barrel of pump, valves also if possible. I think the old-fashioned mill facing the wind will be found to give the best results. Advocates of horizontal mills appear to overlook the fact that they are always leaving the wind. A wind going ten miles an hour would give a fair amount of power with the ordinary mill, where the horizontal, at the part that should be most powerful, would be going about that speed.

Wm. Grimshaw.

The Cedars, Sunderland.

RAISING WATER AN UNLIMITED HEIGHT.

[27001.]—How can your arrangement (let. 26968) be irrespective of the 32ft. column, seeing you have in no part of the apparatus an unbroken vertical column of 32ft.? What a complication of piping in order to raise three gallons of water in stages of about 25ft. Quite provocative of "strong language," and for my part I would much prefer a piece of rope and a bucket. I hope you don't hope to raise the wind by the "invention."

T. C., Bristol.

A CHEAP AND GOOD FLOOR.

[27002.]—When I took possession of my present workshop, detached from my dwelling-house, I found it paved with rough stones, called here "cobbles." This is about the most uncomfortable footing a workman can imagine, so I got a cartload of clean, pugged clay from the brickworks, being fireproof, as my forge had to be accommodated under the same roof. The clay was beaten and rolled, and looked serviceable; but in twelve months time holes began to appear, and much dust, so I looked into an American recipe book for what I wanted: here it is, and a better for all purposes cannot be found. Take of clean quicklime, free from stones, two parts, through a garden sieve add to the heap one part dry coal ashes (very coarse) and a small amount of loam clay; mix well together with a spade, temper well with water, and make up into a heap; let it lie a week or ten days, then repeat the tempering very high till it becomes smooth, yielding, tough, and gluey. I could not get any cow's hair to stir in, or I should have added it. My gardener, with a bricklayer's trowel, having wetted and levelled the old clay floor, spread this compost about 3in. deep, smoothing it well afterwards. The weather was hot, and a few cracks appeared. These were removed by the man putting a plank across the work, and sitting thereon while he repaired these with some fluid stuff, pressing it in with the trowel. Two years have elapsed, the flooring is sound and hard. My book adds: "If anyone would have their floor look better, let them take lime of rag-stones, well tempered with white of eggs, covering the floor about ¼in. thick with it before the underflooring is too dry. If this be well done, and the work thoroughly dried, it will look, when rubbed with a little oil, as transparent as metal or glass."

Eos.

BURNT AIR.

[27003.]—"J. Q. D." evidently confuses together "aqueous vapour" and "steam"; they are totally distinct forms of water.

Steam is a *vapour*, and can only exist at temperatures above 100° C. (or thereabouts, according to barometric pressure). When steam issues into the air it ceases to exist as steam, and suffers condensation.

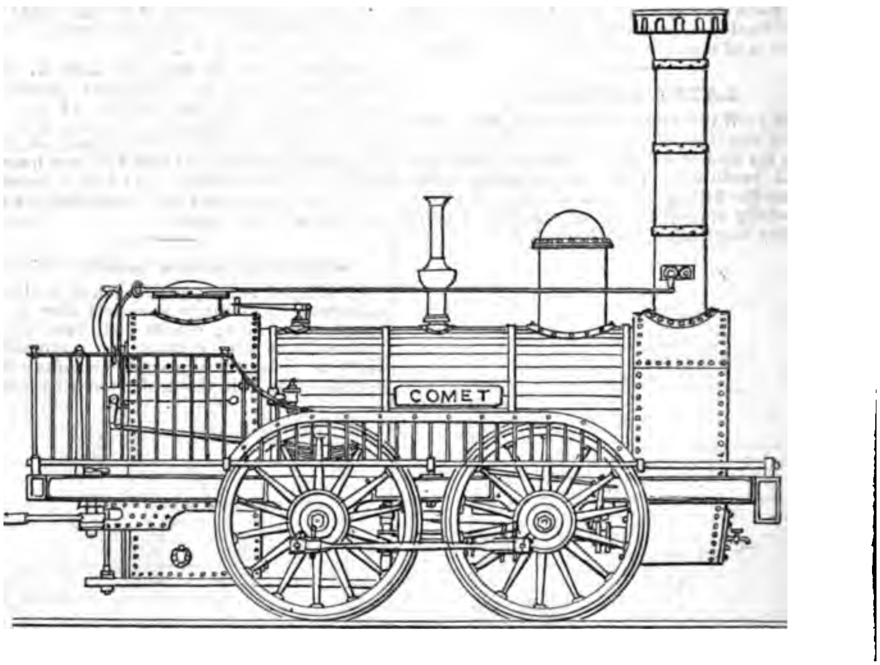
"Aqueous vapour" is a *gas*, and can exist at widely different temperatures; it can be cooled until it deposits in a frozen condition. Aqueous vapour cannot be decomposed by contact with the external surface of a hot stove. Steam can be decomposed by many metals, and in the case of iron a *red* heat is not *necessary*, but the temperature must be considerably above the boiling-point of water.

"J. Q. D.'s" illustration concerning the action of steam has nothing whatever to do with the original question about "burnt air."

A. P. S.

LOCOMOTIVES.

[27004.]—In accordance with the wish expressed by "Inquirer" (p. 420) and "Rover" (p. 465) of last vol., I now forward a diagram of the engine named Comet, which was constructed by Messrs. Hawthorn and Co., Newcastle, and conveyed one of the trains of passengers on the opening of the Newcastle and Carlisle Railway, March 9th, 1835. This engine had four coupled wheels 4ft. diameter. The cylinders were 12in. diameter, and the stroke 16in., and were placed inside and under the smokebox so low down that the piston-rods worked *under* the leading axle. Heating surface of firebox, 35sq.ft.; of tubes, 237sq.ft. Pressure of steam, 60lb. per square inch. The tender ran on four wheels, and carried 680 gallons of water.



This and other engines of a similar class worked for many years upon the Newcastle and Carlisle Railway with the greatest efficiency, and I am now glad to be able to place upon record in your columns the details of such an interesting link in locomotive construction.

Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.
Midland Grand Hotel, London, N., March 10.

RAILWAY SIGNAL LIGHTS.

[27005.]—Your correspondent "P.," p. 35, very truly remarks that it is "very confusing" to engine-drivers who have to run over various lines where different signals are in use.

At several stations and junctions, where the lines of two companies join, a white light in one direction is the all-right signal to start; but in the other direction it implies "signal out of order—danger."

On the Great Northern Railway a *purple light is the all-right* signal for slow or additional lines of rails. On the London and North-Western Railway a *purple light is the danger* signal for bay platform lines, and to regulate trains running to or from sidings. The directly opposite use of the purple light is a source of confusion when men of one company work over the line of the other, and in the case of joint lines, of which there are many, the drivers must be especially careful to remember under which system they are working. It would be far better and safer if red were made the only danger or stop-signal.

"Green," when employed both as a back-light and as an all-right signal, is very misleading.

For a number of years I have examined cases where engine-drivers have made mistakes in signals, and in all these, without exception, I have found the defects existed in the signal itself, which misled the men.

In some cases a white light from the window of a house has been found to be in the direct line of sight of a white signal; the signal has gone out, and the light in the house has been taken for it.

Only recently it has been my duty to examine several signals, and I have found the green back light on a post placed on the wrong side of the railway, was directly in the line of sight, and absolutely for a time blocked the driver's view of the proper green all-right signal on another post. When, on several occasions, I have pointed out such defects, I have been met with the reply, "Our drivers ought to know the road, and not be caught by such traps."

In *theory* that may sound very well; but in *practice* it would be much better and safer to adopt one standard system of signals and positions, and thus avoid the *traps* entirely.

Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.
40, Saxe-Coburg-street, Leicester, 11th March.

[27006.]—Your correspondent "P." (page 35, 26949) calls attention to the above subject. Almost all the drivers of our large railways incline to the opinion that there should be only two lights employed on railways for fixed signals applicable to trains; that is, "Line Clear" (green) and "Line blocked" (red). On some railways, notably the London and North-Western, purple lights are employed at junctions as "danger" signals and green as "all rights." This is a great anomaly, and has led to many mistakes through the lights being mistaken for each other. There is nothing so easily mistaken as a purple light for a green one during foggy seasons.

I don't at all approve of "P.'s" idea of employing purple as a back light, because where two or three signals applicable to both lines are placed near each other on dark, foggy nights, these back lights may be easily mistaken for the green "All right" signal. I am quite at one with him about signals being placed on the side of the line to which they apply; that is, the left side. Of course, there are some odd places where this rule could not be carried out, but wherever possible it should be done. His remarks *re* Midland signals only apply to junctions; nearly the whole of the starting and home signals are white "All right" lights.

I am sorry to say that instead of this company taking the initiative in bringing about a reform, they are taking a retrograde course as far as Carlisle and Appleby are concerned, at any rate. By an order dated March 7th, issued by Mr. Noble, of Derby, we are informed all the distant signals that have been worked "green" at Petterill goods, Durran Hill Junction, and Appleby North Junction applicable to trains from Carlisle and N.E. line, will be changed from green to white for "All right" lights.

It would be a great deal better to abolish all lights except red and green on fixed signals, and thus make the signals and the block agree in these terms and colours.

The white might be used for a back light without a great deal of alteration, especially as the signals are off so short a time before put back to danger. The disappearance of the light should always indicate to the signalman that his signals were off whenever the light went out. It would be an incentive for him to see to it at once.

Rover.

ACCIDENT AT CARLISLE.

[27007.]—Mr. Stretton (26951, p. 36) calls attention to the report of General Hutchinson on the collision that occurred at Citadel Station on Dec, 21st, between the London and North-Western Limited Mail and a Midland engine, 1880.

It will be seen from the inspector's report that Midland engines arriving at No. 2 island platform uncouple and go about 200 yards further north to cross to the up line in order to go to the Midland sheds, and by so doing foul the junction from No. 1 island platform at the point where the collision took place. It is, you will see, a very unsatisfactory mode of working, as whenever the London and North-Western brake may fail, these engines and the North British and G. and S.W. trains are in danger. If the L. and N.W. adopt the automatic vacuum, what is to prevent the same thing happening if the pipe between the engine and tender were to freeze up gradually the same as this on No. 410 appears to have done?

The necessity for Midland engines fouling the Caledonian Junction would be obviated if, instead of as at present, the engines were turned on to the up line through the facing points known as No. 27 and 28, and much time might thus be saved.

Rover.

[61663.]—**Photo. Enlargement.** — If this querist will but look through back volumes, he will have some difficulty in determining which method he will adopt. Let him try that described in an article entitled "A Cheap and Simple Enlarging Apparatus" in No. 1097.—I. H. J.

[61667.]—**Tempering Tools.**—The temperatures for tempering steel range from 420° to 570° Fahr., the former being for fine-edged instruments such as razors, the latter for springs; but if "tools" are the only things the querist requires to temper, about 430° is the scale mark.—NUN. DOR.

[61670.]—**Theory.**—I would suggest to this querist the advisability of procuring some of the examination papers already issued; he will then be able to answer his own query in the most satisfactory manner.—FINSBURY TECH. COL.

[61695.]—**Aromatic Burning Ribbon of Bruges.**—The ribbon is soaked in the perfume first, I believe, and then in a solution of saltpetre; but it is silk ribbon that ought to be used.—VOL.

[61696.]—**Oil Stains in Photographs.**—These may be extracted with ether or Fuller's earth, placing blotting-paper and a warm iron over them.—I. H. J.

[61698.]—**Laundry Blue.**— Artificial ultramarine is the blue generally used for this purpose. —C. R.

[61716.]—**Electric Lighting by Batteries.**—Surely "Iota" has not considered the subject of lighting by primary batteries very deeply, or he would have been more careful as to his statements. Before saying that "no primary battery is used for house lighting continuously direct" (rather a curious expression), he should have been certain that this was true. I think either Messrs. Johnson and Phillips, or Messrs. Laing, Wharton, and Down have numbers of such installations. What does he mean by saying that the Upward battery is "often" used for charging accumulators? I understood that this was a new battery, so I fail to see where the "often" comes in. How does he know that the Schanschieff (a very good battery, but costly to use) is "the only battery the least like direct working"?—ELECTRICIAN.

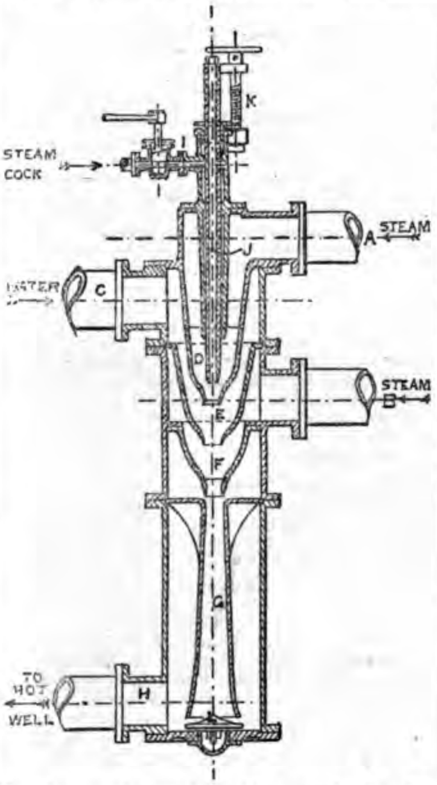
[61789.]—**Gas-Engine.**—I shall be pleased to see the arrangement of "T. N. C." if it is anywhere in this neighbourhood.—T. C., Bristol.

[61789.]—**Gas-Engine.** — In a properly constructed compression gas-engine there is not a sudden explosion, but rather a rapidly increasing expansion, so that the impulse is not a sudden shock, as "T. N. C." imagines. This is, I think, what he wishes to ascertain. In old-fashioned engines the explosion was a sudden shock, and in these the engines were always going wrong. The power in these engines was in the back-stroke, due to a vacuum being formed, so they were really atmospheric engines. Perhaps he is mixing these up with the modern system.—ELECTRICIAN.

[61798.] — **Condenser.** — I am perfectly acquainted with the drawings and published description of Morton's injector, as described by "J. Q. D."; but may I ask him if he has practically used it? I want to know if there are any hitches when at work, and whether a very small leak completely stops it? Also if it lifts its own water any height? and so on—full particulars from one who has used it. The "Macarter" is new to me.—T. C., Bristol.

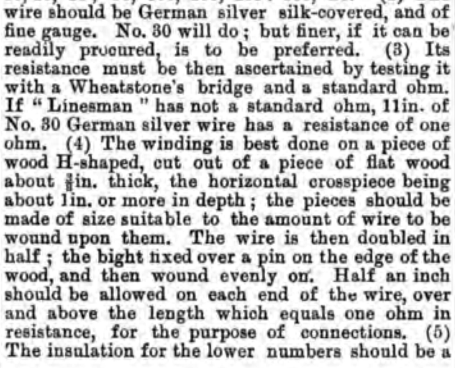
[61824.]—**Lining for Wooden Cells.**—Wooden cells may be made quite impervious, and are unaffected by acids or bichromate of potash solutions, when thoroughly dried, and their insides coated over with melted paraffin wax. This covering may readily be run on with the assistance of a hot iron.—J. T. N.

[61798.]—**Condenser.**—Perhaps the following tracing and particulars of Morton's patent ejector condenser, taken from Winton's "Modern Steam Practice," may be useful to "Joiner" and "T. C., Bristol." The instrument represented is for a double engine; the injection enters at C, and the exhaust from the two cylinders at A and B. The rush of steam takes the water with it, after the manner of an injector, through the combining nozzle F and discharge nozzle G, to the hot well through H. The nozzle G is gradually enlarged so as to check the velocity of the issuing stream, and a reflux valve L is provided to prevent any water from running back into the engine cylinder from the hot well, should the latter be the higher of the two, when the engine is standing. It is found that the suction produced is amply sufficient to lift the injection some 6ft. or 8ft. When, however, it has to be so lifted, a steam valve I is provided, in order to start the flow by means of live steam from the boiler, after any stoppage. This valve can, by a simple arrangement, be made automatic. The injection supply is regulated by the spindle J and hand-wheel K. In contrast to the ordinary condenser, this instrument can lift its own discharge to a height of several feet above its own level, and it is said that a vacuum of 25in. is easily obtained, even with piston speeds of over 500ft. per minute.



More information on the subject can be found in *Engineering* for Dec. 11th, 1885.—M. M.

[61829.]—**Resistance Coils.**—(1) Grouping is rather different to that proposed, with obvious advantages. That usually adopted is—1, 2, 2, 5; 10, 20, 20; 50, 100, 200, 200: 500, &c. (2) The wire should be German silver silk-covered, and of fine gauge. No. 30 will do; but finer, if it can be readily procured, is to be preferred. (3) Its resistance must be then ascertained by testing it with a Wheatstone's bridge and a standard ohm. If "Linesman" has not a standard ohm, 11in. of No. 30 German silver wire has a resistance of one ohm. (4) The winding is best done on a piece of wood H-shaped, cut out of a piece of flat wood about $\frac{3}{8}$in. thick, the horizontal crosspiece being about 1in. or more in depth; the pieces should be made of size suitable to the amount of wire to be wound upon them. The wire is then doubled in half; the bight fixed over a pin on the edge of the wood, and then wound evenly on. Half an inch should be allowed on each end of the wire, over and above the length which equals one ohm in resistance, for the purpose of connections. (5) The insulation for the lower numbers should be a dip into melted paraffin. For the higher numbers dip each layer, and separate it from the next by a thickness of paraffined paper. (6) The connections: Flat wood is used, so as to be conveniently stowed side by side in an oblong box. The lid of this box should be of hard wood or vulcanite. Upon the lid are screwed pairs of brass $\frac{1}{4}$in. thick, $\frac{1}{2}$in. wide, and $\frac{3}{4}$in. long, with a space of $\frac{1}{8}$in. between them. A semicircular notch is filed on the edge of each brass block upon opposing sides, to serve for the reception of a brass plug. A binding screw is fixed upon the initial and finial block. When the pairs of brass blocks are arranged upon the lid of the oblong box, a fine hole may be drilled through each, so that the end of the wire coiled upon the reel may be threaded into it and then soldered. If any of the half-inch allowed is over, it may then be cut off. The coils are then attached to the brass blocks upon the lid of the box in the manner of the diagram. When the plugs are out the current must pass through all the coils; when they are in, the current passes through the brass blocks only from one binding-screw to the other.—K. C. B.

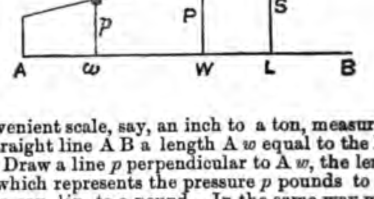


[61845.]—**Softening Cast Iron.**—I have ventured to alter the heading of this reply with a view to the index of the current volume. The following appeared in the *American Machinist*:—"I saw in your valuable paper a few weeks ago a receipt for softening hard cast iron by heating it red-hot and dipping it in water. I thought it was a big thing; very simple, and would try it some day, as I often have light castings brought in, sometimes so hard we can neither drill nor file them, and we have to break them up. About three weeks ago a man brought in two carbon holders of cast iron to be filed out a little in the hole to make the carbon slip through easily. They were so hard my machinist could do nothing with them. I took them, heated one red-hot, dipped it in water, tried it, and it was as hard as ever. Not being discouraged, I thought I would try again. This time I heated it almost to a white heat, and dipped it again in water. Taking it out when cold, I could see by its colour being white, that it was harder than ever. I tried it on a file; but it was as hard as glass, and made a wide scratch on the file. I was discouraged, and concluded that the man who wrote that article either did not know how to do it, or else he would not tell how it was done. I then thought I would try a way of my own. I heated it red-hot, and then held it in a dark corner between the water barrel and the forge until I saw the redness of the iron leave it. I then dipped it in water, holding it there till cool. I then tried it with a file, and found it soft enough to be filed. I tried the other the same way with the same result." If your correspondent tries this plan, I should like to hear if it proves successful.—GLATTON.

[61847.]—**Eccentric.**—If turned on the same centre as before, no difference. If turned so as to reduce the throw, the valve will admit steam too late and cut off too early. Lap must be reduced to cure this; but even then the steam will be wiredrawn. If a reversing link is fitted, the travel of link could, perhaps, be increased so as to make the travel of valve the same as before.—GLATTON.

[61849.]—**Wheel-cutting Engine.**—Multiply the diameter of wheel by 3·1416, and divide by double the number of teeth required. This will give the width of cutter for equal teeth and spaces, the proportion mostly required in clockwork. Example: Diameter of wheel 2in., 60 teeth. $\frac{2 \times 3\cdot1416}{60 \times 2} = \cdot005236$in.; $\frac{1}{200}$ of an inch. The metric system is more suitable for this kind of calculation.—J. MEEK.

[61850.]—**Crab.**—By means of a spring balance, try what pressure p you put on the handle to lift a known weight w. Now try a similar experiment with another weight W, and call the pressure on handle P. Plot a "curve" as follows: Taking any convenient scale, say, an inch to a ton, measure on a straight line A B a length A w equal to the load w. Draw a line p perpendicular to A w, the length of which represents the pressure p pounds to any scale, say, $\frac{1}{8}$in. to a pound. In the same way make A W equal to the load W, and the vertical line P equal to the corresponding pressure on the handle. Join the tops of these lines, and produce the line joining them. Knowing that your strength represents a certain pressure S on the handle, find a point x on the sloping line at a height above A B corresponding to this pressure. A perpendicular from this point cuts A B in L, and A L is the load which you can lift.—GLATTON.



[61857.]—**Proportions of Model Engines and Boilers.**—The rule given on p. 565 of Vol. XXXIX. is as follows:—

$$\left.\begin{array}{r}\text{Heating surface in}\\ \text{square inches} \ldots\end{array}\right\} = C D^2 L x n.$$

Where C = a constant (varying from 14·2 to 16) = say, 15.
D = diameter of cylinder in inches.
L = stroke in inches.
x = proportion of stroke passed through before steam is cut off.
n = No. of cylinders to be fed by boiler.

As this rule does not take the revolutions into account, it evidently represents an average rate of running. The working stress on a thoroughly well brazed copper model boiler may be 1,000lb. per square inch. This gives a working pressure for a circular boiler (with well-stayed ends) $2\,000 \frac{t}{d}$ pounds per square inch, where t = thickness in inches, and d = diameter in inches. As it is not easy to make a good joint if the plate is very thin, the plate should never be less than 20 B.W.G., or, say, ·035in. thick. For boilers working at 20lb. per square inch, this gives as the rule for thickness of copper ·035 + [(D − 3½) × ·01] inches. For any other pressure the thickness should be at least $\frac{d \times \text{pounds per square inch of steam}}{2{,}000}$ and not less than ·035in. thick. See p. 243, Vol. XL., for a few hints on the proportion of vertical model boiler.—GLATTON.

[61876.]—**Primary Battery for Lighting Billiard Table.**—"Ohm" will find what he asks for in a paper I am sending to the Editor, if he sees fit to publish it. The 20-candle lamps are really sold as 16c.p.; but, since zinc is dearer than coal, I find it pay to slightly overrun the lamps. Take a 16c.p. lamp, taking 1amp. at 40 volts. This run at 44 volts, taking 1·11amp., will give 20c.p. The shorter life of the lamp is more than compensated for by the saving in oxidant and zinc. "E. E. V." seems particularly unfortunate in the matter of cost. I for my part thought five farthings an hour too costly; but twopence—that is beyond me.—ELECTRICIAN.

[61885.]—**American Organ.**—"J. S.," p. 21, asks my opinion of the arrangement described. It is easily given. I don't think anything of it. Take a piece of paper, a pencil, and a foot-rule, good "J. S.," and set out your organ in proper proportions, and see where you are going before you start. I don't know that there is any "best" method of fixing the fan tremolo. I gave a description of it with diagram in No. 732, and if "J. S." will do what I suggest above, and state his difficulties in a definite manner, I will do what I can to help him, though I have an aversion to nondescript instruments.—ORGANON.

[61895.]—**Stencilling on Glass.**—The chief difficulty in stencilling on glass is to keep the stencil perfectly close to the glass whilst performing; also to wipe the stencil perfectly clean after each application; to dab the work, rather than brush in the ordinary way of painting. Of course, the judicious consistency of the material has a great deal to do with non-covering.—W. W.

[61898.]—**Hard Water.**—One of the most convenient and precise methods of testing water for hardness is that made use of by Prof. J. A. Wanklyn, and described by him in his very useful book, "Water Analysis." In estimating the total hardness of a sample of water by this method, use is made of a standard soap solution (10 grammes of Castile soap dissolved in 1,000c.c. of weak alcohol). This solution is of such a strength that one cubic centimètre of it precipitates exactly one milligramme of carbonate of lime. A gallon of water being too large a quantity to work upon (and results are best given as per gallon), the fact is made use of that one gallon of water weighs 70,000 grains, and 70 cubic centimètres of water weigh 70,000 milligrammes, from which it will be seen that if 70c.c. of water are taken to work upon, we have a sort of miniature gallon in which the milligramme corresponds to the grain. If, by running the soap through a graduated burette, it is found how many c.c. of soap sol. are required to form a permanent lather with 70c.c. of water, we shall know how many milligrammes of lime carbonate are present in the water, and consequently, from the foregoing, how many grains of carbonate of lime, or salts equivalent to the same, are present per gallon in the water under examination. The number of c.c. of soap sol. used, as read off from the burette, can be regarded as degrees of hardness (minus one degree, consequent upon 70c.c. of distilled water requiring 1c.c. soap sol. to form a lather), or grains of carbonate of lime or salts equivalent to same per gallon. This gives total hardness. If a water charged with carbonate of lime be boiled, the excess of CO_2 escapes, and consequently there is a deposit of more or less carbonate of lime, and the water is rendered softer. If the water now be subjected to the foregoing test for hardness, the result obtained will be the amount of permanent hardness, and the difference between that and the total hardness will be the temporary hardness.—W. H. S. S., Steel-works Chemist.

[61900.]—**Electric Wire Resistance.**—In my answer to this query last week, "r = resistance for pure copper per mile" should be "r = resistance for pure copper per knot = 6,082ft.," which makes the length of wire required to give 150 ohms as 310ft.—ELAG.

[61903.]—**Harmonium.**—If "Queen's" reeds vibrate freely through the apertures when tested in the open air, they ought to do the same when the pan is closed and they are on their wind. Whether broad or narrow, it makes no difference in that matter. Try if the tongues pass readily through the apertures, and give them a slight lift, so that the wind can enter between the reed and the block. The query does not give too much information, and there is no intimation of whether the well is properly constructed, with a valve to the register that does not speak properly. What is the size of valve supplying wind to the 16ft. reeds?—ORGANON.

[61905.]—**Telegraph and Telephone Line Laying.**—Let W. G. Jackson secure his wire at one end, and going to the other end, secure a piece of wire, say, 5ft. long, one end round the pole or arm of same; put other end in the hole which is in the drum of the vice and lap, say, a turn round. Pull as much of your slack wire in by hand as you can; then put on your vice, and wind up with key. If you are running a wire, say, a mile or two long, the quickest way is to pull up at the foot of the pole, one man coming behind and binding in. Pulling at the top is a lot of unnecessary labour. If you write to me I will be glad to give you any information and sketches you will require, if you say whether you want tools for house or road construction. I will send through post, as it will take too much space of this paper.—JOHN CURRIE, Flatgate, Howden, Yorks.

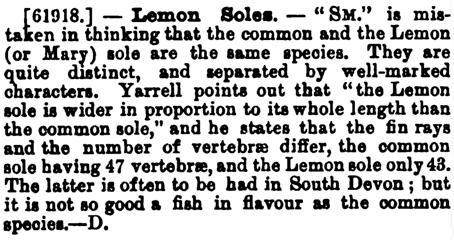
[61911.]—**Temperature.**—The best way for "Liquefaction" to determine the melting point of his mixture would be to make a mixture of 94 parts of water, four parts of soap, one part of starch, and one part of glue, and place some of it in a small tube to about the height of 5mm. The tube, which should have thin walls, is made by drawing out in a flame a piece of ordinary soft glass tubing. A length of the small tubing of about 12 to 15c.m. long, and having a bore so that an ordinary pin can pass into it, is used. The substance having been placed in the tube to about the height mentioned is then fastened by means of an indiarubber band cut from a piece of tubing to a thermometer. The band is placed near the upper part of the tube, and the lower part containing the substance placed near the bulb of the thermometer. The thermometer, with the tube and contents are then placed in a bath of water, melted paraffin, or sulphuric acid. The bath is then heated very gently, and as soon as the substance is seen to melt the temperature indicated by the thermometer is noted—this is the melting point.—HENRY J. HARDY, F.C.S., Sheffield.

[61917.]—**Painting on Glass.**—Are not the directions given on p. 516, last volume, sufficient for this querist, or has he failed to notice the article?—J. M.

[61918.]—**Lemon Soles.**—"SM." is mistaken in thinking that the common and the Lemon (or Mary) sole are the same species. They are quite distinct, and separated by well-marked characters. Yarrell points out that "the Lemon sole is wider in proportion to its whole length than the common sole," and he states that the fin rays and the number of vertebræ differ, the common sole having 47 vertebræ, and the Lemon sole only 43. The latter is often to be had in South Devon; but it is not so good a fish in flavour as the common species.—D.

[61918.]—**Lemon Soles.**—This is a name now well known in London markets for one of the Pleuronectidæ which more nearly resembles the true sole than any other fish. It is broader, in comparison with its length, than the black or Dover sole, and the Minnie or Mary sole is still broader and darker, for the Lemon sole is always a lightish-brown or pink-brown, and does not exhibit so much variety of colour as the *P. solea*, which is said to be "obscure brown," but is often light-brown, and sometimes a black-brown or sepia. Lemon soles are often found in the market reports, the usual price being 6d. a pound, though a few years ago I have often bought a pair, weighing about 4lb., for a shilling. They are not so delicate eating as the Dover sole; but are, nevertheless, second to that. They skin readily on both sides, which serves to distinguish them from the Merry, Mary, or Minnie sole—at least, to me, for I never could succeed in getting the skin off that. I wrote a reply on this subject in No. 959, and asked about bergyllts and latchetts. What is roker? Several other unfamiliar names often appear in the London market reports. Perhaps some reader may be able to tell us what the fish are like.—NUN. DOR.

[61923.]—**Hot-Air Oven.**—TO MR. BOTTONE. The accompanying sketch needs no explanation.



It is made of No. 21 sheet copper, with a rather coarse wire grating, resting on ledges as a shelf. It may be stood on a trivet, and heated by a spirit lamp, Bunsen burner, or a paraffin stove. Cost to make, of the dimensions given, about 3s. to 3s. 6d.—S. BOTTONE.

[61929.]—**Double Star near Castor.**—The pair alluded to by Mr. Holmes may be Σ 1119, which is 3m. 44s. *f.* Castor, and 1° 50′ north; or possibly Σ 1123, 6m. 46s. *f.* and 1° 32′ north. For Σ 1119 Dembowski gives (1869·5) 7·8, 9·0 : 348·7° : 2·77″, and for Σ 1123 (1867·9) 8·9, 9·3 : 160·8° : 3·63″.—H. SADLER.

[61937.]—**Webb's Automatic Air-brake.**—"L. and N.W." will find on p. 397 of Vol. XLIII. Mr. Webb's own description of this brake, though it is difficult to understand without diagrams, which I have not been able to obtain. It will be seen that the principle is the same as the Westinghouse, though, of course, the construction is entirely different. Can any correspondent say if the brake has been fitted to any of the North-Western stock? And if so, an account of its performance would be acceptable.—REYMOND.

[61940.]—**Rear-Driving Safety Bicycles.**—I see no disadvantage in rear-driving bicycles to high machines, only that you cannot break your neck so easy, if that be called a disadvantage. I certainly must say I prefer a safety to high machine, though a little tricky in steering at first, which soon wears off with a few hours' practice. It should be straight steerer; I don't mean automatic. The saddle can be adjusted to your own fancy. The nearer you get to the handles, the more your arms are cramped, and your legs, instead of having a straight down thrust, will have a kind of back pedalling, with your body in a most awkward position over the handle bars. As in the "Rover," you cannot possibly do without chain-gearing, unless you disregard speed as an advantage. You may as well go back to the old bone-shakers, and have the cranks on front wheel. The friction of chain is scarcely perceptible. Tangent wheel; I suppose you mean an ordinary, laced spokes. If so, the only advantage I see you can have is very thin hubs, which must be thicker for direct spokes to screw in. If spokes get broken, laced are more expensive to put in. With regard to saddles, there are several good ones. I prefer the "buffer." I will now point out a few disadvantages which a few readers like yourself when buying might not have noticed. The main point is the perfect adjustment of the chain, which cannot be done with anything like accuracy by pulling the driving-wheel back, which, if not done true, the wheel will not trail well. The best plan I have seen is by drawing the crank-spindle forward, which is made adjustable by bolt, &c. I have ridden several kinds of safeties, including "Rover," "Rudge's bicyclette," "Ivel," "Apollo," "Swift, No. 2." The last two machines are adjusted that way, which is a great advantage over all others. I remember being out in the country at night, with a slack chain on a machine, the chain adjusted by back wheel, which took me nearly ten minutes to tighten, and when I arrived home I found the wheel had been rubbing against the forks, which I afterwards discovered was a common occurrence with machines adjusted that way. The advantage of having lamp bracket extended from front wheel I certainly must condemn. I have always found when riding in dirty weather if I happened to use the brake it threw the mud down on the lamp, which was soon buried from view and was in a filthy condition to handle. A few fellow-riders sincerely join with me in wishing the makers would try their machines themselves; then disadvantages of this kind would soon be abolished.—SAFETY RIDER.

[61948.]—**Steam.**—Omit the last four lines of my reply *re* this, as it does allow for the joint in the 5,000lb. Thus, ⅜in. plate would be used for a boiler this size up to 60lb. pressure.—T. C., Bristol.

[61947.]—**Electrical Query.**—It is true that it is impossible to produce one kind of electricity without the other. In current electricity we have both positive and negative; but to prevent ambiguity and confusion, electricians have agreed, unless otherwise stated, to ignore the negative current, so that by the term current electricity is to be understood simply a current of positive electricity. It can be proved by experiment that both kinds are separated in a common voltaic cell. Connect the wire from the copper plate with one disc of an electrical condenser, and the wire from the zinc with the other disc of the condenser. The two discs being near each other, and each in metallic connection with a gold-leaf electroscope, are to be momentarily connected. Disconnect the cell, and draw the discs away from each other; the gold leaves will diverge. Those previously in connection with the copper will be found charged with positive, and those in connection with zinc charged with negative electricity.—BOBADIL.

[61947.]—**Electrical Query.**—I hope all electricians reading this reply of mine [illegible] that in speaking of electricity [illegible] only using a polite fiction to enable a non-electrical reader to grasp an idea otherwise unintelligible. First, it is impossible, under any circumstances, to store electricity of either sign without inducing an equal quantity of the opposite sign. Take a Leyden jar. Say you charge the inner coating with +. Every spark you put into the jar drives from the outer coating an equal spark of + fixing (inducing) at the same time an equal quantity of –. On discharging, the + and – rush together and neutralise each other. So with "current" electricity, + flows from the + pole, – from the –. Being equal in quantity they neutralise each other. According to this theory, the current enters at *both* loops. The terms + and – are only expressions of degree, as what would be + to a current of lower potential would be – to one of higher. Electricity is, in reality, no more a current than is light, heat, magnetism, or gravity. Each and all of these are simply manifestations of "Force."—ELECTRICIAN.

[61947.]—**Induction Coil.**—Sure to be something wrong with the secondary coil. Have you tested it for continuity? It may be short-circuited somewhere through defective insulation. Did it ever work with you? Your battery solution appears all right. Try another cell, or make one larger one, twice or three times the size of the one you have used. If you do not succeed in putting it right, I will look at it for you with pleasure on hearing from you.—W. HOLDER, Alexandra, Newport, Mon.

[61948.]—**Induction Coil.**—Your coil is in fault. The secondary is short-circuited, or at any rate within easy sparking distance of either another portion of itself or the primary. You do not say much about your coil. Is it a medical coil? I might help you through Address Column, where mine is given.—ELECTRICIAN.

[61948.]—**Induction Coil.**—The recipe for charging fluid for your battery is—Bichromate of potash in powder, 4oz.; boiling water, 1 pint. When cold, add (constantly stirring with a glass rod) sulphuric acid, 3oz. Impossible to say if your coil is wrong or not from your description. You probably would get a shock if you touched the proper terminals, unless the insulation of the coil has broken down.—S. BOTTONE.

[61948.]—**Induction Coil.**—Had this coil been all right, the battery employed should have worked it. A spark at the contact-breaker, but no shock or anything else, means either very defective insulation of the secondary wire, or the wire is broken. See that all the connections are right in the first place. The recipe for bichromate solution is 2oz. of bichromate to 1 pint of hot water; when dissolved and cold, add 2oz. sulphuric acid. The addition of acid generates heat. When the solution is again cold, it is ready for use.—BOBADIL.

[61948.]—**Induction Coil.**—Your secondary wire is broken somewhere, or else seriously short-circuited. Have you tested it with two or three cells and a tolerably sensitive galvanometer? Because, if not, you should do so. If you get any deflection, then short-circuiting is the matter; if no deflection at all, then a break somewhere; and in either case I fear there is nothing for it but to rewind the secondary coil. If it is a short circuit, you would almost certainly be able to detect a spark on touching the ends of the secondary together when the primary is at work, especially if you do so in the dark, as then the tiniest spark shows. It is sometimes possible to save a short-circuited coil by soaking it thoroughly in boiling paraffin wax, the wax gets right in among the coils and insulates the faulty strands.—EDWARD CONRY.

[61948.]—**Induction Coil.**—From the fact that you got a spark at the contact-breaker, it would appear that the fault was not with the battery, but with the coil itself; it is also evident that the primary coil is all right. You had better test the continuity of the secondary by putting it in circuit with a battery and galvanometer. If you get no deflection you will know that the wire has parted somewhere, and the only remedy is to unwind till you find the defect, and after having properly joined and made good the insulation, re-wind it. If you intend using bichromate of potash, Trouvé's solution is about the best, which is prepared by adding slowly 15oz. of sulphuric acid to a mixture of 8oz. powdered bichromate and 36oz. of water. Care must be taken to add the sulphuric acid so slowly as not to heat the solution: it will then become supersaturated, and no crystals will form. I should advise you to try chromic acid, which is much less trouble, and will give better results. Make the solution by adding 4oz. of sulphuric acid to a mixture of 3oz. chromic acid, and 16oz. of water. For either of these solutions you must see that your zincs are perfectly amalgamated.—E. E. VAUGHTON.

[61949.]—**Boiler Gauge Glass.**—If an iron wire is passed "freely" through a barometer tube it has no effect upon it; perhaps it has if it "be" passed through. If the iron wire scratches the interior of the tube, in 999 times out of a 1,000 the latter will break. As to the gauge glasses, correspondent seems to forget that from the moment they are put to work they undergo a slow process of annealing, and that steam will in time corrode almost any kind of glass; that is, if it "be" allowed to come into contact with it.—XENOPHON.

[61951.]—**Legal.**—Getting a few cards printed, with your name and "dental mechanician," might be held to be an infringement of the Dentists Act, 1878, which enacts, among others, that no person will be entitled to use any name, title, &c., implying that he is qualified to practise dentistry unless he is registered, &c.—fine not exceeding £20.—B.Sc., Plymouth.

[61951.]—**Legal.**—As "Dens of Peckham" is a regular dentist by legal apprenticeship, he need not trouble about the Dentists' Act till it troubles him (which it's not likely to do), as it was not intended to apply to regular dentists (of course, you cannot register without passing the exams.), but that can be done at any time, so that there is no need whatever to resort to any underhand dodge. Get your cards printed, with name, address, and title of dentist in the usual way, distribute freely, and go in for all you can get to do. Should you have occasion to send another query to "Ours," please adopt (to prevent confusion) another signature than—DENS.

[61955.]—**Science and Art Exams.**—I think you would find Wormell's "Theoretical and Applied Mechanics," 3s. 6d., suit you for both exams. The thing is to thoroughly master what you read—not merely cram yourself with a lot of formulæ; but understand the method of calculation, and then work every example. More practice than reading required for machine construction.—T. C., Bristol.

[61955.]—**Science and Art Exams.**—Twisden's "Theoretical Mechanics" is a suitable book for the elementary stage in that subject, and for applied mechanics the querist might use Goodeve's "Principles of Mechanics" and "Elements of Mechanism." He will find it best to join a science class next autumn, as otherwise much of his time will be wasted in deciding what to study. The books mentioned, especially Twisden's, contain more than is actually needed for the elementary stage.—WM. JOHN GREY, F.C.S., 1st Adv. Theo. and Applied Mechanics, Newcastle-on-Tyne.

[61955.]—**Science and Art Exams.**—Browne's "Mechanics" would cover all the ground required in the elementary theoretical mechanics. For the elementary applied mechanics, Goodeve's "Elements of Mechanism" and "Principles of Mechanics" are excellent works. The former treats of different motions and conversion of motion, and the latter presents a comprehensive view of the science of mechanics. For the elementary machine construction, Unwin's "Machine Design" is a very good book. I should advise you to send to "The Secretary, Science and Art Department, South Kensington," for a syllabus (price 6d.), which will tell you just what is required for each stage in the above exams.—CONSTANT READER.

[61957.]—**Engine Query.**—Your eccentric appears to have slipped back on the shaft, and you must set it forward until you get a vertical line at beginning of diagram.—T. C., Bristol.

[61957.]—**Engine.**—A diagram to be of any value as an indication of an engine's efficiency, must be taken with care and judgment, and should be viewed only in the original full size. As far as one can judge from your cards, they seem to have been carelessly taken with a slack tension cord and inserted upside down surely? If so, you have too much lead (unless piston speed is abnormally high), sheave wants putting a trifle back, and the slide valve is probably leaking.—J. Q. D.

[61963.]—**Cable.**—The working strain on this cable should not exceed 3,360lb. if of iron, and 5,225lb. if of steel. The greatest tension due to weight of cable is at point of support, and =

$$t_1 = \left(\frac{S^2}{8d} + \frac{7d}{6}\right) w.$$

S = span in feet.
d = dip in feet.
w = weight of 1ft. per cable.

The greatest tension due to weight of load W is when the load is in middle of the span, and =

$$t_2 = \frac{W\,S}{4\,d}.$$

$t_1 + t_2$ should not exceed the maximum strain as given above.—ELAG.

[61960.]—**Boiled Oils.**—I have not tried the following, but believe them to be good. (1) Linseed oil, 16 pints; litharge, finely powdered, 3 pounds. Mix, and digest at boiling heat for two hours. (2) Drying oil: Linseed oil, 20 parts; finely-powdered litharge, 4 parts. Keep them together for one month in a warm place, occasionally shaking the bottle, then draw off the clear. (3) Linseed oil, two gallons; water, two gallons; finely-powdered white vitriol, 1 pound. Boil until reduced to 2 gallons. Boiling oils is a risky amusement, as great fire-risks are run.—ELECTRICIAN.

[61961.]—**Blue Brick.**—Grind blue-black and blue paint, in the proper proportions to give the right shade, with boiled linseed oil. If you desire to lighten the colour, add whiting. This is a rather slow-drying paint, but very permanent.—ELECTRICIAN.

[61964.]—**Battery, Coil, and Dynamo.**—The spark of a coil has high electromotive force (tension) and very small quantity. The current from a battery and a direct current dynamo are very similar, the difference being chiefly one of degree. The current from a battery is, however, steady; that from a dynamo, although practically steady, is in reality slightly undulatory. An alternate current dynamo reverses the current many hundred times a minute. 2. Dynamo depends on the maker; possibly about 10 volts 2 ampères. Bichromate, 2 volts per cell. Current depends on circumstances. 3. Throw away. To remove crystals, dissolve in hot water. Avoid them by using chromic acid. 4. Would be useless, and worse. 5. The currents, if equal and opposite, would neutralise each other; if unequal, the induced effect would be equal to the difference between them.—ELECTRICIAN.

[61964.]—**Battery, Coil, and Dynamo.**—They are essentially the same; but the coil spark is merely the current of either one or the other intensified. The volts and amp. of a 5c.p. dynamo would be very small, and must be determined by measurement, as the term 5c.p. may mean anything almost. 2. ¼ spark coil—this can only be answered by measurement, but the volts would be very great and the amp. very small. 3. Three quart bichromate cells, E.M.F. (volts) about 5·40—the amp. must be measured. The solution of bichromate cannot be restored when exhausted; it is of no further use, and must be thrown away. The crystals should be removed with hot water. 4. No, it would not. 5. I do not understand what you want to know. Please do not ask so many questions under one heading, but separate them under different heads.—C. D. R.

[61964.]—**Battery, Coil, and Dynamo.**—A 5c.p. dynamo will give eight or ten ampères with eight or ten volts, on a low resistance circuit, say, not more than 1 ohm. With a 5c.p. lamp in circuit, the current will fall to about 1 ampère. The volts of an ordinary well-constructed ¼in. spark coil would be about 50,000, the ampères perhaps 1-10. Three bichromate cells in series (of the size described) would give 6 volts and 24 ampères; but if arranged in parallel against a small resistance will give two volts and 72 ampères. When the fluids of a bichromate battery are spent, it is better to throw them away, as the tendency to crystallise renders them unfit for further use. The crystals can be removed from bottom of cell by filling it with water and turn it upside down under water. If allowed to stand thus for a few hours, they will all come out. The addition of iron round the secondary would not be advantageous. If the circuits A and B were exactly of similar strength, there would still be the difference in strength between the current set up on making and on breaking, so that there would be a trifling current set up at each break and make.—S. BOTTONE.

[61964.]—**Battery, Coil, and Dynamo.**—Possibly there may be some scientific difference; but, practically, the only difference is one of quantity. The spark of the battery is usually small quantity and comparatively low E.M.F.—rarely more than 30 volts (i.e., the generality of batteries do not run to more than 15 cells). The dynamo is quantity or tension or both, according to its design for plating, arc lighting, or incandescent lighting. The coil spark is almost invariably extremely high tension, thousands of volts, and correspondingly little quantity; it is, in fact, quantity sacrificed to produce tension. Coils can be made, however, for lighting incandescent lamps very successfully; it is merely a matter of proportions. 2. They might vary considerably, but would probably be something like the following: Dynamo, 15 volts 1 ampère; coil, 3,000 volts and $\frac{1}{100}$th of an ampère; cells, in series, 5 volts and ⅓ of an ampère. 3. Adding fresh chemicals to a partly-exhausted depolariser is not generally expedient, though it is in the case of several solutions. It is usually better to use some depolarising solution that will run itself nearly out before a serious fall of E.M.F. occurs, supplementing this, if necessary, by an extra cell to switch in when the light begins to fail. 4. I think not, but rather the reverse. 5. I should say that the current in C. would be inverse to that in the circuit in which the contact was broken, as the E.M.F. is much higher on breaking a circuit than on making one, and the direction of the induced current would therefore follow the break rather than the make.—EDWARD CONRY.

[61965.]—**Boiler.**—I am unable to refer to the number you name; but your description of boiler reads well. I would advise as large a firebox as you can get in for charcoal, say 6in. long, and chimney not less than 1½in. diameter, with an extra length slip on when raising steam. Of course y exhaust into chimney; $\frac{1}{16}$th copper is iough; but I should use brass.—T. C.,

]—**40c.p. Dynamo.**—To Mr. Bottone. t about 1¼lb. of No. 20 d.c.c. on the arma- 12lb. of No. 22 on the F.M.'s. Drive it 1,600 revs. per minute.—S. Bottone.

.]—**Casting Zinc.**—Put some lead in zinc.—Edward Conry.

]—**Casting Zinc.**—Add a little grain keep stirring with iron rod while pouring.

.]—**Gramme Dynamo.**—To Mr. Bot- lb. of No. 22 = 5 ohms; hence for a series- achine, put on 8lb. of No. 18. Series is rc lighting. For shunt, although in large the resistance of the F.M. coils should st 300 times that of armature, yet in prac- such small machines much less works if you put 10lb. No. 22 on the fields you bout right. Shunt-winding best for incan- ighting —S. Bottone.

]—**Safes.**—These are made burglar proof th of material and various peculiarities anship—e.g., double safes, one inside the d deep ledges just inside the jamb of the so that the safe cannot be forced open by teel wedges in between the door and the e safe, and so springing the latter open bolts of the locks come clear of their slots ch they slide. This was the method o open the safes of a London bank at a urglary, which resulted in a tremendous the ingenious robbers. Safes are made by leaving between the inner and outer f the safe a hollow space, sometimes as in. or more across, air being a great non- of heat. Sometimes this space is filled or asbestos. There may be different owever, in use now; but the construction kept a close secret by the respective make them. Three-quarter inch iron is aterial, and the same of steel is better ward Conry.

]—**Gaseous Silicon.**—The querist will considerable difficulty in obtaining the silicon in the condition of gas. Its melt- lies between that of cast iron and steel, not think that anything definite is known temperature at which it boils. There is, a note in the abstracts of the Chemical or 1885, page 872, as to its apparent tion at a temperature of 440°. It can ed in combination with hydrogen as a gas ily; and perhaps the element itself might in a voltaic arc.—Wm. John Grey, ewcastle-on-Tyne.

]—**Aluminium.**—Mr. Bartel seems to idea as to the difficulties attending the y of this metal. It is usually obtained xite, which is a hydrate of alumina, con- lso iron, silica, and other impurities. This is roasted with soda in a reverberatory and the resulting aluminate of soda is dis- t by water, and decomposed by passing a f carbon-dioxide through the solution. precipitates, and it is dried, mixed with oal-dust, and made into balls, which are redness in a stream of dry chlorine gas. process a double chloride of aluminium um is obtained, which is mixed with odium and cryolite, and heated to redness, n aluminium is set free. In order to from china-clay, the clay would have to d, and then boiled with sulphuric acid, uld yield sulphate of aluminium; this decomposed in solution by carbonate of ich would precipitate alumina, which treated as above. Another way to obtain is to mix finely-powdered cryolite with nd potassium chlorides, and fuse the h metallic sodium.—Wm. John Grey, ewcastle-on-Tyne.

]—**Puzzles.**—The error is in the first your statement, in which you say, "that 2d." In order to be five for 2d. you thirty-six at three a 1d., and twenty-four d. You will easily ascertain by experi- in trying to lay out five for 2d. (from the irty each at three a 1d. and two a 1d.), an only get ten twopennyworths and have anges at two a 1d. I do not understand query.—T. C., Bristol.

—**Two Puzzles.**—If this querist will o lots of 30 oranges on the table, and at a time from one lot and two at a the other to make up five, the "puzzle" vanish. The other puzzle is incom- le. Unless there are two doors in each oms it is impossible to go "through" on. Dor.

—**Two Puzzles.**—Can't make anything econd question; but the first is easily explained. Make all your oranges up into pennyworths. You will then have ten lots to sell at three a penny, and fifteen lots to sell at two a penny. Sell ten lots of the two-a-penny oranges, with the ten lots at three a penny, and you will have disposed of fifty oranges for 1s. 8d.—that is, five for 2d. You have then ten two-a-penny oranges left to sell for 5d. Thus you get 2s. 1d. for your sixty oranges; but you have not sold them all at five for 2d. You sold the last ten at the rate of four for 2d.!—H. T. W.

[61980.]—**Two Puzzles.**—"Thirty oranges at three for a penny cost 10d., and thirty at two for a penny cost 1s. 8d.—that is, five for 2d." If you sell three of the three-a-penny ones and two of the two-a-penny ones for twopence, that certainly would be five for twopence, but after having sold twentypenceworth you will find that you have no more of the three-a-penny ones left, and if you sold the remaining ten (which cost two a penny) at five for twopence you would lose a penny, which accounts for the loss of a penny when selling at five for twopence. If you bought sixty at five for twopence you would have thirty-six at three a penny equal one shilling and twenty-four at two a penny equal one shilling.—Elag.

[61980.]—**Two Puzzles.**—I solved this puzzle the other day. It was put thus: The first day two men went out selling, and took 30 oranges each. One sold at two for a penny, the other at three for a penny—i.e., five for 2d. Next day one man took the sixty, and sold at five for 2d.; the penny remains unaccountable for. The mystery is thus accounted for: When both are selling, you get five for 2d. right enough—i.e., for each 2d. you get three from one and two from the other; but at this rate, after several deals, the man who gives three for 2d. is sold out, and your last coppers have to be invested with his companion. Thus you cannot get five for 2d. throughout the transaction. Set down two columns of dots for oranges, and mark one in 3's and the other in 2's, and this will become apparent.—O. J. L.

[61981.]—**Pocket Accumulator.**—It would be a great advantage if you could get the red lead to stick when in the acid and in use; but this, I am afraid, you will not succeed in doing, and to have it falling off and dropping away means the spoiling of the cell.—Edward Conry.

[61981.]—**Pocket Accumulator.**—The red lead is the active part of the accumulator, when acted on by the current. Completely covering the plates is not advisable, as the peroxide into which the red lead is converted is apt to drop off and short-circuit the cell. I do not like red lead at all. "Harry Frivoli" had better wait, as I am doing, for a reply to query 61968.—Electrician.

[61981.]—**Pocket Accumulator.**—No, it would not. If the red lead be placed upon the surface of the plates, it requires a covering of felt or some porous material to keep it in position, or it will fall off. The felt covering is a great disadvantage in the cell, principally because it does not allow the liquid to circulate upon the surface of the plates, but also because it adds to the resistance. The use of red lead is this, that in the formation of a secondary cell the lead plate is reduced to spongy lead, and appears perforated with millions of small holes. This condition is more speedily arrived at by the use of red-lead powder, because it is already finely divided, and not only so, but is partly converted into the state required before being used in the cell.—C. D. R.

[61983.]—**Transmitter.**—The spring which lies between the diaphragm and the carbon button has one pellet of platinum riveted to it. The loose contact is between platinum and carbon. I am not aware of a substitute for platinum.—Bobadil.

[61991.]—**Haur.**—Haer, or easterly haur, is the name given on the east coast of Scotland to the chilly white mist or haur, which so often comes sweeping in from the German Ocean when the wind is from the east. And Sir David Brewster meant that an easterly haur was on when he read the barometer.—Dens.

[61992.]—**Mushet's Steel.**—Special steel requires no tempering at all, merely forging as ordinary tool steel, and whilst hot must be kept from water.—H. Gilbert, Oxford-road, Sheffield.

[61994.]—**Prof. Rowland's Water Battery.**—Only useful for laboratory work. Won't run a lamp, if that is what "Boy" wants. How can I explain his questions if electrical terms are tabooed?—Electrician.

[61996.]—**Legal.**—The Agricultural Holdings Act extends to holdings over two acres, agricultural or pastoral; consequently, as the ground extends to 2½ acres, 12 months' notice will be required. (2) Yes, he can remove all trees which he has planted.—B.Sc., Plymouth.

[61997.]—**Moulding.**—He has to consider a good many points, involving more or less the whole ar of moulding. When a considerable area of a castin has to be faced, that usually affords sufficient reason for casting such portion downwards. When a casting has to be turned all over or bored throughout it is, as a rule, cast vertically. Hence plungers, rams, and cylinders are so cast. If they were cast horizontally, the metal would be more open or spongy on that portion which was highest in the mould, so that when turned or bored the grain would not be of the same texture throughout. But sometimes cases arise in which surfaces which have to be machined must be cast uppermost; as, for instance, where both faces have to be bright, Then special care has to be taken in running, either with a skimming gate, or by bringing in the metal at some distance away from any faced portions, or by casting head metal, either as a heavy mass or as a thickness of ¼in. or ⅛in. only to be planed or turned off, or by putting several risers on. Very much depends on the way in which the metal is poured; if the gates are badly proportioned, bad metal will flow in, and the same thing will happen if the pouring basin is not kept full of iron. The shape of the pattern, or the way in which it is made, irrespective of other considerations, frequently decide how a mould should be cast; so also does the presence of cores, or the kind of flasks which happen to be available, or the capability of the foundry pits, cranes, or other tackle, so that many considerations have to be regarded. Then, again, there is often a choice of two or three methods, and it is a matter of comparative indifference which is adopted. In fact, there are so many pros and cons. that, apart from special examples, it is almost impossible to lay down any general rules on the subject. By feeding is simply meant the supplying of molten metal to those portions of a mould whose mass diminishes rapidly by reason of shrinkage, hence feeders are termed "shrinking heads." If such portions were not supplied with hot metal to compensate for the loss due to shrinkage, depression and honeycombed masses would be the result. Even with careful feeding it not unfrequently happens that shrinkage holes form, and become apparent only on turning or boring. Hence its advantages. The disadvantages have mostly to do with the careless manner in which it is sometimes performed, rather than with the practice itself. Blowholes often form in the metal around the rod; but they are due to the use of a rusty or cold rod. Sand is thrust down, or cores shifted, if the rod is driven up and down regardless of their contiguity. There is really no disadvantage in the practice if properly done, and the only alternative is to cast tall and large riser heads on.—J. H.

[61999.]—**Force Pump.**—Your cylinder only contains ⅙cub.ft.; so, in order to get in 20c.ft., you would require to compress air 6 × 20 = 120 times. This would give a pressure of 120 × 15 = 1,800lb. per sq.in., which is nearly, if not quite, impossible. I should say your hair will be grey before you finish getting it in—unless you are killed outright first.—T. C., Bristol.

[62000.]—**Oleograph Pictures.**—Before pasting, wet the back of picture well, and it will dry quite free from blisters.—Picture-Frame Maker.

[62000.]—**Oleograph Mounting.**—Thoroughly damp the canvas, then stretch it well on an old drawing board, and tack it down all round; when dry, brush over with stiffish paste, which has been squeezed through a muslin rag to free it from lumps. Lay the oleograph, face down, on a clean board, and damp thoroughly with a sponge; mount in the usual way, and there won't be any blisters.—B.Sc., Plymouth.

[62001.]—**Hydraulic Machinery.**—Gain of power would be $\frac{78}{3\cdot25} \times \frac{\text{area of ram}}{\text{area of plunger}} = \frac{78}{3\cdot25} \times \frac{70\cdot88}{\cdot6013} = 2828$.—Elag.

[62001.]—**Hydraulic Machinery.**—Area of plunger $= \left(\frac{7}{8}\right)^2 \frac{\pi}{4}$, and of ram $= \left(\frac{19}{2}\right)^2 \frac{\pi}{4}$, and mechanical advantage $= \frac{\text{area of ram}}{\text{area of plunger}}$, and that due to lever $= 78 \div \frac{13}{4}$, so whole mechanical advantage equals these multiplied together; or $P \times \frac{19 \times 19}{2 \times 2} \times \frac{8 \times 8}{7 \times 7} \times 78 \times \frac{4}{13} = \frac{1802112}{637} P = 2829 P$. This is different to your figures, but is theoretically correct, so that 2682 must be an error, unless you assume a certain loss in friction; but allowance should be stated in question.—T. C. Bristol.

[62001.]—**Hydraulic Machinery.**—Let P be the power applied at a distance l from fulcrum, r the distance of plunger, a its area, b the area of ram, w the load, n and y the vertical distances passed through by P and w. Then—

$$Pn = wy \ldots$$

the displacement by plu

the vertical distance

displacement of ram is $y\,b$, and these displacements are equal; or—

$$y\,b = \frac{r\,n}{l}\,a \quad\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

by multiplying the two equations together, and dividing out by $b\,n\,y$—

$$P = \frac{r\,a}{l\,b}\cdot w, \text{ or } w = \frac{l\,b}{r\,a}\cdot P$$

and putting $l = 78$, $r = 3{\cdot}25$, $a = ({\cdot}875)^2\,\frac{\pi}{4}$ $b = (9{\cdot}5)^2\,\frac{\pi}{4}$, the result is—

$$w = \frac{78\,(9{\cdot}5)^2\,\frac{\pi}{4}}{3{\cdot}25\,({\cdot}875)^2\,\frac{\pi}{4}}\cdot P = 2829\tfrac{1}{16}\,P.$$

—G. H. H.

[62001.] — **Hydraulic Machinery.** — If I rightly apprehend "Student," the advantage here of the lever is 24, and for W = 2682 P, the power applied to lever must be $\frac{2682}{24}$; therefore, 2682 will be applied to small piston. The relative areas are 70·88 and 0·6; or, simplifying the figures, as 118 and 1. ∴ Pressure on large piston $= \frac{118}{1} \times 2682 = 141{\cdot}28$ tons. By the principle of the equality of work, let small piston descend 1in. or $\frac{1}{12}$ft., then 1 cubic inch of water will be forced under large piston, and it will be raised $\frac{1}{118}$ in. or $\frac{1}{1416}$ ft. Then work on small piston $= 2682 \times \frac{1}{12}$; then work on large piston $= W \times \frac{1}{1416}$ ∴ $W \times \frac{1}{1416} = 2682 \times \frac{1}{12}$, and W = 141·28 tons.—J. Q. D.

[62006.]—**Daniell Battery.**—

$Zn + OH_2 = ZnO + H_2$

$H_2 + SO_2CuO'' = SO_2Ho_2 + Cu.$

—ELECTRICIAN.

[62009.]—**Legal.**—You can't compel your neighbour to alter his ditch in order to save your wall from toppling over.—B.SC., Plymouth.

[62011.] — **Earthquake Predictions.** — Last autumn there appeared the "Seismic Forecasts" of '87 as an "earthquake year" in several London newspapers, quoting Delauney and Falb as to the periods and localities. The *Standard* has lately received some interesting letters from foreign correspondents on the subject. It appears there is a watch connected with a seismic observatory. The former stops before a shock. The message was telegraphed to places, "Earthquake at 9 a.m." It duly came! Had not that first and very severe one occurred during sleeping hours, probably the same timely warning would have reached the towns of the Riviera. In the same newspaper a wrathful correspondent, writing on the 9th March, complains bitterly of Falb's warning for that date having alarmed the inhabitants to no purpose; but it did occur on the 11th. Dr. Falb is now giving lectures on "Seismic Observations" to crowded audiences at Berlin, and we shall soon hear something scientific. The 22nd of this month and 7th April are forecasts.—EOS.

[62013.]—**Silica and Alumina.**—A portion of the clay is first freed from moisture by drying for several hours at a temperature above 100° C. About 1 gramme (15·43 grains) is then accurately weighed out; this is then fused in a platinum crucible with about 6 grammes of pure fusion mixture (sodium and potassium carbonates in equal quantities). The mass when cold is thoroughly extracted with distilled water; the insoluble residue is then filtered off and digested with hydrochloric acid until the evolution of carbonic acid ceases. The still remaining residue, consisting of earthly impurities, &c., is filtered off. The silica is estimated in the water solution by precipitating with hydrochloric acid, filtering, and washing. The precipitate is dried at 100° C., gently ignited in a platinum crucible, and weighed as silica (SiO_2). The whole of the alumina is contained in the hydrochloric acid solution, from which it is precipitated by the addition of excess of ammonia. The precipitate is filtered, washed with warm water (distilled), dried at 100° C., ignited in a platinum crucible, and weighed as alumina.—M. ISADER.

[62014.]—**Guttapercha.** — "One in a Fix" wants a material which will behave in a contradictory manner, and I fear will not be able to obtain it. He does not say what it is for, but if he cares to write to me (see Address Column), giving full particulars of what it is for, I will see if I can suggest any other remedy.—ELECTRICIAN.

[62015.]—**Engine and Boiler.**—I understand size of boiler to be 30in. by 21in. diameter. If this is correct, it is far too small unless driven very slowly, but should work a planing machine at 20lb. Are the valves set right?—T. C., Bristol.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Sm." has replied to 61625, 61628, 61629.

61385. Shunt Dynamos. To Mr. Eaves, p. 441.
61418. Irish Locos., 442.
61417. Midland Engines, 442.
61422, To Mr. C. E. Stretton, 442.
61427. Energy in Coal-Gas, 442.
61429. Calculation of Chemical Analyses, 442.

61641. Dynamo. To Mr. Conry, p. 531.
61644. Albategnius, 531.
61654. Sidney's "Arcadia," 531.
61659. Spiral Springs, 531.
61665. Portable Engine, 531.
61668. Walnut Veneer, 531.
61677. Steel Castings, 531.
61680. Pendulum, 531.
61683. Organ Music, 531.
61686. Tin-plate Creaser, 532.
61688. Condenser, 532.
61699. Electroplating, 532.

QUERIES.

[62018.]—**Horse-Power of Compound Loco.**—Can any reader kindly give me a simple rule for calculating the indicated horse-power of a three-cylinder compound locomotive; also I should like to know if it is true that the G.W.R. are building two four-cylinder compound engines?—J. G. H.

[62019.]—**Optical Lantern.**—What are lamp and what battery did Prof. Tyndall use for his American lectures on "Light," given a few years since in the United States of America?—AJAX.

[62020.]—**Incandescent Lamp.**—How can one tell, by testing, how many volts any lamp is intended to be run at?—AJAX.

[62021.]—**Liability.**—I occupy the unfurnished upper half of a house, at a three-monthly agreement with the tenant. Should the tenant fall in arrears of his rent or taxes, am I, in any way, liable? My rent to the tenant is always paid punctually.—W.

[62022.]—**Photographs.**—My prints, when first out of the printing frame, look bright and crisp, but after toning and fixing look quite flat and a bad colour. Can any reader explain this?—W.

[62023.]—**Dynamo for Gas-Engine.**—I have a one-man gas engine to which I have attached a small dynamo (made from Mr. Bottone's instructions in "E. M.") which I can run at 1,800 a minute. Shall I have sufficient power for this to charge accumulators to work a dental engine which is now worked from six half-gallon bichromate cells, the monthly recharging of which is a nuisance? —F. MASTERS.

[62024.]—**Torque.**—Will any electrical correspondents give details as to the torque of their motors in terms of radius of armature, and the force in pounds measured at the circumference of the armature? A few principal dimensions of the motors measured would oblige.—QUETTA.

[62025.]—**Evaporation in Boiler.**—If a boiler evaporates 9lb. of water per 1lb. of coal, at the pressure of the atmosphere, or 212° F., how much should it evaporate when the pressure is kept at 80lb. above the atmospheric pressure?—DUTCH PAUL.

[62026.]—**Steam.**—In our shop there is a boiler 12ft. long, 5ft. diameter; and a steam-engine—diameter of cylinder, 8in.; length of stroke, 18in.; the steam is cut off 3in. before end of stroke. Now on Saturdays the fire is totally drawn out 30 minutes before stopping, the pressure being 30lb. At the end of the 30 minutes there is still 20lb. of steam in the boiler. What I want to know is, where the steam comes from to keep the engine going 30 minutes without a fire?—A. FRASER.

[62027.]—**Black-Bronzing Brass.**—Can any reader of the "E. M." kindly tell me how I can black-bronze the eyepiece, edge of reflector, object-rack, and rotating disc of a microscope? I have tried size black without success. It would require to be something that would not affect the lens in the eyepiece.—MICROSCOPE.

[62028.] — **Recovery of Mercury.** — I have regularly to reduce a quantity of chloride of gold with nitrate of mercury. I am at present obliged to use a fresh quantity of quicksilver each time to make this nitrate from. The quicksilver remains, of course, in the solution after the gold has been removed; and I wish to know the best way to recover this, so as to be able to use it again for the next lot without having to employ a fresh quantity of quicksilver. I have tried to precipitate with soda, and dissolve the resulting oxide of mercury with nitric acid; but this is both troublesome, and the nitrate obtained in this way does not give the same result as that obtained from the metal direct. I have also tried throwing zinc scraps into the solution; but I can only get back about half the quantity I originally made use of; besides, it is very difficult to get this quicksilver quite free from zinc, and this is very objectionable. Could any of the able readers of the "E. M." help me by describing a way by which I can get back all the quicksilver in a pure state?—O. B. O.

[62029.] — **Resistance of Armature.** — When speaking of the resistance of an armature of a two-pole machine, do you measure between the brushes? and, if so, will the resistance be ¼ of the entire circuit of coils?—SHORT CIRCUIT.

[62030.]—**M. R. Engines.**—Could any reader give me principal dimensions of the M.R. 1,552, 1,700 (goods), 1,472, 1,492 (passenger)?—F. HOLMES.

[62031.]—**Marbled Paper.**—How is the m done which we see on the covers of books some different coloured veins and spots? Will any knows kindly give a description of the manipulati the materials used?—O. B. O.

[62032.]—**Iron Turning.**—I recently had a fe to turn. The castings were 7in. long and 7in. dia., to be reduced to 6in. dia. in an engineer's 10in. cen acting lathe. They were mounted on a 1½in. mand long. By how much would a practical engine turner have reduced the dia. at each cut, and wha feed would he have used? I did it with three eq with a feed of 36 turns of mandrel for 1in. travers riage. Was this heavy or light cutting? For t job I had a shaft to turn; it was a piece of old shafting, 2½in. dia., 7½ft. long, and had to be red 2in. dia. I meant to do it at one cut. I turned 2in. as much at end to get backstay carried by applied, and started tool, being before stay; but time I got to the middle, my work was exceedi from round (circular in cross section), although t distance I turned at end for stay was right, and not have been the iron, as some turner had made job of it before. What was it, and what would ha a proper rate of feed for this job? I used 36.—V

[62033.]—**To Mr. Wimshurst.**—I have, a whole winter evenings' hard work, just finished one compound influence machines, with eight 15in exactly the same as described in the "E. M.," Oct. I have followed out the details there given most c and have succeeded in making a very fine strong m and in every way satisfactory, as far as finish an manship go. As it is the first machine without j I have made or seen, I wish to ask a few questions the machine will start working without the s coaxing, and there seems abundance of electricity point in the combs and brushes; but I cannot spark at the balls of the discharging terminals. my finger within ¼in. of either of the balls there i tiny spark leaps to it. I am quite sure there is metallic contact in all parts. The upright rod is in a thick glass tube, with its ends projecting ¾in. think there is any leakage caused by the termi touching the wooden ball at the top of the glas Shall I have to get jars connected to get the brigh ing spark? If so, how many, and where are th connected, and what size? I find the sectors wil their charge for over five minutes after stopping. sume that to be a proof of the discs being of good glass. Any assistance you can give me will be th received.—J. R.

[62034.] — **For Aperture and Magn Power of Telescope.**—Can your esteemed spondent, "F.R.A.S.," or any of my fellow-read me to any published data bearing on the following The magnifying power which an object-glass quality will bear is commonly stated to be propo to its aperture, and the rule, no doubt, holds goo very wide range of apertures with the air in such as to afford first-class definition. Unfortunately, h this condition of the air but rarely occurs, partic the neighbourhood of large towns, and to those w to make their observations in such places it is a of much interest as to how far they may probably to realise the benefit theoretically due to incr aperture. For instance, under favourable co thoroughly good object-glasses of 4in., 6in., a aperture may be expected to bear powers of 400, 6 800 respectively; but on a night when the state atmosphere was such that 200 was the highest powe could be effectively used on the 4in., would the 8in. bear powers of 300 and 400 respectively, or wo be also limited to a power of 200, or a little over? as I have been able to test the points by the use in a 4in. Cooke's refractor of excellent quality, th effectively available under the conditions abov does not increase in anything like the proportion aperture. I should, however, be much obliged i the readers of the "E. M." can refer me to furt derived from experiments on telescopes of larger a —M.

[62035.]—**Bellows.**—I have to make a nu bellows for a pneumatic action, very similar to t for operating organ keys. As I am absolutely experience in bellows making, I would be grateful assistance. The following are the data: (1) The are to act by exhaustion (not pressure), and the m degree of exhaustion will never exceed a pressur per sq. in.—that is to say, the pressure in the p exhausted receiver will never fall lower than square inch below the pressure of atmosphere. bellows for producing the exhaustion are 6in. with a stroke of 1¾in. They will consist simply and bottom board of pine, 7-16in. thick, and by a parallel motion the boards will always be parall The bellows to be operated by the vacuum will 8in. by 1½in., and hinged at one end. Wood, ¼in. throw at end, ⅜in. The points upon which especially seek help are the following: (*a*) Proper leather, as I have a number to make. Cost is a co tion, though not by any means the chief one. T bellows will, I think, require much thinner leat the large ones. (*b*) How to join the leather—whe stitching, gluing, or both? (*c*) How to attach —whether by glue or tacks? (*d*) Proper mate hinges of small bellows and for valves of large bel know how to fold the leather at corners.—GLASW

[62036.]—**Power of Engine.**—I have a smal slide-valve engine, 1in. bore, 2in. stroke, 12in. f Could you tell me if that size gives out 1-man-pow not, what power can I get from it? I want it to very small dynamo, 15c.p. Could you tell me w boiler to make for same? To be made of copp about 16-wire gauge, with one central conical t if that gauge will stand pressure enough to work say what pressure I have to work at, boiler to be or seamed?—J. H. R.

[62037.]—"**Pity the Sorrows of a Poo Man.**"—Who was the author of the verses know above title?—TYRO.

[62038.]—**Brass Foundry.**—To "J. H."— amateur moulder, I have always had trouble in cores, they being more or less broken in removi box, evidently caused by sticking. To prevent

.tly oiling core-box, also damping and dusting dry sand ; but with no better result. The points know are about how wet should core mixture be, ns are taken to prevent sticking, and may the thdrawn from core immediately after making ? at diam. should runner pin be in cases shown on ast volume ?—CICERO.

—**Electrical.**—What is the best mode of ıg the medulla oblongata ? Where should the laced ? Would it be sufficient to place a large nnected with the positive pole on the head and the hands a brass rod connected with the nega- '—CAROLUS.

—**Electro-Motor.**—Can anyone inform me cost of a 1-man-power electro-motor ? Also best number of batteries to be employed, and cost per orking same two hours daily ?—CAROLUS.

—**Dynamo Coils.**—What size and quantity hould there be for shunt and series coil of a whose armature is wound with 16 coils of No. 18 each coil having 16ft. of wire ? — SHORT

—**Soldering Fluid.**—Will someone kindly ıe what I can do to prevent the fumes from of zinc when soldering ? As I have a good deal solder in my trade, I should esteem it a favour ıe could help me to overcome the horrid fumes ways seem to give me a very bad cold, and st, I think, be injurious.—C. L. S.

—**Stains in Macintosh.**—I have a light which has been stained with the dye out of waterproof driving apron when wet ; the stains d yellow. Will someone kindly say if I could do to get out the stains ?—C. L S.

—**Dissolving Amber in Chloroform or** l someone kindly give me some information on subject ? I have tried numberless experiments, ut the least success. "Chloroform varnish" is scribed as a solution of amber in chloroform, 'o varieties in commerce seem to be simply this, r will not dissolve in chloroform, but floats on ıd remains unchanged. The formula for oil nish is thus given in all the books I have seen : amber in an iron pot and add the oil heated to emperature." This sounds easy and simple, only, ber will not fuse ; it first swells and softens a then frizzles up like ham, and then blackens or ı. Yet these varnishes are made, for the hers could, some years since, always buy the roform varnish ; I have used lots of it. Then the re supplied with a very thick amber varnish of chloroform, whilst oil amber varnish is for artists. It is pretty clear to me that there ay of preparing the amber first, but so far I have any process make it in the least degree soluble.

—**G.W.R. Engines.**—I should be obliged if uld supply me with a few dimensions (especially l base giving centres) of No. 3,501 class, new ge tank engines. Also of No. 2,007 type, 7ft. 6in. ress engines ? These 2,007, 2,014, are like the footers ; but on a smaller scale. They belonged stol and Exeter Railway.—CLYDE.

— **G.W.R. Broad - Gauge Goods** s.—Can Sir O. H. P. Scourfield, or any other lent, inform me how many engines there were ı" class, and, if possible, their names and dates. r.

—**Waterwheels.**—Will some of our readers is the best speed for a wheel 18ft. broad, eter, 14ft. fall. At present the wheel runs five minute, or 4¾ft. per second, nearly, with water. Would it be better to run it faster ?—

—**Boiler - Plate Furnace.**—Can any of rs furnish me with a sketch of a boiler-plate urnace, about 20ft. long, and 10ft. wide, to be coal fire ; also say if there is anything better ay for building same. I am desirous of making ould be got hot in about an hour with common .—R. SMITH.

—**Antidote for White Lead-Dust.**—My carriage-body maker causes me to inhale a quante-lead dust, which gives me indigestion, and great suffering. I have been under medical but with no beneficial result. I shall be glad our numerous readers who may have similarly ould inform me of any antidote or remedy against ous effects of the dust, and feel grateful for any n ?—R. DOBSON.

— **Circular Arcs.** — In Templeton's r's Pocket Book," a table of circular arcs, whose ty, is given—that is, the chord being considered the versed sine (height of arc) being given, the he corresponding arc is indicated ; but the table omprehend arcs of which the chord being unity, sine is less than ·1. Will someone kindly inform I can find a table in which the versed sine, arc are tabulated down to, say, versed sine hord, or such table in which the versed sine is erms of the arc ?—LEVALTON.

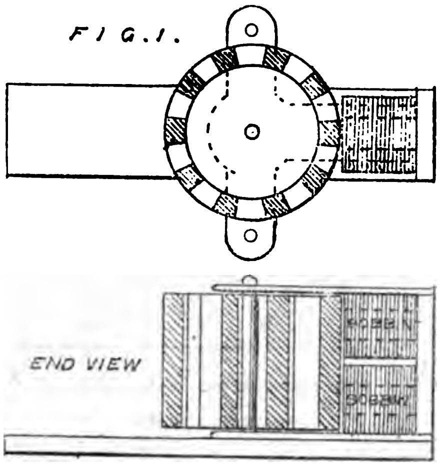
—**Bending Brass Tubing.**—What would way to bend straight lengths of 12ft. treblettss tubing, 1-16in. thick, into right-angle sweeps, ? In bending of these tubes, they must be ridges (this is a most important part), and the st be exact. What means must I adopt to get a -angle sweep ? Must they be loaded, and with rial ?—G. H., Bristol.

—**Dynamo.**—I intend using a single vertical r use with the 30-light dynamo described by Mr. 'ol. XLI. I should be obliged if you would give s of the magnet (length, breadth, and thickness).

—**Engine.**—I should esteem it a favour if istol," would oblige me with the dimensions of to indicate 5H.P, working at a pressure of 80lb. ıg 200 revs. a minute. What should be the dia. t, the dia. of the flywheel, and the dia. of the ? What sized boiler would be suitable for the ne ?—H. H.

[62054.]—**Electric Motors.**—Would any correspondent kindly assist me ? I have two motors, one with wheel 1⅝in. diameter. 1⅝in. wide, and 10 armatures, and the other with wheel 3½in. diameter. ⅝in. wide, and 14 armatures ; but they are of different arrangements. The smaller one has two magnets side by side, and both attract the same armature at the same time. This motor, Fig. 1, runs beautifully, but has not sufficient power ; the other one has the two magnets set at right angles to axis of wheel, and each magnet acts on separate armatures (as shown) ; but this one, Fig. 2, does not work well, making only 70 revolutions per minute, and I want about 300 revolutions. The coils on this one are much larger than the other, but the current does not seem to pass through. I work them with a four cells (quart) bichromate battery. A little advice on this subject will be very thankfully received.—A. J. P.

FIG. 1.



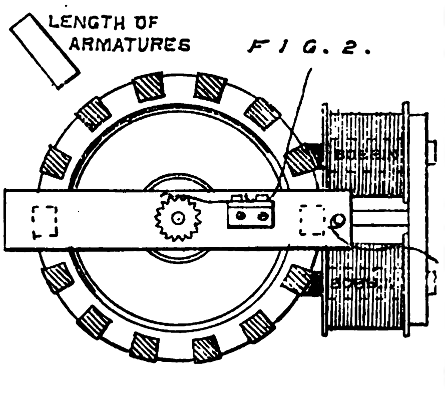


FIG. 2.

[62055.]—**Musical Clock.**—I have a small peal of hand-bells in the key of C, which I think of fixing in a case similar to that of a long clock-case, the bells to hang in four rows of three each, the small bells being at the top, the pendulum to swing at the back of the bells. Would any kind reader give me instructions how to spike the chime barrel for three or four easy tunes ?—J. W.

[62056.]—**Organ Bellows.**—Will someone tell me how the corner gussets are made to sit, as I find a difficulty in making them fit in the angles of inside folds and on the corners of outside folds without cutting ?—H. D.

[62057.] — **Photographic.** — TO S. BOTTONE, OR OTHERS.—Can anyone who has tried orthochromatic photography tell me the cause of my failure ? I dipped some ordinary plates in a solution of erythrosine and silver, as directed a short time ago in the "E. M.," and when, after exposing the plate, I developed it, not a vestige of orthochromatic effect showed itself, the only difference from an ordinary plate being that this one was dyed of a red colour all over.—ORTHOCHROMATIC.

[62058.]—**Ornamental Table-top.**—I intend to lay pieces of wood, 1-16in. thick, of an irregular shape, to form a design on a perfectly level table-top. How am I to cut these pieces to fit each other, and, after fitting, how can I French-polish same ? I have a well-made top, and wish to use up the ornamental wood in this way. Any particulars will be most welcome.—U. C.

[62059.]—**Brattice Cloth.**—Would any reader kindly say process and what mixture is used to make Archangel tarred brattice cloth, backed and unbacked ? Also say the best sort of rolls to use, and any other information in connection with same ?—ENQUIRER.

[62060.]—**Solidified Oil.**—Can anyone give instructions how to make solidified oil ?—STUDENT.

[62061.]—**Lining Brasses with White Metal.** —TO "T. C., BRISTOL."—A few practical hints would be thankfully received as to the best way to fill up worn brasses, eccentric straps, and others ? I cannot get the mandrel to leave the white metal, and in getting mandrel out often break part of metal with it.—LANCASHIRE.

[62062.]—**Dynamics.**—A series of tubes of infinite length slide one within the other. Their weights are proportional to the product of the radii and thickness. Each one is in contact with the adjacent tubes over a length h ; the normal pressure of contact is p per unit surface, which surface is such that a force c is required to act parallel to plane to move a pressure of one unit with a velocity of unity per second. Supposing the outer tube to be fixed vertically and motion to commence in the remaining tubes at the same instant, what is the state of motion at any instant afterwards ?—G. H. H.

[62063.]—**Wheels and Axle.**—A while ago, I asked through these columns how to make a good cart-wheel, and also how to fix the arms so as to run well afterwards, but am sorry to say that no one replied to the above, but referred me to some back numbers that had appeared before I commenced taking the "E. M.," so I am still in the same fix. Would any kind reader help me out of my difficulty, as I want to make them by hand ?—A NOVICE.

[62064.]—**Lathe Matters.**—Will some of our lathe correspondents please say if a flat pitch chain could be used as a cheap substitute for back-gear in a foot-lathe ? I find I could reduce speed to seven or eight of crank shaft to one of mandrel and chain could not slip. Has anyone tried speeding up the flywheel of a lathe five or six to one of crank-shaft, similar to Britannia Co.'s circular saw ? If so, should be glad to hear result.—H. M. D.

[62065.]—**Micrometer Indicator for Drilling.** —In describing a lathe in the "Metal Turner's Handybook," it says : "The boss of the hand-wheel (of the poppetheadstock) carries an adjustable sleeve for indicating the exact advance of the centre, forming a gauge in drilling." Would some fellow-reader kindly oblige by giving particulars of the arrangement, and, if possible (with the editor's permission), a drawing of same ?—H. EVENS.

[62066.]—**Kepler's Third Law.**—In a footnote to page 7 of Proctor's "Saturn" is the following : p and P, a and D, being the periods and distances of two planets ; then, by Kepler's law, $p : P :: d^{\frac{3}{2}} : D^{\frac{3}{2}}$. Is this proportion found by extracting the square root of each term of the following proportion, which is the simpler expression of Kepler's third law : $p^2 : P^2 :: d^3 : D^3$?—T. S. S.

[62067.]—**Astronomy and Mathematics.**—The querist desires to make the acquaintance of the higher mathematics as applied to astronomy. Presupposing such knowledge of Euclid, algebra, plane trigonometry, statics, and dynamics, as can be acquired from textbooks like Todhunter's, will one of your accomplished correspondents kindly suggest a course of reading adapted to one who has no access to a teacher ?—T. S. S.

[62068.]—**G. and S.W.R. Engines.**—Can "G. and S.W. Fitter oblige with dimensions of new 79 class bogie engines ? How many are there, and what are their numbers ? Which engine was fitted with Morton's valve gear on this line ?—G. H. F.

[62069.] — **To Mr. H. Austin.** — Referring to "miniature battery," you say, "fill the corners with grain manganese peroxide." What advantage (if any) would there be in using equal parts of crushed carbon and manganese peroxide (as in the ordinary Leclanché cell) in lieu of all the latter ?—DEPOLARISERS.

[62070.]—**Cleaning Heads of Wax Figures.**—Can you give me any information as to cleaning wax dolls' heads ? I have a very large quantity, and have tried several methods. My greatest difficulty is after having washed the face, I cannot then get the powder or rouge to stick on. The question is this : How is the wax head coloured after having been taken from the mould ? —J. KEMPT.

[62071.]—**Boat Carriage.**—Can any of our readers give me an idea of the best kind of carriage to take small boat across a sandy beach, when the tide is out I have about a quarter of a mile to drag it. I had a four-wheeled carriage for it with broad wheels, but it still sank in the sand ? Any information will much oblige.—JOINER.

[62072.]—**Gulletting Circular Saws.**—In gulletting circular saws with the emery wheel, that does not cut away the steel as it ought to do, burrs the teeth, and makes some of them so hard that they strip the files. I have seen a liquid used on the wheel which prevents all this. Can any of your numerous readers kindly tell me how this can be made ?—E. J. M.

[62073.]—**Gold Ores.**—Can any brother metallurgist inform me if gold ever exists in its ores as a sulphide ? I know it is often said to exist as such by directors of companies, mining engineers, &c., but I have doubts on the subject. Free gold might, no doubt, be protected by a coating of iron pyrites, and thus escape the amalgamation process. If such is the case, can anyone suggest a process by which such "pyritous gold" may be determined apart from the free gold ?—A METALLURGICAL CHEMIST.

[62074.]—**Locust Bran.**—Any information respecting grinding this article would greatly oblige ; also names of makers of the machinery necessary. Communications will be forwarded if addressed as advertised in the Address Column.—NEW ZEALAND.

[62075.]—**Pepper.**—I want to put up machinery for decorticating, dressing, and grinding peppers. Is there any book published giving information on same ? Any wrinkle from readers of "ours" will oblige.

[62076.]—**Salt of Mercury Solution for Cell.** —Will anyone inform me the strongest solution of a salt of mercury that can be made for use in a single-cell battery either alone or in conjunction with another salt, which will act for some time without polarising ; also how the Schanschieff solution is prepared ? I find sulphate of mercury, even when sulphuric acid is added, very sparingly soluble in water.—OWN.

[62077.]—**Electrotyping.** — Having certain ornaments, I want to reproduce them by means of electricity, the copper depositing to a certain thickness on the ornament, giving a kind of mould. Could any reader inform me what material to use, and which batteries are most suitable for it, and how to proceed ?—A. K. H.

[62078.]—**Working in Sheet Lead.**—At one of the stalls in the Architectural and Building Trades Exhibition at the Agricultural Hall, there is a remarkable piece of lead work, which I may describe by representing it as the bottom or cone shaped portion of a vertical drainpipe, into which several horizontal branches enter with in some cases vertical branches entering them. It is stated, and I saw no reason for doubt, that the piece has been worked out of a sheet of lead without seam, solder, or burning. Can any reader describe how such work is done ?—PLUMBER.

[62079.]—**Paste with Acids.**—Can anyone kindly explain precisely what the action is, chemical or otherwise on account of which nitric or acetic acid or alum is added to paste.—L.

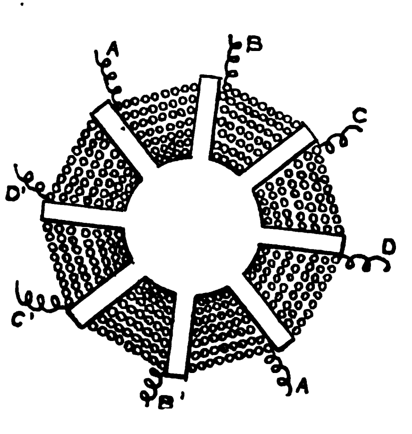
[62080.]—**Hoisting Crab.**—I saw a crab with patent brake (Tangye's); but the latter being boxed in, I could not see its action. When using it, the pawl and ratchet was always left in gear, whether the load was being raised or lowered, and the load had to be lowered by turning the handle, and if the handle was let go, the load stood still. Would someone kindly make a sketch showing action of brake? When the pawl was raised, the brake did not act.—G. M. S.

[62081.]—**Medical Battery and Coil.**—Will anyone please inform me the best solution to use for chloride of silver battery—the sizes of wire requisite for coil of about 3in. length—whether they should both be silk-covered, and how much of each? Also whether there is any other method of applying the current besides wetting the sponges to avoid the sensation of pricking to the skin?—W. BLACK.

[62082.]—**Exploding Gas-Burners.**—Can any scientific reader explain the cause of a peculiar occurrence that happened in my office a few days since? I have had, for 7 years past, an Argand gas burner with chimney in regular use. The other day, before my office was opened in the morning, an explosion resembling a pistol-shot was heard by a caretaker on the premises, which report apparently proceeded from the office, and on the door being opened, the chimney of the burner referred to was found completely pulverised, some portions of the glass being blown into another room adjoining. The gas had been turned out as usual the night before. I should much like to know the cause of this chimney, after being in use so many years, exploding like a "Prince Rupert's drop."—AN OLD SUBSCRIBER.

[62083.]—**Speed of Waterwheel.**—I have a stream passing about 2,000c.ft. per minute over a 15in. fall in which I have placed an undershot waterwheel 11ft. dia., 10ft. wide. Will some of our practical readers kindly inform me the speed the periphery should travel to give the best result?—OLD SUBSCRIBER OF 20 YEARS.

[62084.]—**Siemens Armature.**—I have just made a Siemens armature for my dynamo, and have wound it with four coils, something like this: A A being the ends of one coil; B B the ends of the next, and so on. I wished to connect up the ends to a commutator in the same way as in the large Siemens dynamo, if that were possible; if not, can any reader suggest a method? Also, what current ought I to expect from it? The armature is 2½in. in diameter, and about 5in. long, and wound with about 1½lb. of No. 20 silk-covered. The magnets are wound with 9lb. of No. 16. Could I connect each coil to an ordinary two-plate commutator and thus have four commutators and four pairs of brushes?—NO SIG.



[62085.]—**Electrical.**—I have an ammeter and a voltmeter by the Consolidated Electric Company, expensively made and finished, but which appears to want calibrating with a single bichromate cell. The needle of voltmeter is deflected to 22°. Will Mr. Bottone, or some practical man, inform me what resistance coil should be used to make it read 1·9 instead of 22? With 16in. of two immersed plates of carbon, or 64in. of exposed surface in a strong bichromate solution, the needle of ammeter was driven up to the stop.—OWN.

[62086.]—**Legal.**—Having purchased a leasehold house from a firm of builders (my property commencing from the front railings). I find that the builders kept a piece of the ground (out of the original lease) in front of my property to themselves, part of which has been taken up for pavement, and the other part has been given to the parish by the builders, in return for the parish making the pavement. The builders have now come on me for payment for the pavement in front of my house. Am I liable?—H. W.

[62087.]—**Fishing Lines.**—Can any reader inform me as to the best means of waterproofing the above? I have tried several recipes, but have found them all useless when subjected to friction through the rings of rod in fishing with the Nottingham reel.—AQUA.

A METHOD of producing a screw or bolt, which is adapted to receive a nut, having either a right or left-hand screw-thread, consists in forming a blank having two opposite arc-shaped portions and intermediate flattened portions, in cutting a thread upon such blank, and in subsequently chamfering portions of the thread by means of dies.

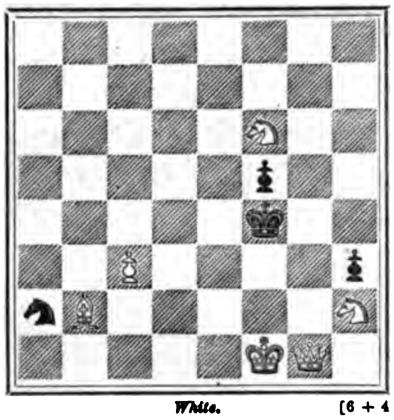
Metal for Bearings.—To make lining metal, melt in a crucible 1½lb. of copper, and while this is melting get a big ladle and melt 25lb. of tin and 3lb. of antimony; heat it red hot, and pour the two together, and stir till thoroughly mixed.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXXVI.—BY G. J. SLATER.

Black.



White. [6 + 4

White to play and mate in three moves.

SOLUTION TO 1,034.

White.	*Black.*
1. Q-R 3.	1. K-B 6 (*a*).
2. Kt takes P (ch).	2. K takes B.
2. Q takes P, mate	
2. Q-B 5, &c.	(*a*) 1. K-K 6 (*b*).
2. Kt takes P (ch), &c.	(*b*) 1. P-Kt 7 (*c*).
2. B takes R (ch), &c.	(*c*) 1. Kt moves.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,034, by Link, E. C. M. (Ipswich), W. Hewson-Kilbee, T. H. Billington, Major, A Beginner, F. Krasser, V. S. Pochin, H. Hosey-Davis, J. Mackenzie, and Cotswold; to 1,033, by T. H. Billington, V. S. Pochin, H. Hosey-Davis, Country Boy, Hensing, Snowdrop, J. Palmer, and Avon; to 1,030, by L. C. Wadsworth (Canada).

L. C. W.—It was pointed out in the next number that the B P at K R 7 should be a B B. In 1,029, you have overlooked that if 1. $\frac{\quad}{\text{Q takes B}}$ the W K is in check.

ROLAND OLDHAM (Dublin).—1,033 is a two-mover.

A. FLAWN.—In 1,034, if 1. $\frac{\text{Kt-K 2}}{\text{K takes B}}$, 2. $\frac{\text{Q-B 5}}{\text{R takes Kt (ch)}}$.

A. DEAN.—In your attempt at 1,034, how do you proceed if 1. $\frac{\quad}{\text{K-B 6}}$?

MAJOR.—The other solutions are 1. R takes B (ch), 2. Q takes P, 3. Q-B 7, and 4. Q-K Kt 8.

BLACK PAWN.—Thanks for the two problems; they shall be examined. Of course you score full marks for the others.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 23, and unacknowledged elsewhere:—

BLAKEY, EMMOTT, AND CO.—R. E. Phillips.—A. J. Herbert.—Chas. Birchall.—King, Mendham, and Co.—D. G. —J. McG.—Edinon.—Phonoscope.—Quæsitor.—Joiner. —Vincent.—Oak Green.—A Country Parson.—H. Austin. —G. Ralph.—E. E. Vaughton.—Electrician.—J. Q. Gubbins.—Philip Vallance.

G. G. (Directions for making electric clocks in Nos. 1083, 915, 920, 895; but all except first out of print, and of that only a few copies are left. An electric clock was described so recently as p. 297 of the last volume. You might be able to obtain some of the above numbers from Mr. Sladen, Cank-street, Leicester.) —FRENCH MEASURE. (We do not know of any easily-worked formula. It is a matter for experiment, especially as the metal is not specified. 2. The decimals of such fractions are written by placing the decimal point in front of the numerator—thus, ·1 means 1-10th. If
that is not what you mean, procure a copy of t
gauge.)—AMETURE. (To amalgamate batter
see pp. 82, 397, last volume. Clean the zinc wi
solution of soda, immerse it in dilute sulphuri
in 10) until the acid bites well, then withdraw
well with pure mercury. The necessity for r
will depend on the use made of the battery,
care taken with it; but reamalgamation must
formed when the zincs exhibit a grey granular
—J. M. C. (The reason is very simple. Teleph
the subjects of several patents.)—A. F. (Th
been so many articles on electro-plating that w
pretend to remember the special one referred t
is a letter having that title in No. 519. Possib
what you mean—especially as the directions gi
with those you send.)—SPEED. (See what
said about them in earlier volumes. Replies t
query might come from those interested in se
machines. As a rule, price is a guide.)—A. B. (
iron is malleable; but there is also malleable c
—S. C. D. (See "Blueing a Revolver," pp.
Vol. XLIII. The blue on the specimen sent is
heating the articles. The other kind of blue i
coloured lacquer. See indices in back volu
read Hint No. 5 above.)—JUMBO. (Iron will w
the action of mercury; but most of the oth
known metals amalgamate with quicksilv
fusing temperature of metals can be found in
the textbooks.)—JOHN THOMPSON. (Procure
sition form from the secretary of the society,
ton House, W., and get it filled up. The ques
answered on p. 267, last volume.)—GUILLAU
(You will see in our columns what has been
present, very little. There are several electr
lamps in the market. We suppose the greate
culty" is the expense.)—AMPHION. (It
whatever it was intended to mean, and we
know what that was. We should read i
farthings and half a farthing; but it
fusing to mix up fractions and decimals i
manner.)—C. (Alum, tungstate of soda, an
other things. See indices for fireproofing solu
REGULATOR. (The only way is to apply to th
intendent or inspector at the locomotive sheds
he usually has a number of men who have w
cleaners, and are anxious to get on to the f
your chances of success are rather remote.)—
NEAVE. (Answered many times. One part
solved in as little water as possible, four parts g
and as much whiting as is necessary to colour.)
TICAL. (We think there is a work on the sub
lished by Mr. L. U. Gill, 170, Strand, W.C.;
is a good deal about the practical work
volumes.)—CONFECTIONER. (Lemon-juice an
will answer for one; but we never heard of
which is a dry powder, being made in the f
syrup. There are many recipes for drinks of
in back volumes.)—L. C. V. (A similar q
already been inserted. There is a descriptio
form of the Herz telephone in No. 831.)—L. W
(No space for paradoxes at present.)—X. (Th
cuticle with a core or pith, as it may be called;
because of the locality. See indices.)—PRINT
not understand you. Use more varnish, or ad
copal.)—TUNNEY. (Any good piece of leather-
a bit of buckskin belt—will do; or you can gl
of good calf on a bit of wood.)—R. H. C. W. (
no "best and cheapest way." Warm the arti
almost too hot to hold, and then coat with th
lacquer, using a flat camel-hair brush, and bein
not to go over the same place twice.)—EMM
(It is entirely a matter for private arrangeme
should have a proper agreement, and see that i
stamped.)—CARBO. (See No. 781, or No. 894,
trations of the Blake transmitter—the form
used; but there are many others described
numbers.)—DANDIE DINMONT. (Surely you k
the fees payable for foreign patents were s
length in No. 939, p. 62. In the U.S. the sta
£7 17s. 6d. for 17 years. In Canada, term varies
being granted for five, ten, or fifteen years, and
are 20dols., 40dols., and 60dols. respectivel
SUFFERER. (You want more fresh air. B
Medical Column in the *Weekly Times and Echo*
(Any good paste. See indices. 2. As to fixin
to harmoniums, you will find suggestive illustr
Nos. 908, 605, 606, 609, and many other back num
A YOUNG BEGINNER. (With emery and oil on fl
or by grinding in machine.)—JOHN G. HATCHA
varies with the quality of the coal; but it may
as 15,000 units, and 15½lb. of water per pound
See p. 17 this volume, and any textbook on th
engine.)—T. W., Caergwrle. (Equal parts.)—
(See any textbook on electricity and magneti
an examination question.)—FORGE. (Acetic
acid; but the emery will fly off if the belt
used.)—ONE IN PAIN. (Better let a surgeon
hands. The case is not one of ordinary "cha
there is some special cause for such cracks.
TEES. (If your white flannel cricketing shirts
red at the armpits, you should consult a medi
and ask him to examine the white substance l
which forms on your coats.)—P. A. RANSOM.
are some published; a few special sections in
columns; but you can easily ascertain on ap
to the engineer of any railway whether sect
procurable.)—C. O. (Depends on the design
injector and the arrangement of the parts at
2. Proportion of carbon, which should be la
small quantity of ash.)—W. W. (Watch the dis
—A. E. J. (A commonly used composition is
gypsum and alum; but some use Epsom sal
alum or the salts give up their water of cryst
when subjected to heat. 2. The "Amateur Wo
commenced in No. 1055.)—L. (It will be foun
course in the *Transactions* of the Royal Society;
author may possibly have a spare copy in roug
—GWADUR, VIA KARACHI. (Thanks. We will
it, and insert when we have more space.)—
(The series of articles on "Pattern-Making,"
appeared in sundry numbers ranging from 938
were issued in book form by Crosby Lockwood
price 7s. 6d. There is also the "Pattern-
Assistant," by Joshua Rose, an American wo
can probably be had of Sampson Low and
other works see the list published by Mr. C
your own city.)—VIR SAPIENTIÆ. (See
No. 1064; or Bancroft on "Tall Chimney Constr

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 1, 1887.

MICROSCOPICAL ADVANCES.—XVII.

By DR. ROYSTON-PIGOTT, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians; Fell. Cambridge Phil. Society; formerly Fellow of St. Peter's College, Cambridge.

Diffraction, Ancient and Modern.

THE phalanx of philosophers who have devoted themselves to this department of science enrols the most distinguished names on record for nearly 250 years. But it was not till nearly 200 years that a man appeared competent to unravel this strange mystery in light.

About 1640 Grimaldi wrote 1,000 columns of elegant Latin, giving many diagrams. Hooke soon afterwards gave a fine paper, which touched the key of the position; so did Newton and Huyghens. Young, the brilliant secretary of the Royal Society, now hit the gold centre of this most difficult target. Fresnel, Fraunhöfer, Airy, Herschel (nor should I omit the name of La Grange, of Turin), Potter, Lloyd, Brewster; then arose Stokes, Helmholtz, and a host of others. All these laboured incessantly to solve the diffraction mystery. The materiality of light and its emission theory were abandoned for a luminiferous ether perfectly elastic, penetrating all bodies and all space with inconceivable force and rapid undulations.

The undulatory theory of light was established by innumerable experiments and facts, and not among the least are those displayed by diffraction phenomena.

Wollaston was the very first to discover the black lines which cross a very pure solar spectrum. But after him Fraunhöfer examined them with such philosophical care and refinement that they are now generally called by his name.

Three orders of lines can be produced. First, those arising from the solar spectrum; secondly, interference; and thirdly, diffraction spectra. The second and third are often mixed up together.

In using telescopes, most beautiful varieties of diffraction spectra can be obtained by applying various discs and annular apertures to the object-glass, provided a brilliant but minute pencil of rays can be observed at some distance. I have employed the leisure hours of many years in watching these things. A small 1¾in. telescope of superb quality (by Tulley) enlarged a star disc with perfect equality on both sides of the best focus with scarce any diffraction.

The better the glass the thinner and more delicate were the diffraction rings round a star. I have a magnificent glass of 3¼in. by Steinheil, of Munich, which renders the diffraction rays so delicate and few as almost to escape detection. It is the same in the microscope. An object-glass made for me in 1862 by Powell and Lealand produced one large broad brilliant diffraction ring. The same glass gave a bright blurred outline to carry insect scale. This marginal brilliance was always ascribed to unavoidable (!) diffraction—a most convenient term for unexplained phenomena.

That the number of diffraction rings is dependent upon interference phenomena, caused by overlapping cones due to spherical aberration, is fully demonstrated in my paper on "Circular Solar Spectra." In the foci of a plano-convex lens exposed to a minute cylinder of sunlight, I have counted no less than 48 magnificent rings. These all gradually diminished in number as glasses of less aberration were employed, until at last, under a very perfect glass for forming miniature images, they were actually reduced to two or three under 1,000 diameters. Colonel Woodward accurately described the diffraction lines seen outside the margins of a gnat scale as follows:—

"The longitudinal diffraction lines are clearly seen alike in the microscopic image and in the photographs to extend into empty space beyond the contour of the scales, almost as far as the ends of the bristles in which the parallel ribs terminate."*

He noticed, also, that they increased in number as solar light was more obliquely used, though passed through a strong blue solution of copper to produce homogeneous blue light.†

The diffraction lines generally follow the contour of the object. If straight edges are viewed, the lines are straight; if circular discs be observed, they are also circular. Brilliance is necessary for their complete development, and a very small cone of light.

The size of the bright rings and dark ones has been elaborately calculated by Sir G. Airy on the basis of the undulatory theory of light; but no explanation has been found for their variable size in large and small stars. In every case where the brilliance is subdued these rings begin to fade. Thus when clouds pass over Arcturus, the rings all disappear, and even his disc diminishes to a point.

In all the old photographs of microscopic objects, bright spots are always surrounded with diffraction rings, and Nobert's 18th and 19th bands were obscured by a great many diffraction lines, which made accurate counting almost impossible, even in the photographs of Woodward, of Washington.‡

My friend, the Rev. J. Allinson,§ exhibited here a double series of diffraction lines of great beauty by placing two narrow slits behind the microscope object-glass (withdrawing the eyepiece).

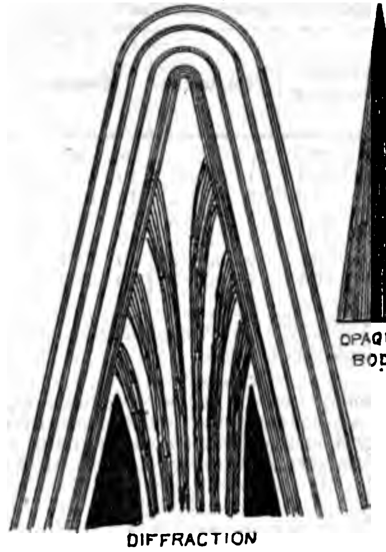
Diffraction spectra vary almost infinitely, according to the forms of the apertures or interruptions occurring in the transmission of rays, placed either in front of the object-glass of a telescope or benind that of the microscope. Fraunhofer succeeded in constructing wire gratings of perfectly parallel wires 0·00202 Paris inch thick, and about 0·00386 apart, also in Paris inches.‖ A slit 1-100th parallel with the wires was illuminated with a narrow beam of light. Diffraction occurred: a bright central bar, supported by two dark spaces, and then ornamented with a series of coloured spectra of perfectly homogeneous colouring, not shaded off; the violets were, unlike the usual solar spectrum, placed inwardly, while the reds were outwards.

The spectra formed by glass ruled accurately with a diamond are worthy of attention. Fraunhofer met with a puzzling peculiarity. Some of his glass ruled gratings produced spectra of a different breadth on the right and left side of the centre. He suspected this was owing to the form of the diamond cutting-point, and discovered that by tilting the tool he could at length produce symmetrical results. No one knows the shape of the glass grooves in Nobert's test-bands. A magnificent class of optical phenomena is described by Fraunhöfer. Substituting for these gratings very small apertures of regular figures—such as circles and squares, either singly or arranged in regular forms—in great numbers, as, for instance, when two wire gratings were crossed at right angles. In the bands we can plainly see the origin and minute structure of the vertical and crossed fringes of diffraction. As the number of the apertures increased, the spectra became purer and more vivid. Fraunhofer's diagram of the spectra produced when the two wire gratings are crossed may be justly termed the most magnificent phenomena in the whole range of optical science (Sir John Herschel).

Here is one of the most simple of all the experiments. If a pin be held in a strong divergent beam of light, and its shadow be examined on a sheet of white paper, it will not appear black, but always luminous in the centre; besides this, some of the rays are deflected, and, meeting on the paper, cause interference bands, varying in colour with ordinary white light, but devoid of colour, being black and white if homogeneous light be used. A minute round hole changes the phenomena; a black patch is seen surrounded with coloured fringes.

Experiment.—If an opaque pointed body be placed in the solar beam passing at a distance through a minute hole, the spectra of diffraction may be viewed with a lens, most beautifully though complicated. Fig. 1 is a diagram of the effects produced.

FIG 1.



(*To be continued.*)

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* *Monthly Mic. Journal*, 1876, p. 253.

† Ammonio-sulphate of copper.

‡ After some years' work, I really rejoiced when the extremely thin Nobert cover mounts were cracked. Though costing £9, the observation of these lines with the microscope is one of the most trying things I know.

§ Formerly Fellow and Tutor of Sid. Sussex College, Cambridge; resident here.

‖ These are 1-560 and 1-312th respectively.

ASTRONOMICAL NOTES FOR APRIL, 1887.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination North.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 3 58·68 P.M.	0 42 6	4 31 48	0 38 6·93
6	0 2 29·46 ,,	1 0 19	6 26 22	0 57 49·69
11	0 1 5·05 ,,	1 18 38	8 18 9	1 17 32·45
16	11 59 48·16 A.M.	1 37 3	10 6 29	1 37 15·22
21	11 58 40·79 ,,	1 55 39	11 50 41	1 56 57·98
26	11 57 44·44 ,,	2 14 25	13 30 3	2 16 40·75

The method of finding the Sidereal Time at Local Mean Noon at any other station will be found on p. 382 of Vol. XLIV.

The Sun may be watched for the occasional spots which rarely appear on his surface; but they are singularly small, few, and far between. During the earlier part of the month the Zodiacal Light may still be seen after sunset.

The Moon

Enters her First Quarter at 1h. 52·8m. in the afternoon on the 1st, and is Full at 5h. 38·9m. a.m. on the 8th. At this date high tides may be expected. She will enter her Last Quarter at 4h. 3.8m. in the early morning of the 15th, be New at 8h. 53·2m. a.m. on the 23rd, [illegible] her First Quarter [illegible] the month, at 11h. [illegible]m. p.m. [illegible]

y of onth.	Moon's Age at Noon.	[illegible]
	Days.	h. m.
1	7·[illegible]	[illegible] p.m.
6	12·[illegible]	[illegible]
11	17·[illegible]	2 [illegible] a.m.
16	22·8	7 [illegible] ..
21	27·[illegible]	[illegible] 44 [illegible] ..
26	[illegible]·1	2 [illegible] p.m.

e Moon will be in conjunction with [illegible] p.m. on the 1st; with Jupiter at [illegible] a.m. [illegible] 9th; with Mercury at [illegible] p.m. [illegible] with Mars at 6 a.m. on the [illegible] at the same hour on the [illegible], with Saturn again at 7 a.m. on the [illegible]

Mercury

Morning Star throughout the month ing his greatest elongation West [illegible] m. on the 18th. His angular diameter ses from 10·6" on the 1st to [illegible] by the ay of April. He is not particularly well ed for the ordinary observer.

Right Ascension.	Declination.	Souths.
h. m.	° ′	h. m.
23 36·6	1 34·0 S.	10 5[illegible] a.m.
23 37·3	2 51·3 ..	10 3[illegible] ..
23 45·4	3 5·8 ..	10 2[illegible]·1 ..
23 59·5	2 23·5 ..	10 22·[illegible] ..
0 18·1	0 53·4 ..	10 2[illegible]·4 ..
0 40·4	1 16·3 N.	10 24·0 ..

whole of the path indicated above [illegible] blank part of Pisces.

Venus

Evening Star, and is now becoming a very nt and conspicuous object after dusk over by N. and W.N.W. points of the horizon. now very perceptibly gibbous in the pe. Her diameter, which subtends an of 11·6" at the beginning of April, in- s almost imperceptibly to 13·3 by the last the month.

Right Ascension.	Declination North.	Souths.
h. m.	° ′	h. m.
2 29·4	14 54·9	1 51·0 p.m.
2 53·2	16 59·5	1 55·1 ..
3 17·4	18 53·6	1 59·5 ..
3 42·0	20 35·6	2 4·4 ..
4 7·0	22 4·2	2 9·6 ..
4 32·3	23 18·1	2 15·3 ,,

ce it will be seen that Venus will travel a considerable portion of the constella- ries and over a portion of that of Taurus: g between the Hyades and the Pleiades course. She will be in conjunction with ne (2° 35′ North of him) at 5 p.m. on the

Mars

into conjunction with the Sun at 11 p.m. e 24th, and is, of course, absolutely in-

he brightest of the Minor Planets.

Vesta

into opposition to the Sun on the 16th ril, we give an Ephemeris of her for tenth day. Observers with keen vision, ng exactly where to look, may quite ly pick her up with the naked eye.

Right Ascension.	Declination North.	Souths.
h. m.	° ′	h. m.
14 10·4	0 6·5	1 34·0 a.m.
14 1·7	1 9·3	12 42·1 p.m.
13 52·5	1 55·7	11 53·6 ,,

m this it will be seen that Vesta is travelling backwards beneath the 4th—5th mag. star τ Virginis, between 20′ and 30′ almost due South of which she will be found on the nights of the 17th and 18th of April.

Jupiter

Is an Evening Star after the 8th, and is now visible practically all night long. He comes into opposition to the Sun at 11h. a.m. on the 21st; but his South Declination renders his present position a by no means favourable one for the observer. His equatorial diameter increases almost insensibly from 40·8" at the beginning of April to 41·4" by the end of it.

[illegible] of and near approaches to Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.				h. m.			
[illegible]	[illegible]	[illegible]	[illegible] p.m.	[illegible]	[illegible]	[illegible]	[illegible] p.m.	Bright	252	288
[illegible]	[illegible]	[illegible]	[illegible] ..	[illegible]	[illegible]	[illegible]	[illegible] 5 ..	Dark	294	275
[illegible]	[illegible]	[illegible]	[illegible] ..	[illegible]	[illegible]	[illegible]	[illegible] 2 ..	Dark	269	271
[illegible]	[illegible]	[illegible]	[illegible] ..	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible] a.m.	[illegible]	[illegible]	[illegible]	[illegible] a.m.	Dark	253	273
[illegible]	[illegible]	[illegible]	[illegible] p.m.	[illegible]	[illegible]	[illegible]	[illegible] p.m.	Dark	210	173
[illegible]	[illegible]	[illegible]	[illegible] ..	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible] a.m.	[illegible]	[illegible]	[illegible]	[illegible] a.m.	Dark	286	274
[illegible]	[illegible]	[illegible]	[illegible] ..	[illegible]	[illegible]	[illegible]	4 9 ..	Dark	258	238
[illegible]	[illegible]	[illegible]	[illegible] p.m.	[illegible]	[illegible]	[illegible]	[illegible] p.m.	Bright	325	359
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] 4 a.m.	Bright	259	293
[illegible]	[illegible]	[illegible]	[illegible] ..	[illegible]	[illegible]	[illegible]	[illegible] p.m.	Bright	291	330
[illegible]	[illegible]	[illegible]	[illegible] ..	[illegible]	[illegible]	[illegible]	[illegible] ..	Bright	198	236

[illegible] * Moon setting. A description of the [illegible] will be found on p. 383 of Vol. XLIV.

[illegible] Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
[illegible]	[illegible]	[illegible]	4	[illegible]	a.m.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	p.m.	21	I	Oc D	9	47	p.m.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	..	21	I	Ec R	11	57	4,,
[illegible]	[illegible]	Ec D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	..	22	I	Tr E	9	5	,,
4	[illegible]	Oc R	[illegible]	[illegible]	a.m.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22	I	Sh E	9	10	,,
4	[illegible]	Ec D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	..	23	*III*	*Oc D*	4	50	a.m.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	35	p.m.	26	*III*	*Tr E*	7	45	p.m.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	46	..	26	III	Sh E	8	31	,,
[illegible]	I	Sh E	4	[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	..	27	II	Tr I	1	19	a.m.
[illegible]	*I*	*Tr E*	4	[illegible]	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	..	27	II	Sh I	1	33	,,
[illegible]	*II*	*Sh E*	8	[illegible]	p.m.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	27	*II*	*Tr E*	3	50	,,
[illegible]	II	Tr E	9	10	..	[illegible]	[illegible]	Oc R	[illegible]	[illegible]	..	27	*II*	*Sh E*	4	9	,,
[illegible]	I	Ec D	[illegible]	[illegible]	43	[illegible]	*I*	[illegible]	[illegible]	[illegible]	..	28	I	Tr I	2	14	,,
6	I	Oc R	2	[illegible]	a.m.	[illegible]	[illegible]	Ec D	[illegible]	[illegible]	[illegible]	28	I	Sh I	2	23	,,
6	*I*	*Sh I*	8	41	p.m.	[illegible]	[illegible]	Oc R	[illegible]	[illegible]	a.m.	28	*I*	*Tr E*	4	26	,,
6	I	Tr I	9	[illegible]	..	[illegible]	[illegible]	Ec D	4	6	9	28	*I*	*Sh E*	4	36	,,
6	I	Sh E	[illegible]	35	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	p.m.	28	*II*	*Oc D*	7	39	p.m.
6	I	Tr E	11	13	..	[illegible]	[illegible]	[illegible]	[illegible]	6	..	28	II	Ec R	10	32	16,,
[illegible]	*I*	*Oc R*	8	31	..	[illegible]	[illegible]	Sh E	[illegible]	35	a.m.	28	I	Oc D	11	30	,,
[illegible]	III	Ec D	[illegible]	[illegible]	32	[illegible]	[illegible]	Tr E	[illegible]	[illegible]	..	29	I	Ec R	1	50	51 a.m.
[illegible]	III	Oc R	[illegible]	41	..	[illegible]	I	Ec D	[illegible]	[illegible]	[illegible]	29	I	Tr I	8	40	p.m.
11	II	Ec D	1	[illegible]	[illegible]	[illegible]	I	Sh I	[illegible]	29	p.m.	29	I	Sh I	8	52	,,
11	*II*	*Oc R*	4	31	..	[illegible]	I	Tr I	[illegible]	[illegible]	..	29	I	Tr E	10	52	,,
12	I	Sh I	4	6	..	[illegible]	I	Tr E	[illegible]	[illegible]	a.m.	29	I	Sh E	11	5	,,
12	I	Tr I	4	[illegible]	..	[illegible]	I	Sh E	[illegible]	42	..	[illegible]	I	Ec R	8	19	19,,
12	*II*	*Sh I*	[illegible]	26	p.m.	[illegible]	*II*	*Ec R*	[illegible]	[illegible]	[illegible]						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* shows that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

Approximate Greenwich Mean Times of the Greatest Eastern Elongations of the Four Inner Satellites of Saturn.*

Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.
3	Enceladus	11·0 p.m.	10	Mimas	9·9 p.m.	25	Tethys	1·3 a.m.
5	Dione	8·3 ..	11	Tethys	8·1 ..	25	Mimas	11·8 p.m.
8	Tethys	1·5 a.m.	11	Mimas	8·[illegible] ..	26	Mimas	10·4 ,,
8	Enceladus	1·7 ..	14	Dione	1·4 a.m.	26	Tethys	10·7 ,,
[illegible]	Mimas	2·1 ..	14	Enceladus	10·2 p.m.	27	Mimas	9·0 ,,
9	Tethys	10·[illegible] p.m.	1[illegible]	Enceladus	12·8 ..	28	Tethys	8·0 ,,
9	Mimas	11·3 ..	24	Dione	12·2 ..	29	Enceladus	11·9 ,,

An illustrated description of the above table will be found on p. 384 of Vol. XLIV. * Rhea does not attain its greatest Eastern Elongation at any hour when observation is possible throughout the month.

Jupiter.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	'	h.	m.	
1	14	7·1	11	17·1	1	30·7	a.m
6	14	4·9	11	5·3	1	8·9	„
11	14	2·1	10	50·3	12	42·5	p.m.
16	13	59·8	10	37·4	12	20·5	„
21	13	57·3	10	24·3	11	58·4	„
26	13	54·9	10	11·4	11	36·3	„

It will be gathered from the above Ephemeris that, during the month of April, Jupiter will describe a short retrograde arc below the 4-5th magnitude star κ Virginis.

Saturn

Is an Evening Star, but is now approaching the West, and should be looked for as soon after sunset as may be to be at all well seen. His equatorial diameter decreases almost insensibly from 16·8" to 16·2" during April. He is in quadrature with the Sun at 1 a.m. on the 6th.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	'	h.	m.	
1	7	8·5	22	29·5	6	29·3	p.m.
6	7	9·2	22	28·9	6	10·3	„
11	7	10·0	22	27·9	5	51·6	„
16	7	11·1	22	26·6	5	33·0	„
21	7	12·3	22	25·0	5	14·5	„
26	7	13·7	22	23·1	4	56·2	„

Starting thus from a point to the N.E. of ζ Geminorum, Saturn will travel towards δ in the same constellation, and be found close to the last-named star at the end of the month.

Uranus,

although he is not in a very favourable position for the observer, is yet above his horizon all night long. His angular diameter of 4" remains unchanged throughout the month.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	'	h.	m.	
1	12	39·4	3	26·9	11	59·3	p.m.
6	12	38·6	3	21·8	11	38·8	„
11	12	37·8	3	16·9	11	18·4	„
16	12	37·0	3	12·1	10	57·9	„
21	12	36·3	3	7·5	10	37·5	„
26	12	35·6	3	3·1	10	17·2	„

The short retrograde arc thus described by Uranus lies beneath γ Virginis.

Neptune

Is invisible.

Shooting Stars

Should be looked for from the 11th to the 13th; from the 19th to the 23rd (notably on the 20th), and between the 26th and 30th.

Greenwich Mean Time of Southing of Ten of the Principal Fixed Stars on the Night of April 1st, 1887.

Star.	Souths.			
	h.	m.	s.	
β Cancri	7	31	2·70	p.m.
ι Ursæ Majoris	8	12	0·97	„
α Hydræ	8	42	30·21	„
Regulus	9	22	42·80	„
α Ursæ Majoris	10	16	58·21	„
δ Crateris	10	33	51·84	„
ε Corvi	11	24	21·11	„
γ^1 Virginis	11	55	52·83	„
α Canum Venaticorum ...	12	10	38·87	„
Spica Virginis...	12	39	4·21	„

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above List for any other night in April, as also that of determining the Local instant of its Transit at any other Station, will be found on p. 384 of Vol. XLIV.

MICRO-ORGANISMS IN THE ATMOSPHERE.

AN interesting paper "On some Conditions Affecting the Distribution of Micro-organisms in the Atmosphere" was read last week before the Society of Arts by Dr. Percy F. Frankland, B.Sc., who has for some time been investigating the subject and examining the air of various parts, in order to obtain information as to the distribution of various minute organisms in the atmosphere. It is well known that the air we breathe, except in some spots and at high altitudes, is positively laden with living organisms or their germs, a few of which play a useful part in the economy of nature, while others are suspected of being inimical to human life in certain conditions. To the distinguished Frenchman, Louis Pasteur, we owe the first clear demonstration of the truth of what had been previously suspected, while Prof. Tyndall may be said to have proved the case for the opponents of spontaneous generation by his researches in connection with the aërial microbes. The presence of living organisms and germs having been demonstrated, endeavours were made to ascertain the actual number to be found in the air of different localities. Suitable cultivating media are exposed after sterilisation for the germs and organisms to settle upon, or air is drawn through tubes containing similar cultivating media, and the numbers are estimated from the "colonies" which develop after several days. Taking samples of ten litres of air from above the roof of the Science Schools, South Kensington, Dr. Percy Frankland found averages ranging from 4 colonies in January to 105 in August. In ten litres of air taken from the top of Primrose Hill he found 9 organisms, while in a similar quantity of air taken at the bottom of the hill (a difference of less than 100ft.) he found 24. From the top of the spire of Norwich Cathedral (300ft.) he obtained 7 as compared with 18 on the ground, while from the air near the Golden Gallery of St. Paul's 11 organisms were obtained as compared with 70 in the Churchyard, 10 litres of air being the quantity in each case. The results of those experiments agree with others, which show that the higher the source from which the sample of air is obtained the fewer the organisms. Locality, too, exhibits a great difference in the numbers, for Dr. Fischer found in 12 experiments made at not less than 120 sea-miles from land 11 samples of air were absolutely germ-free, while in the remaining sample only a single organism was found. In experiments to ascertain the number of organisms falling on a square foot in one minute, Dr. Percy Frankland obtained 15 in four experiments at the chemical laboratory, and 1,662 in two experiments at the Natural History Museum on a Whit-Monday. Similarly, in a third-class carriage, while travelling from Newmarket to London, with a full complement of passengers, the air near a closed window deposited no fewer than 3,120 organisms on a square foot in one minute. That number, however, was exceeded in an experiment made in a barn where flail-threshing was being prosecuted, and the atmosphere was visibly laden with dust—the extraordinary result of upwards of 8,000 organisms being obtained in one minute. Dr. Percy Frankland says it would probably be difficult to find a place in which the suspended microbes are in greater numbers than in a barn while thrashing is going on. Continuing his investigations, he naturally made improvements, or, at least, modifications, in the methods of taking the samples of air, and in the subsequent treatment to which the organisms or germs are subjected; but the general results previously obtained by himself and other observers were not affected, while a further fact was demonstrated—viz., that aërial micro-organisms do not float about in aggregates or masses, but as isolated individuals. It will naturally be asked, If these minute organisms are so numerous, of what do they consist, for they cannot all be pathogenic? They are of many different kinds—moulds, bacilli, micrococci, and various forms of yeast, saccharomyces. Of the moulds, the best known is the *Penicillium glaucum*, which thrives so vigorously in pots of preserved fruit; but moulds are in reality the most widely distributed of all organisms, for even in those localities or at those altitudes where fewest organisms are found, the proportion of moulds is much higher than in the air of towns or of inclosed spaces, which is accounted for by their greater buoyancy. The different kinds of bacilli and micrococci occurring in the air are less generally known; but the importance of studying them is now fully recognised. Some few forms—those which give rise to striking appearances when growing upon natural nutritive media—e.g., articles of food—have long been known, and at times have excited much curiosity. Thus the Micrococcus prodigiosus of Cohn (really a bacillus, according to Dr. Percy Frankland) produces what has been called "blood-rain" on bread, &c., and flourishes in milk, to which it imparts a blood-red colour. M. chlorinus (or B. chlorinus) is very common in air, and forms, on suitable matter, sap-green mucous masses. Amongst other pigment-forming aërial organisms, Saccharomyces rosaceus is frequently present, as are also M. candicans, M. rosaceus, M. carnicolor, B. aureus, and Sarcina aurantiaca, while the hay bacillus, or B. subtilis, is too well known by its effects. Little is known in connection with the functions of these micro-organisms, though it has been clearly established that the various processes of spontaneous fermentation, decay, and putrefaction are due to their action; but, as Dr. Percy Frankland says, recent researches have shown that many of the most familiar changes of this kind—e.g., the conversion of sugar into lactic and other acids—are capable of being brought about by the agency of different forms of micro-organisms. So far it may be said that the existence of pathogenic forms in the air has not been demonstrated, though some of the aërial micro-organisms are pathogenic to a few of the lower animals, and others may be so to man: hence the antiseptic treatment of wounds, and the Listerian practice in surgery. Dr. Percy Frankland considers that it is the chemical side of bacteriology which at present imperatively demands attention, and, thanks to the labours of those who have studied micro-organisms, the difficulties which once stood in the way of investigating the chemical phenomena of bacterial life have been considerably reduced; but it is the pathological side which has most interest to humanity at large.

A NEW METHOD OF EXTRACTING ALUMINIUM.*

WE have recently had the opportunity of seeing commercially pure metallic aluminium produced direct from its ore by a process invented and carried out by Dr. Kleiner, of Zurich. The entire operation only occupies from two to three hours, and is effected by the simplest apparatus. A steam engine, a dynamo, and a hearth or melting vessel are all that are absolutely necessary, and by these appliances the aluminium is divorced from the elements with which it is combined in the ore, and is produced in lumps, which vary in size from a marrow-fat pea to a small potato. The agent which effects the reaction is the electric current, but it plays an entirely different part from that which it takes in the Cowles aluminium furnace. In that the current is merely a source of heat, and serves to raise the aluminium ore (corundum), together with the copper and the carbon, by which it is surrounded, to such a temperature that the oxygen in the ore combines with the carbon, and the aluminium alloys itself with the copper. In the Kleiner process it is the chemical power of the current which is principally brought into play, the metal being extracted by electrolysis at a low temperature. At the same time there is sufficient heat developed to fuse the ore, and thus bring it into a fluid condition, which is an essential condition of a material before it can be electrolysed. As the substance employed melts at a low heat it rapidly attains the fluid state and becomes a conductor, and after this is arrived at there is little or no further rise of temperature, as the comparatively large area of the bath offers but small resistance to the passage of the current, and hence after the preliminary operation is complete the action becomes mainly chemical.

The ore employed is cryolite, a double fluoride of sodium and aluminium. This is ground to a fine powder, and under the action of the current has its aluminium removed, leaving a double fluoride of sodium, which is soluble in water. After the process has been carried as far as is commercially economical, the slag is allowed to cool, and is then broken up and washed. The metal comes out in lumps, the soda salt is dissolved, and can be saved for conversion into caustic soda, while the unreduced ore, which is insoluble, is dried and returned to the bath. It will be seen from this that the two elements of the process are the ore and the power required to drive the dynamo. As aluminium enters into very firm union with other bodies it requires the expenditure of a large amount of energy to break up the connection, the theoretical result attained by an amount of electric energy represented by 1H.P. per hour being 3½ grammes ($\frac{1}{100}$lb.) Of course, the full efficiency cannot be obtained in practice, but in an experiment made in London by Dr. John Hopkinson, F.R.S., it appears that 3 grammes of metal per H.P. are already attainable when working on a very moderate scale. In other words, a dynamo machine giving 100 electric H.P., and working twenty hours per day, would produce 80lb. of pure aluminium per week of six days.

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* From an article in *Engineering*.

The hearths or crucibles in which the operation is carried out are very simple. According to one arrangement an ordinary plumbago crucible has a carbon electrode, formed of a group of rods, inserted through the bottom (negative), and a second electrode (positive), fixed to a bracket above, dipping into it. Another method, which is preferred, is to use a vessel or cavity formed of bauxite pressed hydraulically into a box or case. In either case the heat is so low and is so entirely confined to the interior of the bath that there is no injurious action on the walls. At the commencement of the operation the ground and dried cryolite is placed in the vessel until the lower electrode—the cathode—is covered, and then the centre rod of the upper electrode is lowered until an arc is established, the current having about 80 to 100 volts, and 60 to 80 ampères. A very short time suffices to effect the fusion of the cryolite in the immediate vicinity of the arc, and fresh powder is added until there is a glowing fluid mass in the centre of the bath. This makes a path for the current which no longer forms an arc, and as the heat extends other rods of the upper electrode are gradually brought down until the greater part of the contents of the bath are exposed to the current. At the same time the electromotive force of the current is reduced to 50 volts. A smooth and tranquil fusion, at the lowest possible temperature, is maintained from two to three hours, and then the process is stopped and the current switched on to another vessel.

An important and valuable improvement on the above has, we learn, just been patented by Dr. Kleiner. It was found that the consumption of the carbon rods used as anodes formed an expensive item of cost in the process, and having observed that the ends of these rods submerged in the molten bath of cryolite remained almost intact throughout the operation, whilst that portion immediately above the surface, and for about 2in. to 3in. upwards, was more or less eaten away to the core, it was decided to adopt a new system of applying the positive carbons to the bath. This system consists in completely submerging hollow cylinders of pure carbon in the melted cryolite, and connecting them with the positive current by means of projecting ears through each side of the vessel; whilst the negative carbon is raised up through the bottom of the vessel until its apex is on a level with the upper part of the hollow carbon cylinder. Being thus fixed in position, the powdered cryolite is fed in as in the previous system, and the first fusion is achieved by forming an arc between the negative carbon and the long carbon rod suspended from the top used only for this purpose, and which can be moved in any direction by the hand, so that as the cryolite around the two poles is melted the positive rod is slowly moved across the vessel towards the hollow carbon cylinders forming the sides, until the current freely flows through the melted cryolite between these and the negative carbon in the centre. This requires about ten minutes, and once attained, the carbon rod is withdrawn and the electrolytic process continues its even course to the end—the bath flowing smoothly—whilst the hollow carbon cylinders scarcely, if at all, attacked, will serve over and over again.

SEISMOGRAPHIC APPARATUS

AS a good deal of attention is being attracted to earthquakes at the present time, we illustrate some of the generally used apparatus for detecting and registering movements of the earth's crust. In Fig. 1 [illegible] graphs, such as those in use at the [illegible] Mount Vesuvius. The apparatus marked A is of the simplest kind. It is a needle of [illegible] firmly in a vice, and [illegible] adjusted by a weight that can be set at different heights. It is, though simple, [illegible] B and C are intended to work electrical registering apparatus. They have [illegible] mercury in cups, and kept [illegible] it. On being vertically agitated [illegible] into the mercury, thereby closing a galvanic circuit and operating registering apparatus. B is intended for weak and C for strong shocks. D shows an apparatus for indicating horizontal shocks. A pendulum terminating in a platinum point hangs within a glass case. The point lies within an annular trough filled with mercury, shown on a larger scale in Fig. 2 at E. The least horizontal movement causes the pendulum to swing so as to immerse the point in the mercury, closing an electric circuit and effecting the registration. To produce the registration, an apparatus shown in Fig. 3 is used, comprising two clocks and recording mechanism. The one marked A runs continuously. The clock B is held arrested, and starts only when a current due to the movements of the vertical or horizontal movement seismograph passes through either the electro-magnet m m or n n. Such a current attracts the armature of the magnet, starts the clock into motion, and rings an alarm bell, thereby causing the recording tape to be un-

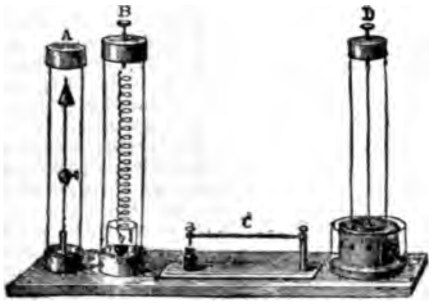

FIG. 1.

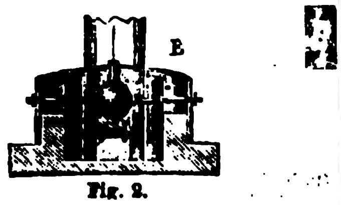

Fig. 2.

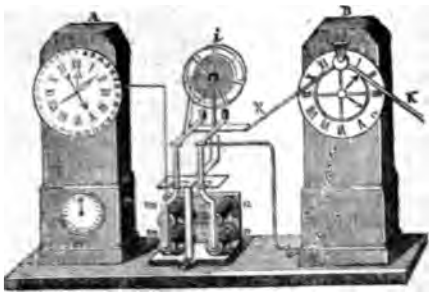

FIG. 3.

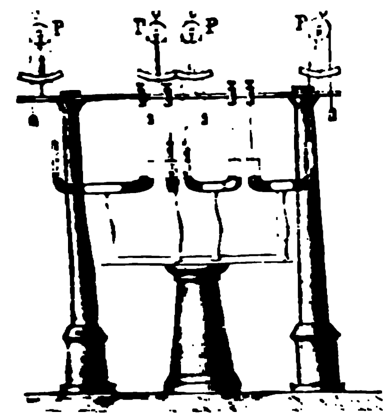

FIG. 4.

[illegible] connected with [illegible] vertical movement [illegible] a pencil of definite [illegible] as the disturbance [illegible] magnet, m, whose [illegible] with a pencil of different [illegible] horizontal shocks. [illegible] the apparatus [illegible]

IC NEWS.

:he Boyden fund have
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misphere will be prefer-
ns. The southern stars
i the United States have
ı the northern stars, and
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Cambridge can be ex-
ı system to all parts of

: Liverpool Astronomical
he nights of March 23rd
7·5 mag., was observed
.ere is no star in the D.M.
v star shows a spectrum
of 26 Cygni for 1887
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The fastest vessel in the world is a twin-screw topedo boat built for the Italian Government by Messrs. Yarrow. The length on water-line is 140ft., beam 14ft., draught 5ft. 4in., and the engines have a combined power of over 1,400 horses. During six trips below Gravesend the mean speed came out as 25 knots or 28 miles an hour.

A patent has been granted for a method of preventing the slipping of locomotive wheels by means of a jet of live or exhaust steam play-on the rails.

At a meeting of the Liverpool Literary and Philosophical Society last week, Prof. Herdman, D.Sc., delivered a lecture on "A Natural History Museum of the Future, arranged so as to illustrate Evolution," in which he said: "It is generally admitted amongst biologists that the only natural arrangement of animals or plants is according to their genetic affinities, and this, when carried out, gives rise to a branched or tree-like form, representing graphically at one and the same time the blood relationships of the different groups, and also their phylogenetic or ancestral history. Why is it that museums do not follow this, the only correct method of classifying and arranging organic objects?"

An ingenious system of fire and burglar alarms, invented by Dr. Taussig, of Prague, which has been adopted in that city, in Vienna, and Gratz, is about to be tried in connection with the Metropolitan Fire Brigade. The object of the system is to give intimation of the outbreak of fire to the authorities, and also in certain conditions of the presence of a thief.

The Smithsonian Museum at Washington has received one of the famous stone images of Easter Island. The statue weighs about fifteen tons.

USEFUL AND SCIENTIFIC NOTES.

◆

Photographic Lenses.—Mr. W. Wray, the well-known optician of Highgate, sends us his price list of photographic lenses for 1887, from which we learn that while he keeps up the high standard of quality, his prices are moderate.

Salol. — Salicyl-phenol-ether (HO,C_6H_4CO,OC_6H_5) was produced about three years ago by Prof. Nencki. The British patent is No. 8,018, 1886. It may be prepared by—1. Heating salicylic acid and phenol or naphthol with phosphorus pentachloride or phosphorus oxytrichloride. 2. By melting sodium or other metallic compounds of the salicylic acid and phenol or naphthol together with phosphorus pentachloride or oxychloride. 3. By treating with phosphorus pentachloride or oxychloride the crude product of the reaction obtained in the manufacture of salicylic acid. Dr. Sahli has proved that salol is a valuable antiseptic, antipyretic, and anti-rheumatic. Salol crystallises in large, well-developed crystals, possessing a not disagreeable aromatic smell. Its melting-point is 43° C.

A Demagnetising Watch-case. — An American contemporary thus describes a watch demagnetising case made by Messrs. Giles and Co., Chicago, Ill.:—"The plan of this invention is to inclose the watch movement in a perfect circle or box—which is made neat and compact so as not much to increase the size of the case—of highly magnetic metal, the effect of which is to make the space inclosed, in which the watch movement plays, free from magnetic force — a sort of magnetic vacuum, and the force, of whatever degree it may be, is exerted on a circle from without, and equal on all sides. The conditions are constant, so that the watch can be regulated to its best, while a watch unprotected by this device is subjected to all varying magnetic conditions, caused by the earth's magnetic force, and the various electric and magnetic appliances at the present time so numerous. This shield is composed of decarbonised steel of the finest quality, and pure copper and gold, so arranged as to secure the result required, which was accomplished after many tedious and expensive experiments."

Waterproofing Fabrics. — It is found that when paraffin is thoroughly mixed with linseed oil, cast into small blocks, and cooled, it may be used to make any fabric, as cloth, felt, and leather, waterproof, by rubbing it with such a block and ironing afterward to equalise the distribution of the material in the pores. If too much is not put on, the material may be made to be only impervious to water, but not to air, the small, greasy particles simply repelling water.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

A MISSING STAR—MERCATOR.

[27009.]—As Mr. Espin will have seen by No. 2777 of the *Astronomische Nachrichten*, D.M. + 47° 192 is a mistake. It is an observation of 47° 191. There are numerous errors of this description in the *Durchmusterung*.

The crater in Mercator referred to by Mr. Elger (letter 26980, p. 80) is not shown by Lohrmann. Schröter does not draw Mercator. Is it one of the two shown by Neison? Schmidt does not seem to draw them either on the great chart or on the one of the rills near Campenas, Ramsden, &c., in "Uber Rillen auf dem Monde."

H. Sadler.

65 P^3 LEONIS (β 599).

[27010.]—In a letter published in the ENGLISH MECHANIC for May 29, 1885 (24270, Vol. XLI.) I mentioned that an examination of several of Burnham's pairs at the present time would show whether they were physical objects or not, and among them I called attention to 65 P^3 Leonis. Mr. Burnham discovered this interesting object in 1878 with the 18½in. at Chicago, the mean of four nights' measures in that year giving—

82·4° : 1·78" : 1878·2. Mags. 5·5, 11·5.

The R.A. given by Mr. Burnham is 1m. 2s. too large, and the declination 6' too small. The only other measures known to me are those made on one evening in 1879 by Howe at Cincinnati. His results are—

84·3° : 1·47" : 1879·3. Mags. 6·0, 9·5.

The large star has a proper motion, according to Auwers, of − 0·0287s. in R.A., and − 0·060" in decl. annually. If the pair is simply an optical one, the position-angle of the *comes* should now be about 291°, and the distance 2·4". Its place for 1887·0 is XIh. 1m. 8·4s. + 2° 34' 6". Perhaps Mr. Tarrant, or some other correspondent who is engaged in making micrometrical measures of double stars, would kindly examine this object and report. Mr. Burnham says that it is only moderately difficult, and if the magnitudes noted at Cincinnati are correct, it should be measurable with a comparatively small aperture.

H. Sadler.

SATURN.—REQUEST TO OBSERVERS.

[27011.]—In compliance with Mr. Kempthorne's request, I give a few instances of the most recent observations of the notch and concavity of Saturn's shadow. The "E.M.," March 5th, 1886, has sketch of Saturn by Mr. Franks, 11½in. mirror, showing notch and concavity of shadow. Mr. Mills, 8in. mirror, also gives sketch of the same, "E.M.," March 26th, 1886. Mr. Ryle, "E.M.," April 2nd, 1886, sees notch with 8½in. Cooke; but shadow to him seems convex. Mr. Perkins, L.A.S. *Journal*, March, 1885, draws notch, but shows shadow convex. Captain Noble, L.A.S. *Journal*, May, 1885, with 4·2 refractor, draws both, and asserts concavity of shadow "*is most appreciable.*" Mr. G. Davis draws notch and shadow very concave. Mr. Green, 18in. mirror, gives, I think, both notch and concave shadow in his drawing to the R.A.S. in 1885. Mr. Elger, in answer to my request, writes March 8th, 1887, that he sees the notch, and he draws it the same as I had done. The names of so acute and accurate observers justify the existence of the notch. Trouvelot draws the notch and concave shadow in his drawing of Saturn, with 28in. refractor, in 1872. Against the notch we have Prof. Hall, in 1885, remarking he could never see it with the 26in. Washington refractor; and Proctor, in his "Saturn" and in all his other works, shows shadow quite concentric, and so does Mr. Percy Smith, "E.M." page 84. Dr. Terby's drawing exactly corresponds with my former description, page 83, the shadow in my 8½in. Calver "not being seen concentric, but widening southwards, cutting through ring A with a notch, and ring A overlaps ping B by an appreciable amount." The reversed curve may be an optical illusion caused by the juxtaposition of curved lines. This would apply to concavity of shadow on ring A, and possibly to *c*, but hardly to ring B, where angle is more obtuse and width of ring great; the peculiar form of shadow rather seems to indicate that ring B is in parts convex, the thickest part being not far from Cassini's division. It will be interesting when the plane of rings passes through the earth in 1892 if such appears then to be the case. Mr. Percy Smith, in his drawing, makes the south pole overlap ring A, but not north pole. I do not know if he intended this, for would not such an appearance imply that the plane of rings did not then exactly coincide with equator, or else ring A was lower than B? Encke's division must indeed have been plain to be seen nearly all round with so low a power as 130. I note Mr. Clapham draws ring A continuous over the ball. The belt just south of equatoreal belt is now conspicuous and definite. The notch is evident on really good nights when high powers can be used; but whether from Saturn's rapidly decreasing diameter, or from the minor axis of ring decreasing from 18·85", Feb. 7th, to 17·99", March 19th, it does not now appear so prominent as in February, when its shape reminded me strongly of the web of a duck's foot. In indifferent air, or with low powers, it seems concentric. I have at times doubted if shadow over crape ring, C, was concave. It is very satisfactory that observers are now directing their attention to Saturn, which affords such an interesting field for close scrutiny and discussion, and which yearly is becoming worse for observation. Mr. Elger writes to me 12th March that with his 8½in. Calver, power 384, preceding ansa of ring C is ragged like a saw, and "*surface irregularly dark*," and he inclosed most interesting sketch of the same. This seems to correspond with the "masses sombres dans l'anneau obscur surtout à l'occident" seen by Dr. Terby. Will observers kindly direct their attention to all these points?

March 28th. **H. Watson.**

SATURN.

[27012.]—In my letter (26976), doubtless owing to bad writing, "With 8¼in." appears as "with 8½in.," and "clearer line" should be "cleaner line." Best thanks are due to Dr. Terby for his beautiful sketch. I see Ring A almost exactly as there represented, the outer boundary of the "trait brillant" coinciding with Encke's division, and the inner boundary of late with the division of Cassini. I have several times observed a notch similar to that depicted in the sketch. It would be presumptuous to question what experienced observers have seen with larger apertures, but I have no doubt that what I have noticed is an illusion.

March 26. **P. H. Kempthorne.**

ASTRONOMICAL—ERRATUM.

[27013.]—In the condensed report of the paper on double-star measures read at the meeting of the Liverpool Astronomical Society, and reported in last week's issue, I note a serious inaccuracy in the concluding lines of the paragraph relative to the binary star τ Cygni. This states the period to be the shortest in the Northern hemisphere, but the paper expressly states "probably *one of the* shortest"; for although the period is short, it is undoubtedly longer than that of δ Equulei, and probably both β Delphini and 42 Comæ Ber. complete a revolution in a shorter time.

Kenneth J. Tarrant.

Letchford House, Pinner, March 28.

PLANETARY CONFIGURATIONS—ZODIACAL LIGHT—PINK STREAMERS.

[27014.]—I am obliged to "F.R.A.S." for correcting the statement (letter 26930, p. 32) about the conjunction of 15th September, 1186. I have not "Chambers's Descriptive Astronomy" by me now to refer to; possibly the book I consulted was a different edition.

"J. D.," from letter 26982, p. 80, appears to be a careful observer of the sky with the naked eye. May I ask if he has lately seen the zodiacal light? I have never seen it better in England than recently, the reason I think being that my point of view was situated in the country, a somewhat remote part of Hampshire, where there was no glare whatever from houses, lamps, &c., to interfere with its visibility. I find that even there it is necessary to have a fairly clear horizon, that is, uninterrupted by large dark masses of trees, buildings, or the like. The light is so delicate it can best be seen by averted vision. 12th March, 8.30 p.m., it was superb—"pearly" seems the term most applicable to its light, stretching up to the Pleiades. 13th, beautifully seen as a rounded or rather bulging cone, stretching to Pleiades. 16th, 7.35 p.m., broad and ill-defined, Venus near its axis. 19th, very strong, a cone extending upwards in a sloping direction to Pleiades. Venus estimated 2° preceding the axis, or perhaps 2° distant from nearest point on axis. The preceding edge of the light passed nearly over α (Alpha) Arietis. It was brighter than the Milky Way, especially at bottom, where it mingled with the horizon light (*vide* note on Zodiacal Light, by H. C. Lewis, in *Ast. Register*, No. 236, August, 1882). In addition to the above observations, I have seen it on several occasions recently when near London; more particularly on the 23rd inst., it was bright enough to be at once detected through the glare over London.

While on this subject, the following extract is taken from p. 331 of the "Memoir of Caroline Herschel." "To my nephew. On reading your letter to the editor of the *Times*, of March 31st, I recollect having written down some observations of your father's on the zodiacal light. He never lost an opportunity of noticing anything remarkable during twilight, or in the absence of nebulæ, &c., and I remember also his explaining to me another kind of ray, which is after sun-setting, reaching up very *high*; but this only appears for one or two nights at the equinox." Does this refer to the phenomenon called, in the above quoted note of Lewis, the "zodiacal band"? It is there described as an extremely faint zone of light, somewhat wider than the Milky Way, which like a narrow slip of gauze is stretched across the sky along the Zodiac from horizon to horizon, to be seen at all times of the year, and all times of the night. I cannot say I have ever seen this.

Regarding the rose-coloured streamers of "J. D.," *vide* letters 26390, No. 1,126, Oct. 22, 1886, and 26416, No. 1,127, Oct. 29, 1886.

March 28th. **E. E. M.**

RAILWAY BRAKES.

[27015.]—As mentioned in "Scientific News," page 77 of this day's English Mechanic, the paper on "Brakes," read by Mr. Marshall before the Society of Arts, "threw no further light upon the subject."

Unfortunately, Mr. Marshall assumed certain incorrect statements, and consequently all the theories and conclusions at which he ultimately arrived were also incorrect, and of no value. Without giving any proof, he took it for granted that automatic air and automatic vacuum brakes are equal in quickness of action; but as I stated in course of the discussion this is not the case, and having attended nearly all the important brake trials during the past nineteen years, I can say I have never yet been able to find a brake as quick in action or as efficient as the Westinghouse.

The average of the slip stops taken at a speed of 50 miles an hour in the Lancashire and Yorkshire trials was—

Westinghouse	441ft.
Automatic vacuum	722ft.
Eames vacuum	754ft.

The compressed air which actually puts on the Westinghouse brake is stored under each vehicle within 2ft. or 3ft. of the brake cylinders.

The atmospheric air which forces up the pistons in the vacuum brake has to enter at the valves on the engine and in the vans, and travel through the brake pipe to the various brake cylinders, and the longer the train the greater distance the air has to travel, and the longer time it requires.

In back numbers of the English Mechanic numerous accidents are recorded due to the dangerous "two-minute" leak-off vacuum brake. However, at the Society of Arts its inventor stated that it had, "up to a certain point, answered very well." Unfortunately, the meeting was not told what the "certain point" was; but probably it meant the buffer-stops at Portskewet, Leeds, Bradford, Manchester, &c.; or perhaps the train running back at Swadlincote. Surely on those occasions the "certain point" must have been reached. It will be remembered that Messrs. Bramwell and Cowper, in May, 1881, reported to the Midland Company that they found that the Clayton brake leaks off in two minutes; but they considered "the two minutes are sufficient to admit of the application of scotches to the wheels." Every railwayman knows that the idea of using hand scotches (in place of an efficient automatic continuous brake, which will remain "on" until purposely released) is perfectly absurd; and this was evidently the view held by those present at the Society of Arts.

Instantaneous automatic action and early retardation are the great points that are required in a life-saving appliance such as a continuous brake, for in the case of disaster half a second of time becomes a question of life and death to those in the train.

Clement E. Stretton.

Consulting Engineer Amalgamated Society of Railway Servants.

306, City-road, London, E.C., March 25th.

ENGINE DRIVERS' EYESIGHT.

[27016.]—Reference was made last week, page 77, to the testing of the eyesight of engine-drivers and firemen. No one could for one moment think of allowing a man to be upon an engine who could not distinguish railway signals, or see for any necessary distance in front of his train.

At the present time, numbers of men who can see signals, and go through a practical test, entirely fail to tell the names of certain shades of coloured wool. They are said to be "colour blind"; but, in fact, they are nothing of the kind. They can *see* the colour, and they can point out that there are various shades; but they are ignorant of the names, and this ignorance causes them to be suspended from duty, and reduced to some lower position at a very great reduction of wages. Instances have occurred, and been brought to the notice of the Amalgamated Society of Railway Servants, in which the tests have been "unfairly applied," in order to remove certain men from their engines. Naturally this has caused a very strong feeling amongst the men who suffer, and it has formed the subject of meetings and resolutions in all parts of the country, requesting that the tests shall be made on the line with actual signals, both by night and by day, and be of a practical character.

The absurdity of a theoretical test is clearly shown by the fact that some men who fail to pass the "dot and wool test," can see signals at any distance required, whereas some who have successfully passed those tests can only imperfectly see the railway signals.

The following resolution has been adopted by the Amalgamated Society:—

"That this society is of opinion that while good eyesight is of the highest importance to enginemen, it believes that the only really useful test should be of a practical kind, and consist of ability to discern at long distances by day and night the signals they have to obey."

I trust railway companies will give the question serious attention, as it is of the greatest importance to both that eyesight should be practically tested, and that no injustice should be done to the drivers through unfair tests being employed.

Clement E. Stretton,

Consulting Engineer Amalgamated Society of Railway Servants.

40, Saxe Coburg-street, Leicester.

ODIC FORCE.

[27017.]—Having read "Odometer's" letter (No. 26946, page 35), as soon as I had time to spare, I commenced, with very little faith, to make an "odometer" (silk thread and sealing-wax) and to make experiments. To my astonishment, on suspending it from my finger over a florin, it immediately began to revolve. I tried this several times with different metals, and it always revolved, though not always in the same direction. If no metal is placed underneath, there is little or no motion. Upon my disengaged hand being grasped by a person of the same sex, it gradually stops, and then oscillates to and from me. If a person of the opposite sex touches the disengaged hand, it stops and then revolves in the opposite direction. I repeated these experiments some eight or ten times, and always with the same results. I may mention that in each case the hand was steadied by means of a pile of books or rules, and the "odometer" placed in a glass globe to protect it from draughts or currents of air. Experimenting with the magnet, I obtained results exactly opposite to those given by "Odometer"—that is, held by right forefinger over North pole, it revolved as the hands of a watch, and the reverse direction over the South pole. Two friends of mine have also tried, and both obtained similar results to myself. I also tried hanging it up to the gas bracket, and placing different metals underneath, but could obtain no motion at all.

Newcastle-on-Tyne. **G. Ralph.**

ON PRIMARY BATTERIES, AND ON CHARGING ACCUMULATORS FROM THEM.

[27018.]—Primary batteries have been discussed a great deal lately, and the verdict is yet pending. I propose to give my views as a practical electrician, and invite discussion thereon, with a view to arrive at some definite conclusion about them. A few words on electric lighting by machinery will not be out of place, as affording data with which to compare battery lighting. I will, therefore, take an installation of 24 lamps of 16c.p., run without accumulators, and power supplied from an engine giving 2H.P. Where no man is kept we shall need help once a fortnight for engine-cleaning. Starting the engine can be done by a domestic, and occasional help from the owner. Oiling can be also done by the domestic. Take the first cost of such an installation at the extremely high figure of £200, and the cost of running 2d. an hour, or 1d. per H.P. hour. We will further allow 2s. 6d. a month for engine cleaning. Now, taking the average run all the year round as 24

MEDICAL ELECTRICITY.

[27023.]—As I am of opinion that a more exact and detailed discussion upon our present knowledge of medical electricity is very much needed, I beg to suggest one or two points which have been impressed on my mind during practical use of the different forms of electric current for therapeutic purposes. There seems great vagueness in the general directions met with as to details, both of construction of apparatus and choice of current for various disorders. As we are yet only on the threshold of the vast store of utility of electricity we should not be surprised at such vagueness; but I think that it is a serious matter when patients, and even medical men, apply the wrong current in the wrong way, and handle ignorantly a force which has such tremendous affinities with the nervous system of man.

With regard to apparatus, there is no difficulty in the case of induced current machines; but the induced current, and even the interrupted primary current, are of far less utility (so far as present proof goes) than the continuous voltaic current. I have seen many medical batteries which contain arrangements of cells of far too large surface, giving increased intensity of current by diminishing the internal resistance without supplying also increased tension. Such batteries of small numbers of large cells I have found to be of little practical use, and to give a painful current, tending to produce erosion and sores under the poles on the skin. The resistance of the human body being very great (from 1,000 to 3,000 ohms), it is necessary to use batteries of high tension, having a resistance in proportion to that of the external circuit, and such a battery is to be made of a large number of small cells.

Practically such batteries do good, and the others do not. I believe that the corrugated carbon cells, containing a zinc rod, and excited with sal-ammoniac, measuring 4in. by 1in. or so square, are amongst the best to be found, and 40 of these cells will give a penetrating current which is far more active therapeutically, and far less painful, than the current from half the number of cells of larger surface. From 15 to 20 cells is the number most generally useful; but 40 are sometimes required.

Painful currents are, I believe, never needed, and I would draw attention to the fact that the seat of the pain is in the superficial nerves of the skin almost entirely, and that it may be avoided when a large current is applied, by thorough soaking of the skin with a saline or acid solution, and by using very large electrodes well-moistened and pressed firmly on the skin. The electrodes I believe to be best are sheets of lead as large as the hand, oval in shape, covered with "spongio-pilin," or wash-leather, and having indiarubber finger-stalls fixed behind, to enable the operator to hold them curved in his hand, and to grasp or press the patient firmly.

The method so commonly used of measuring the "dose" of current by the number of cells in circuit is very fallible, for not only do cells get weaker, but the resistances of different patients differ, and various disorders modify the normal resistances. A galvanometer, graduated by standard cells, when freshly charged and used in all subsequent operations, will give the necessary indication of how far the cells have fallen off, and of other differences in current actually passing through the body.

A small point in battery-construction is important in a battery of many cells; the full strength being seldom used, the first half of the cells run down whilst the latter ones are idle; and therefore use a switch to bring into circuit either half of the cells at will.

The relative position of the electrodes on the body is important, for, besides the fact that a current flowing in one direction acts differently to one flowing in the contrary direction, there is a very striking increase in the current, if the position of the poles be reversed after a current has been for a time passing. This well-known fact needs more complete investigation—perhaps some of our "electrical" readers will take it up. It seems to be the result of a polarisation of the nerves or tissues, since the augmented current is apparently the result of an addition to the original; and yet I do not think that the existence of such a secondary or "storage" current can be demonstrated on a galvanometer by the "polarised" patient and electrodes. Here I am very likely at fault; but I am sure that the overcoming of resistance in the body, as the result of the soaking of the skin and the passage of the first current, does not account for the increased current on reversal, because the increase is, as shown by the galvanometer, temporary, the needle soon returning to the original point.

The fact that the current, whether primary voltaic or the induced current from a coil, must be applied so as to traverse the diseased structure is obvious, but very often is neglected. I have heard again and again of persons who have held the metal handles of a coil or of a magneto-electric machine in their hands, and have submitted to wholly useless tortures, with the hope of soothing neuralgia in the head or elsewhere, or of reviving paralysed limbs!

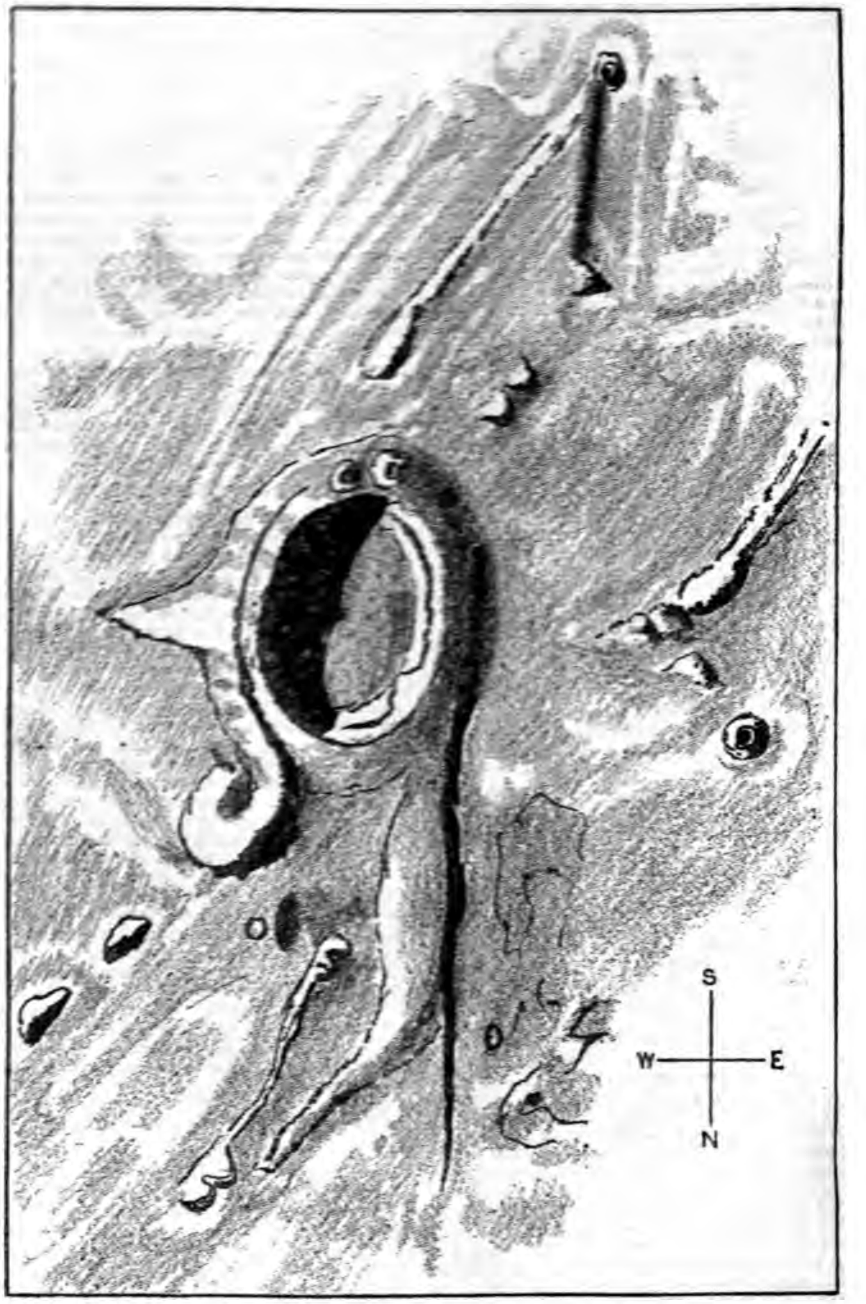
I have seen the good effect of a mild continuous voltaic current upon a neuralgic nerve entirely and instantly converted into cruel aggravation of suffering, through the electrodes having been removed from the body before the cells were switched off; the least shock, even a single interruption, in the continuous current applied to a genuine case of neuralgia, may destroy the perfect rest and freedom from pain conferred by the carefully-applied continuous current.

The secondary or induced current is an excitant and stimulant both to motor and sensory nerves, but has little or no "catalytical" effect, whilst the primary and continuous voltaic current is a sedative to motor and sensory nerves, and influences the nutrition of tissues through which it passes, perhaps on account of its catalytical action. I believe that it is a great error to look upon the amount of movement and spasm produced in a muscle by the induced or other interrupted current, as a proof of the benefit of the current. If a muscle is found to respond to the stimulus of a current, it is not in danger of degeneration, and the current applied to it will not influence the diseased part of the spinal cord or brain.

On the other hand, I venture to believe that if muscles are wasting or losing their power of acting under electrical stimulus, the application of any strength of stimulant current to the muscles themselves will not prevent their wasting, nor influence for good the diseased spine or brain; but a continuous voltaic current applied through the brain or spinal cord may so modify the disease as to restore the lost functions.

Electricity markedly influences the functions of secretion in different organs, allays spasm and neuralgia, and may, therefore, prove of benefit i numerous spasmodic diseases, and may influenc digestion, the elimination of poisons from the sy tem, restore sensation to anæsthetic parts, and, i days to come, be raised to the highest place amongs our therapeutic armoury. Let us not delay, in an case, finding out all we can on this most valuabl subject.

Upper Clapton. **Gerard Smith, M.R.C.S.**



OCCULTATION OF ALDEBARAN—MARIUS.

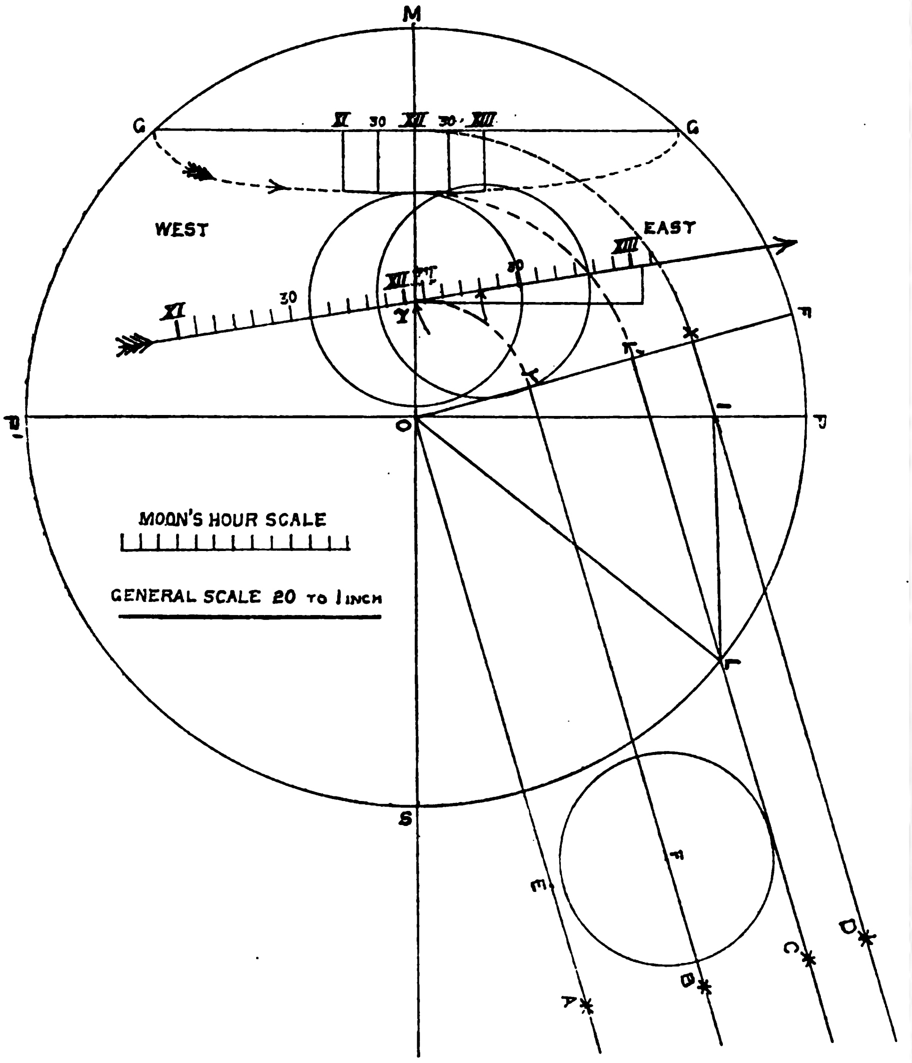
[27024.]—THE occultation of Aldebaran w seen here, about 51° 25′ North, by F. Blatch, Es Reading Micro. Soc., with a marine binocula The star disappeared near the terminator, to r appear at a much greater distance from it on t bright side.

During the late splendid weather, in a 3¼i Wray, Saturn showed a bright zone on the inn part of ring A. The outer portion of B was e ceedingly brilliant. The shadow on rings mere appeared broader on outer edge of A than ne inner part of B. There also seemed to be a portio of a northern dark zone above the crape ring. Th is not shown in diagram given on the 11th. Is it mistake or an omission?

As Mr. Elger has called attention to Marius the *L. A. S. Journal*, perhaps a sketch of it woul not be unacceptable to your readers.

Since making sketch, a depression was see under east wall, where shown, a peak on wall i position marked A, and a crater cone on N.W portion of floor. The dark spot on S.E. outer wal is the third object to which Mr. Elger alludes.

Theale. **G. T. Davis.**



OCCULTATIONS AND ECLIPSES.

[27025.]—Our mutual friend, Mr. W. G. Franks, of Leicester, has scarcely given the study of occultations and eclipses the time it deserves, or he would not have questioned the late occultation at Greenwich. In order that he may see that the compilers of the *Nautical Almanac* are correct in their figures, and also to show how the occultation in question may be easily worked out without mathematics, and approximately with very little labour, I send you the following:—

Required the circumstances of the occultation of Aldebaran at Greenwich on March 2, 1887:

1st. Find the star's hour-angle:—

	h.	min.	sec.	
Sid. time, G.M. noon ...	22	39	51	—*N.A.* p. 39.
G.M.T. of conj. in R.A.	5	46	35	„ 409.
Acceleration			57	„ 480.
	28	27	23	
Deduct	24	0	0	
R.A. of Green. Meridian	4	27	23	
R.A. of star	4	29	26	„ 409.
Star's hour-angle East...		2	3	

2nd. Find geocentric latitude:—

	°	′	″	
Geographical lat. =	51	28	38	„ 487.
Reduced Raper's Table, No. 52 =		11	12	
Geocentric lat. =	51	17	26	

Note.—If great accuracy is not required, the geographical latitude may be used in the place of the geocentric.

3rd. Take out the following elements from the *Nautical Almanac* to the nearest tenth of a minute of arc:—

	°	′	
Star's declination	16	16·7 N.	—see p. 409.
Diff. of dec.		16·8 N.	„ 409.
Moon's hor. par.		56·1	„ 40.
„ semi-diam.		15·3	„ 40.
„ H.M. in R.A.......		32·6	„ 42.
„ H.M. in Dec.		5·4 N.	„ 42.

Note.—The Rev. Jas. Pearson, M.A., says: "The moon's horary motion in R.A. is taken from the variations for 10 minutes as given in the *N.A.* by calling the seconds of time minutes of arc, and increasing these quantities half as much again. The moon's horary motion in dec. is taken from the corresponding quantities in the same page by regarding the seconds of arc as minutes of arc and dividing by ten."

4th. Construct a diagram similar to the one here given, making it on as large a scale as convenient. To do this proceed as follows:—

Take the moon's hor. par. in the compasses, and from O as a centre describe the circle Q F M P′, draw the earth's equator M O Q and the axis P O P′ perpendicular to it. From the earth's centre O set off the star's dec. Q O A, and from the same centre the Greenwich geocentric Lat. Q O L. At right angles to O A set off the line O F, which will be the plane of the projection. Take any point E in O A, and at right angles from it set off the difference of Dec. E F; then from F as a centre with moon's semi-diam., describe the moon's circumference; draw the parallel of lat. I L through F and L and I, draw lines parallel to A O, cutting the fundamental plane F O in the points Y and L′ and X. This completes the sectional projection of moon upon the fundamental plane. If, now, one limb of the compasses be placed at O, we may mark off upon O M the position of the moon's centre, the extreme limit of the semi-minor axis, and the centre of ellipse the line G G perpendicular to O M, representing its major axis. We are now supposed, as before, to be situated at the star from which we see the moon projected upon the earth, and the elliptical path of the Greenwich Observatory. From Y, the place of the moon's centre at conjunction in R.A., lay out the base and perpendicular of the right-angled triangle, making these respectively equal to the moon's H.M. in R.A. and in Dec. Then the hypothenuse will represent the hourly motion of the moon in its orbit from west to east, the observers at Greenwich moving in the same direction in the path of the ellipse. Construct the very small portion of ellipse required as follows:—Measure its semi-axis major, and multiply it by the factors ·131 and ·259; set off the products on either side of the centre of the ellipse which is represented by the hour XII. on diagram. This gives the abscissæ corresponding to the hours XI. 30 and XI., XII. 30 and XIII. To find the corresponding ordinates measure the semi-minor axis XL′, and multiply it by the factors ·99 and ·97. Take these products, and laying them off at right angles to the major axis, draw the portion of the ellipse required. Lastly, divide the moon's orbit into hours and minutes, making the star's hour angle fall upon the meridian O M at Y; then, with the moon's semi-diam. in the compasses, place one leg upon the moon's path and the other upon the ellipse, and the two places where the hours and minutes in each correspond will indicate the times of beginning and ending. From an inspection of the figure it will be seen that the times are respectively about 12h. 2m. 8s., and 12h. 20m. To find the Greenwich Mean Time to correspond, we proceed thus:—

	h.	m.	s.
Beginning	12	2	8
Hour angle	12	2	3
Interval	0	0	0
G.M.T. of conj.	5	46	35
Beginning G.M.T.	5	46	35

	h.	m.	s.
Ending	12	20	0
Hour Angle	12	2	3
Interval after conj.		17	57
G.M.T. of conj.	5	46	35
Ending G.M.T.	6	4	32

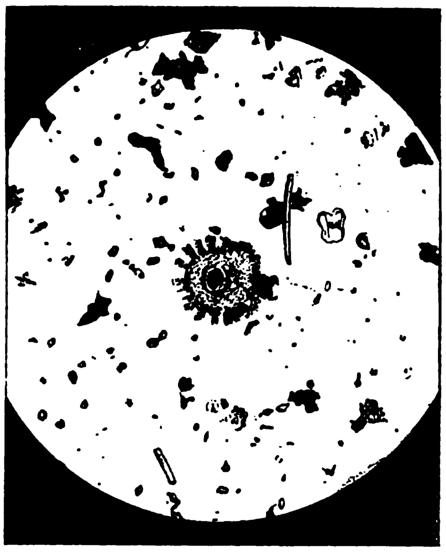
Duration, 17m. 57s., which is very close to *Nautical Almanac* prediction (see page 440).

If this simple method commends itself to your readers, I shall be pleased to supplement the above with a table of factors, from which the whole of the ellipse may be laid down if required. I have not indicated the angles on moon's limb, as it crowds unduly the diagram.

Tow Law, March 14th. **H. P. Slade.**

STRUCTURE OF ARACHNOIDISCUS E.

[27026.]—I have no doubt that "T. F. S." is right in his supposition that he has found a membrane on one of the frustules of the above diatom. In Vol. II., new series, of the *Journal* of the R. M. S., I pointed out that I had found gelatinous casts of diatoms, and believed that the movements of the diatomaceæ were carried out by undulations of the membrane. I have found them in many cases both free and attached in several forms of Navicula, and separate in one case of Surirella. On one of my slides I have a cast—of which I send a photo. to the Editor—which I should like to attribute to Arachnoidiscus; but, unfortunately, it is separate, and no frustule of the above diatom on the slide. It may, therefore, not be a diatom-cast at all. Are the different markings spoken of by "T. F. S." simply the opposite sides of the same frustule, or do they depend on separate plates into which most discoid diatoms can be split?—some into two plates, some into three plates, and I think I know one that will split into four, all having different markings. **R. O. H.**



[27027.]—The reason why "T. F. F." is unable to see the finer markings on Arachnoidiscus Ehrenbergii when the valve is mounted with the "Gothic window" side upwards, is simply due to the high N.A. of his objective, which has therefore no penetration to speak of, also to these fine markings being level with the outer surface of the outer layer of silica of which the valve is composed.

The consequence is (assuming for a moment there is no inner layer or gum whatever between the observer and the object) that when the inner surface of the outer layer is in proper focus, the ultimate and finer markings are beyond and out of focus; but as one focusses downwards towards the outer and ultimate film, the edges of the "angular perforations" begin to get obscured and blurred with a surrounding coma which, by the time the ultimate film is reached, is sufficiently great to destroy all proper definition. To examine the finer markings in this diatom, the valve requires to be mounted with the outer surface uppermost.

My objection to an inner film, as described by "T. F. S.," is that, comparatively speaking, it is of a very large area, my experience being, "The finer the film, the smaller the area." A large film would be excessively fragile, and would require strengthening by means of ribs, brackets, or other supports, which would at once make its presence apparent. I look upon the whole of the "Gothic window" arrangement with the various radiating ribs as being merely supports for the large and outer layer of silex.

With respect to "T. F. S.'s" diatom where a small piece is chipped out of the edge, I presume that the fracture on the inner side does not penetrate within the "Gothic window."

I will take an early opportunity of corresponding with "T. F. S." direct with a view of making an appointment. I do not live in London, but some little distance in the country.

H. Morland.

THE CATASTROPHE OF FIFTY CENTURIES AGO.

[27028.]—OUR friend "E. L. G." (No. 26953, page 55) is sublime in his courage. Alone he faces the astronomical world with his theory of a comet-sea; alone he charges "all English geologic theory, at least since Lyell, with postulating a universe that nature shouts to us yearly, or oftener, is a non-existent figment"; and, again, "the blundering absurdity that this catastrophe must be geological runs through and poisons every word now thereon, from preacher Kinns up to the Duke of Argyll"; and, again, "Mr. Howorth says that nobody to-day will believe in a general deluge, which is nearly equivalent to saying that none but fools are alive to-day." Like the circle-squarers and flat-earth men, he faces alone the science of his day; like Hamlet, he is "born to set it right." But alas! to me, one of the aforesaid fools, he seems like Don Quixote tilting against the windmills, or like Canute bidding the ocean stay. For the facts are all against him. "E. L. G." will admit that in asking the whole geological world to give up its cherished convictions arrived at by men who have given years of study to this particular science, he must show that he has an accurate knowledge of the facts, and that the facts support his inferences. I join issue with him on both points—sometimes his facts are wrong, at other times his inferences. First as to facts: I do not intend to follow him through all his arguments, but will confine myself to those cases which I know best. Take the case of the structure of Auvergne. "E. L. G." says this country gives monumental proof of the suddenness of the catastrophe. The real fact is that Auvergne is always quoted as an incontrovertible proof of the impossibility of a general deluge. I know the district well, and I assert that no sane person could study the phenomena there, and believe in any such a catastrophe as "E. L. G." requires us to believe in. For, scattered over the granite plateau of Auvergne there are a very large number of baby volcanoes, hills varying from 20ft. high to 500ft. and more, each surrounding the crater of an extinct volcano. Many of these hills are composed of loose cinders varying from 1in. to 3 or 4in. in diameter, not compacted together by sand or ashes, but lying quite loose; you can pick them up by handfuls. Many of these craters are tiny little things, 20 or 30ft. wide, with their little heap of cinders round them.

It is absolutely certain that any sea or current would have washed them clean away into the valleys below the plateau; but there they stand, many of them nearly perfect, some with one side removed.

But further, the granite plateau round the Puy de Dome is covered now with loose cinders, some lying where they fell after being projected into the air, others, no doubt, washed down by rain from the cinder hills. All these would have been washed away off the plateau by any sea.

Again, "E. L. G." says the valleys are a proof of the suddenness of the catastrophe, and that this occurred fifty centuries ago; but, unfortunately for his facts, the valleys existed before the volcanoes ceased working in a good many cases, for the lava-flows ran down the valleys.

Again, take his illustration of the clay and lead put under a waterfall; to represent the country really, you must put little heaps of loose sand all over the clay, and after the shower-bath you must find all your little heaps of sand unharmed! The thing is impossible.

Next take the assertion that all our river valleys and their gravels and drifts are the work of a single day. Putting aside the physical impossibility of the thing, I unhesitatingly assert that there is not a river valley in England which does not contradict "E. L. G.'s" hypothesis. He demands one grand sheet of gravel spread over the valleys and the hills on their sides and over the vast plains of the Nile, Ganges, and Mississippi. The facts are that the gravels of the sides of the valleys and of the plateaux are of many different ages, some containing Arctic shells, others Southern shells, others remains of man; these are separated by stratified beds of sand, and are traceable in unbroken succession over hundreds of square miles. They are not overlaid by any sheet of more recent gravel. The true river gravels are generally confined to a small patch on each side of the stream, and show no evidence whatever of a large flow; otherwise their materials would be similar to those spread over the slopes, which is not the case.

As regards the statement that a bed of peculiar gravel is found at about 5,000 times the depth of the annual increase of the plains by floods, before I can believe it I must have facts and figures. I do not say that it is not so, but in a case of such importance (to "E. L. G.") we need references to the papers where these facts are proved, or the facts themselves. What is the depth of the gravel bed in the Ganges plain, and what is the rate of addition? Who proved it?

Next, as to inferences from facts: "E. L. G." quotes Prof. Boyd Dawkins to show that the Mediterranean rivers once ran into a lake or lakes 3,000ft. below the present sea level. Granted the fact; I ask "E. L. G." to explain the formation of the delta of the Nile. A river forms a delta only when its waters are checked by the sea; there the mud settles, and the river begins to divide. According to "E. L. G.," 5,000 years ago the Nile flowed into a lake 3,000ft. below its present level. It must have been a rapid river; in any case, it could not begin making a delta till the Mediterranean sea reached the level of the present delta. But the town of Zoan, built far down the delta, existed 4,000 years ago, so "E. L. G." is left with, say, 1,500 years for the filling of the Mediterranean and the formation of this immense delta. Again, the thing is impossible.

I will add only one more point. "E. L. G." again refers to Darwin in support of his view that a catastrophe is required to account for the destruction of the animals of Patagonia. On page 284 he quoted the passage at length; but he left out three lines in the middle of the passage, in which Darwin distinctly states that all the geological evidence points to the fact that the changes in the shape of the country were slow and gradual. If Darwin's evidence is good as regards the animals, why not as regards the geology? I believe that every one of "E. L. G.'s" statements, if examined carefully, would prove as mistaken as those to which I have alluded.

F. G. S.

[27029.]—BEING the querist mentioned by "E. L. G." in the above letter, I should like to state that my query to "F.R.A.S." (as to where I could find any trustworthy information as to images of Krishna crucified being found in India) was really asked as a protest against the loose statements used so frequently in support of arguments. As to the reply of "F.R.A.S." to read Higgins's "Anacalypsis," I had read the book three or four times over before receiving "F.R.A.S.'s" advice, and knew very well that Higgins never mentioned that any trustworthy evidence could be found of such images. I believe in Thibet modern crucifixes of Indra can be obtained. I do not agree with "E. L. G.'s" estimate of the "Anacalypsis," which I consider wonderful, and valuable both in research and for reference.

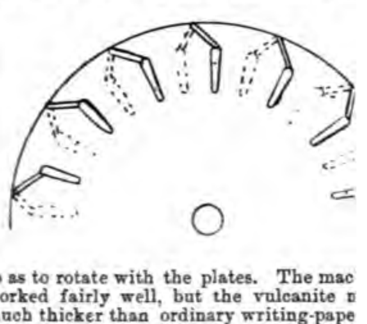
R. O. H.

WIMSHURST MACHINE WITH DOUBLE SECTORS.

[27030.]—KNOWING that so many readers of the ENGLISH MECHANIC, in common with myself, take a keen interest in the Wimshurst electric machine, I venture to submit a brief description of a machine of this type which I have lately constructed with double sectors—that is to say, with sectors on both sides of each plate. The machine is the outcome of an attempt to utilise the inner surfaces of the plates.

A pair of 16in. discs have 14 sectors of the usual size and shape affixed, as just stated, to both sides of each plate, thus making 56 sectors in all. The sectors on each disc are then connected in pairs by means of a strip of tinfoil carried over the edge of the disc, thus joining each sector on one side of the glass to its companion sector on the other side. The sectors on the inner surfaces are not, however, placed exactly opposite to those on the outer surfaces, but midway: hence the connecting strip passes round the edge of the glass obliquely. This will be best seen in the annexed sketch. It will be obvious that with sectors so
arranged no alteration whatever is requi
neutralising brushes. Every time a brus
one of the outside sectors, it neutralise
inner sector with which it is in metalli
tion by means of the tinfoil strips. The
combs, &c., are as ordinarily arranged.
stage of construction, the plates are mo
rotated, they prove freely self-exciting, th
tion being accompanied by a volley of sh
due to electricity leaping, as bright spa
the interior sectors of one plate to the
sectors of the other. As might be exp
sparks pass between the terminals.

To insulate the plates from each oth
tried several expedients. First, a pair
18in. in diameter, cut from a sheet of the
vulcanite manufactured by the Indiarub
pany, were affixed by means of a small
of shellac varnish (very little, on accou
difficulty of getting it to dry when inclosed
vulcanite and glass), one to the back of e

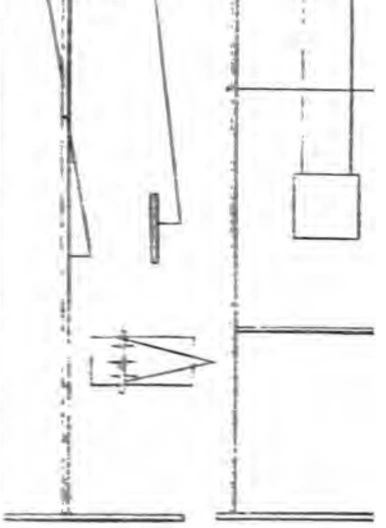


so as to rotate with the plates. The mac
worked fairly well, but the vulcanite
much thicker than ordinary writing-pape
sulation was not sufficiently good to give
results. I therefore removed the vulca
and substituted an intermediate fixed
varnished glass, also 18in. in diamet
arrangement acted very well indeed, and
according to my observation, accompanie
intermittent action, as found by Mr. Gr
experiments with the ordinary machine (
p. 62, Vol. XLIII.) The fixed plate is,
objectionable on account of the difficult
viding adequate support for it without
complicating the machine: therefore I
furnish it with a solid centre, and
by means of screws to the back of on
working plates, so as to revolve with th
This method appears the best, as it is
simple, but less space is required. The
with the plates thus arranged, does not, o
afford greater length of spark than an
machine of the same size; but the qua
electricity appears to be considerabl
judging by the number of turns necessary
Leyden jars. Theoretically, it ought to
nearly as much as a four-plate multiple m
usual design; but I am not at present
make the comparison. It is perfectly self
—in fact, it excites and gives short sparks
the terminals when one plate only is revol

H.

A WIND-GAUGE.

[27031.]—As the subject of wind powe
terested the readers of the ENG. MEC. I



effective and easily-made wind-gauge may
them also.

I send a sketch of one I contrived a f

ago, and I find it answer very well, telling the pressure from 2oz. to 4lb. to the square foot of surface.

It consists of a light deal frame on a strong stand, supporting on a centre two bent wires, carrying at one end a 3in. square of thin wood, and on the other a thin bar of wood, to the centre of which is attached a fine string tied to a spring letter balance scaled to ⅛ of an ounce and up to 4oz. As the square of 3in. is the 16th of a foot, each ounce on the spring is equal to 1lb. pressure on the square foot. The letter balance slides in the V-frame at the back so as always to keep the square parallel to the face of the frame, whether the wind is strong or light, and the balance must be slid in or out until the face of the square is so placed before registering the force of the sound. By attention to this it will register very truly up to 4lb., which is the extent of my balance. I send a front view, also a side view, and a bird's-eye view, as also one of the bent wires and the 3in. square, and I think they require no further explanation. **Philip Vallance.**

AQUEOUS VAPOUR—BURNT AIR.

[27032.]—"A. P. S.," p. 84, asserts that aqueous vapour and steam are two distinct forms of water. I consider this a misleading statement. There is no real difference between a vapour and a gas, a vapour merely being a gas capable of easy condensation. One would suppose, from "A. P. S.'s" letter, that aqueous vapour and steam could exist at the same time. A certain amount of chloride of lead is soluble in hot water, but a less amount in cold water, consequently, as the water cools, some of the salt is precipitated. Does "A. P. S." consider that in the hot solution two distinct forms of the salt exist?

I should certainly like to see some explanation of the fact (if it is one) that heated iron will act upon a large amount of water-gas (steam); but not upon a small amount (aqueous vapour). Would not iron rust, if kept at a constant low temperature in a saturated atmosphere? **Kensingtonian.**

FILES AND FILING IN INDIA.

[27033.]—I CAN remember the primitive days when the Eastern blacksmith manufactured his own files and rasps, tools remarkable for their clumsiness, irregularity of cut, and unsightly shape. Yet old "Heera Lal," of Agra, was so mighty a gunsmith that he was called the "Joe Manton of India," and "Amachellum," of Salem, Madras, as a maker of hogspears and hunting-knives, had more English customers then he could supply. I remember a double-barrelled gun, by the first-named artisan, was exhibited in England to men high in the trade, and valued by them at £60 or more. A1 steel and pure charcoal are great advantages to a manufacturer, and they were generally procurable at a low rate from one end of the great empire to the other. Nowadays, steam by land and sea have furnished the native workman with new tools and new ideas, encouraged by the good wages of railway workshops. I adopted a mode of antiquated filing they generally employ in finishing and fitting high-class work, being "draw-filing" reversed. I am very fond of this operation. According to the size and shape of your metal, select a flat file, lay it on your table with the "tang" (or handle end) furthest from you, firmly secured in a bit of wood screwed down; having previously with dividers marked off the desired level, press, push, and drive your metal along the surface of file by steady, repeated strokes; then examine the piece—you will see all prominent and uneven parts have been rubbed. I then remove these by gentle hand filing, and so on, till the whole metal shows uniform lines. I test finally with the dividers, and finish my job on a sheet of emery paper, or a board dressed with polishing powder, laid on the same table. When the Eastern workmen desire a very smooth, glittering polish, they scrape with a hard steel curved burnisher; a block of corundum having a hollow in the centre is moistened with oil, another piece of the same mineral is rubbed briskly thereon, resulting in a dark fluid; the article is smeared therewith, and hard rubbed frequently with a piece of cowhorn, then wiped with a clean rag. Should any file-marks remain, this process is again repeated, till thoroughly bright; lastly, the metal is cleaned with linen rag and well rubbed on old leather (usually a discarded boot sole) until it resembles silver. I have done every bit of the various lathe chucks made by myself from beginning to end in the manner herein described. I am running out of corundum, and wish to know where it can be got in lump. I have purchased several composite wheels of sizes and qualities, but decidedly prefer my own make—a 3in., just like solid mineral, about which I wrote to the "E. M." many years ago, Indian cutler's pattern, two wheels, coarse and fine, on the same spindle; a third one of tough leather would be a good addition. Of course, I work this in the lathe. A small hone made of same stuff I use for delicate cutlery, needles, &c. **Eos.**

A LARGE CHAMBER ORGAN.

[27034.]—HAVING just completed a most elaborate organ for a private gentleman, we inclose a few particulars which will be at once interesting and instructive to your musical patrons. Several of the appliances in this immense instrument are entirely novel; and it is almost a unique circumstance for a Chamber Organ to be built to such dimensions. We may say that the organ is not overpowering in the hall it stands in, and that eminent critics pronounce it a great success.

DESCRIPTION OF THE NEW ORCHESTRAL CONCERT-ROOM ORGAN, BY NORMAN BROS., FOR OAK LODGE, THORPE, NORWICH.

PEDAL ORGAN. C C C to F. 30 NOTES.

1	Open diapason	16ft.	metal	30
2	Violone	16	„	30
3	Bourdon	16	wood	30
4	Violoncello..............	8	metal	30
5	Trombone	16	„	30
6	Bassoon	8	„	30
				180 pipes

CHOIR ORGAN. C C to C. 61 NOTES.

7	Salicional	8ft.	metal	61
8	Dulciana.................	8	„	61
9	Viol d'Amour	8	„	61
10	Lieblich gedact.........	8	„	61
11	Flute d'Amour	4	„	61
12	Dulcet	4	„	61
13	Flautina harmonique.	2	„	61
14	Clarionet.................	8	„	61
				488 notes

GREAT ORGAN. C C to C. 61 NOTES.

15	Double diapason	16ft.	metal	61
16	Open diapason	8	„	61
17	Gamba.....................	8	„	61
18	Wald flute	8	wood	61
19	Stopped diapason	8	metal	61
20	Principal.................	4	„	61
21	Flute octaviante	4	„	61
22	Sharp mixture	3 ranks		183
23	Trumpet	8	„	61
				1,086 pipes

SWELL ORGAN, C C TO C. 61 NOTES.

24	Lieblich bourdon	16ft.	wood & metal	61
25	Violin diapason...	8	metal	61
26	Viol di gamba ...	8	„	61
27	Rohr gedact	8	wood & metal	61
28	Voix celeste	8	metal	61
29	Geigen principal	4	„	61
30	Lieblich flute ...	4	„	61
31	Mixture	3 ranks	„	61
32	Horn	8	„	61
33	Hautboy............	8	„	61
				720 pipes

ECHO SWELL ORGAN, C C TO C. 61 NOTES.

34	Echo gedact	8ft.	wood & metal	61
35	Echo dulciana ...	8	„	61
36	Echo dulcet	4	„	61
37	Echo celeste......	4	„	61
*38	Vox humana......	8	„	61
				305 pipes

SOLO ORGAN, C C TO C. 61 NOTES.

*39	Viola	8ft.	metal	61
*40	Vox angelica (2 ranks)	8	„	96
41	Flute harmonique ...	8	„	61
42	Flute harmonique ...	4	„	61
43	Cremona	8	„	61
44	Tuba harmonique ...	8	„	61
*45	Orchestral oboe	8	„	61
				462 pipes

* These stops are made of pure tin.

COUPLERS.

1. Swell to great.
2. Swell super octave to great.
3. Swell to choir.
4. Solo to great.
5. Choir to great.
6. Swell to pedal.
7. Great to pedal.
8. Choir to pedal.

The stops of great, swell, and solo organs are governed by 15 pneumatic pistons distributed equally on each manual.

The key, drawstop, and pedal action is on an improved tubular pneumatic system whereby all trackers are dispensed with. The pipes are of the finest spotted metal; those marked * are of pure tin. The wind is supplied from two main bellows, which feed reservoirs placed under each sound-board. The motive power is supplied by an Otto gas-engine.

The swell, solo, and echo organs are inclosed in separate swell boxes with vertical shutters, which will remain in any desired position. The case is of walnut and wainscot, and the whole of the inside work is mahogany carried out on an elaborate scale.

Number of speaking stops	45
Couplers and accessories	8
Total number of stops	53
Total number of pipes	3,241

Norman Bros.

Organ Works, Chapel Field-road, Norwich,
March 15.

LATHE MATTERS.

[27035.]—I THINK Mr. Armstrong's contribution to the ideal lathe of the future a good one; the adaptation of cone and hollow in chuck-fitting seems strong and simple. I have made a number of useful chucks, carried in hole of "main chuck," thereby saving delay and screwing; but the stop by screw bolt is a faulty one: it wears loose, and relaxes its hold. I shall try something more steady.

The Americans have long ago cut a screw on the end of back spindle, for many good reasons. I felt the want of this, and have made that easy addition. It now carries a good iron cup chuck 1½in. diameter, 2in. or 3in. deep, with four stout screw bolts at opposite angles; besides which, I can attach any bit of hard wood by screwing, as receptacles for miscellaneous articles. A vice jaw-chuck on end would be a very good addition. Necessity, in the shape of dirt and damage to my foot-lathe, made me construct a shifting tray to catch metal shavings, wheel-dust, and drips. This slides on the shears, being kept in place by a hole through which the bolt-rod of the tool-post passes—an arrangement of special value to me, who have turned brass, horn, wood, and iron on same day, and have my own uses for this collection of shavings, apart from the more important object of shielding the frictional parts of the machine. This tray is of zinc, but light sheet brass would be preferable. **Eos.**

THE EDMUNDS LATHE MANDREL.

[27036.]—UNDER the above heading, Mr. A. Gray ("E.M.," Jan. 21st, page 454), asks me to go again into the various questions which were discussed two years ago. As we are beginning a new volume, and it is never too late to mend, I now write to apologise to Mr. Gray for having left his letter so long unanswered, and to say that of late I have been so much occupied with other work that I have been unable to review the questions with sufficient care to justify me in again occupying space in the "E.M."

But while unprepared to publish final conclusions upon the subject, I may well make a few notes in order to bring the subject up to date and lay a basis for our contributions to its final settlement.

1. As to the importance of our having a standard interchangeable lathe-mandrel, I am more clearly convinced than ever. The standard mandrel should be of such dimensions as to serve for a 6in. foot lathe, and meet the wants alike of the scientific mechanic, the amateur who would have a generally useful lathe for making his own philosophical instruments and doing geometric or artistic work, and the idler whose object is practically to kill time by the manufacture of gimcracks in ivory and blackwood.

2. The present "ornamental lathes" serve admirably to unburden those who have surplus time and money on their hands; but they do not meet the wants either of the scientific mechanic or of the amateur instrument-maker. The lathe want must utilise the principle of modern standar sizes, simple screw-thread rates, and general interchangeability of parts. Such a lathe should be manufactured at a greatly reduced price, with an immense reduction in the complexity of its appendages and in the bother it inflicts upon the user: at the same time, it should afford more efficient action and greater range of capacity. So much for the want which we feel.

3. As to the supply. If our London manufacturers are obliged to devote themselves exclusively to the service of those who have on their hands more time and money than they know what to do with, we must visit the office of Sir Joseph Whitworth and Co. in Great George-street, or run down to the works of Thos. Cooke and Son, of York. But if we settle upon a standard interchangeable lathe-mandrel, and our London makers still cannot or will not make it, we might subscribe among ourselves for a hundred copies upon the co-operative principle, and have the lot made at wholesale price from the Small Arms Factory at Birmingham. A subscription of three guineas would, I believe, be about the price for an exemplary standard interchangeable mandrel, with its two collars in hard steel. An additional 17s. would probably furnish the standard taps and gauges necessary for the fitting of the chucks. Upon the co-operative principle, if the number subscribed for were considerable, the price might be much less; but if probable

subscribers will send their names to me, I will take care to circularise them when our plans are settled. I will now only point out that the possessor of two such mandrels might get his own lathe-heads cast, and bore them out to take the collars which he would receive with the mandrels. The lathe-bed and other appendages could be purchased economically, or the co-operative principle might easily be extended to these other parts so as to give such subscribers a complete standard lathe. The standard mandrels would serve alike for all lathes, whether simple traversing heads, back-geared heads, or self-acting slide-lathes. I should add that Mr. G. Birch, of Pendleton, has actively taken up this question of late, and has manufactured several lathes which are a great advance upon the common ornamental lathe. Perhaps he would assist us in this discussion.

4. For a really first-rate full range lathe I should adopt the 6in. centre, back-geared for heavy or slow work, and fitted with a traversing mandrel. I should also have a self-acting slide-lathe, the slide passing the dead-centre head as in the front-slide Cooke lathe, and with the dead-centre capable of being thrown off the lathe axis for conical or other special turning. I should begin such a lathe with four interchangeable standard mandrels—one for the ordinary front spindle, one for the back-gear spindle, one for the dead centre head, and one for use in the slide-rest, the latter to carry work to be submitted to the action of cutters in the lathe-head spindle.

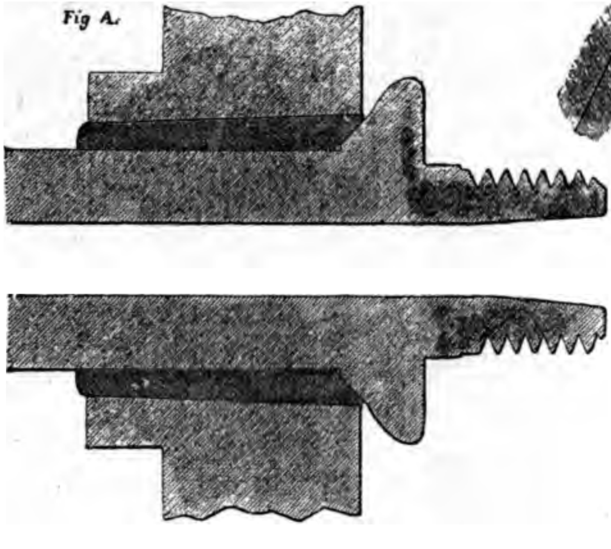
5. The interchangeable mandrel involves questions of two distinct orders. Firstly, we have to settle those questions of form on which the principle of interchangeability depends. Secondly, we have to fix upon those dimensions in which that form can most advantageously be cast for the purposes we have in view. Without identity in all its dimensions we cannot get interchangeability; without simplicity of manufacture and permanence of form we cannot adequately embody those principles upon which excellence of form depends. Therefore, we have to secure identity of dimensions as well as excellence of form in materials of an enduring character.

6. Upon such mandrels valuable chucks will become as exchangeable as microscopic objectives have already been made. But there are other points to consider. We shall look for a mandrel which, to the scientific engineer, will be a work of art. It must run so lightly as not to fatigue unduly a worker whose brains have to be on the stretch, and whose muscles can be allowed but a small fraction of his available energy. The bearings, therefore, must be small in diameter and short in length; while, to prevent heating, they must be fitted most excellently in hard steel. Yet, that the mandrel run light, it must be so rigid between its bearings as to undergo no perceptible flexure. Nothing is gained but failure by making the mandrel so small as to flex under the action of the band; and here we come upon one of our limitations in fixing upon a diameter for our bearings. In point of length our bearings must suffice to hold a film of lubricant large enough in area to sustain the pressure of the spindle without being squeezed out, and here we come upon the limit of the shortness which we can afford to adopt. The fixings of the pulley and back gear must be such as do not incise the central parts of the mandrel so as to facilitate flexure. The torsion-resisting strength of the mandrel is as the cube of its diameter, and the torsion-resisting power of a tubular mandrel is given by cubing its external diameter, then cubing its internal diameter, and deducting the latter from the former. Now that portion of the mandrel which lies between its gear wheel and its chuck is the portion on which all heavy strain comes, and one fundamental question is what, in cast steel of high quality and practicable condition, need be the diameter of this portion if we require a ·4in. bore? If we could afford ourselves a ·5in. bore without leaving the mandrel-tail too weak for carrying screw-gear, that is what we should like. The diameter of our mandrel at its front bearing was taken at 1·2in. Can we do better than adhere to this? With this diameter of front bearing we could get perfect fixings for pulley and back gear, ample resistance to torsion, not too weak a mandrel-tail with a ·5in. bore, and great stiffness as against flexure between the bearings. Light running with a 1·2in. bearing may certainly be secured with a short collar and sperm oil of fine quality. For occasional heavy metal turning castor-oil or heavy mineral oil would sustain any pressure that should be needed. The journal must be perfectly oil-borne, and so fitted in its bearings as to abolish metallic friction. But this is a point on which perhaps Mr. Gray and other readers will favour us with their opinions.

7. As to the mandrel-head, I have seen no reason to modify what I wrote as to the methods by which eccentric and angular variations are to be eliminated in chucks transferred from one mandrel to another. Eccentric variation is to be eliminated by the nose carrying a cylinder-base slightly larger than the outside diameter of the screw thread; the screw thread is to fit so easily as to leave the set of the chuck to be determined by the action of the cylinder-base. Angular variation is to be eliminated by the wide mandrel-face and by equally wide chuck-faces finished off so as to take their real bearing upon the outermost zone of the mandrel-face.

The nose should, I think, project 1in. from the mandrel-face; but whether the diameter of its threaded portion should be 1in. or 1·5in. is, in my mind, an open question. On the whole, I incline now to throw overboard still more completely the traditions of the "ornamental" school, and to make the diameter of the threaded part of the nose 1·25in. and the cylinder-base 1·375. As to the screw-thread, 10 turns per inch would be too fine, and I now see that it would be preferable to have for the chucks special taps that would never be hacked about for other purposes. In that case the introduction of a special thread which would prevent the risk of common chucks being forced on to the mandrel would have many advantages and no disadvantages. The rate of the thread must be an aliquot one, and the perfect thread-form for a lathe-nose would be a truncated buttress-thread, its vertical face towards the lathe-head, and its other face at 45°. A rate of five or six turns to the inch would answer well. But the thread must do for wooden chucks as well as metal ones, and it may be that a truncated angular thread will prove unavoidable. The buttress thread may be seen in the breech-pieces of the Whitworth cannon, and was called by Sir Joseph "the resistance thread." It has answered admirably. In the Whitworth gun the threads are cut away in alternate sixths, and the breech closes perfectly with one-sixth of a turn.

Fig A.



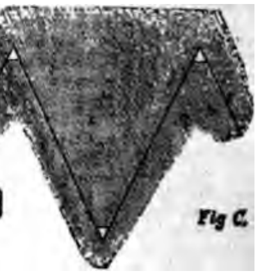
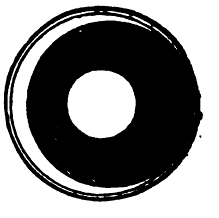
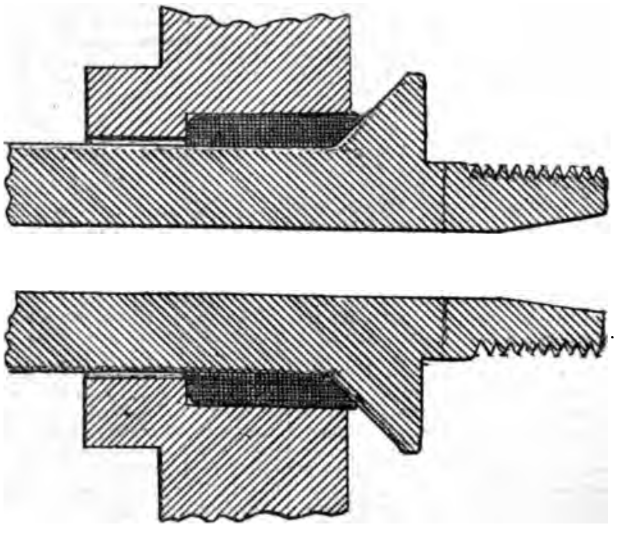


Fig C.

Fig B.



The Editor has kindly reproduced above the engraving of the model mandrel-head and its front bearing which illustrated our discussion two years ago. I now think that ·5in. to ·75in. might be cut off from the left end of the front collar so as to shorten it considerably, and increase the lightness



of its running when required to work at high velocities for wood-turning. The following rough cut will show my notion of a shortened collar.

I shall look with much interest for further discussion with a view to settle the matter.

James Edmunds.

8, Grafton-street, Bond-street.

A LATHE SCREWING APPARATUS.

[27037.]—I must make full apologies for proposing to add yet another to the many devices for cutting screws in the lathe which have appeared in the ENLISH MECHANIC; but as I have not seen (possibly only from want of research) any description of such an apparatus as I fitted to my own lathe some years ago, and as the said apparatus does its work very well, I send a short description of it herewith. It seems, at any rate, to have the advantages (1) of being perfectly correct in principle, (2) of being available for any thread, right-handed or left-handed, from about 5 to 50 per inch, (3) and not requiring traversing mandrel, slide-rest, leading-screw, change-wheels, or carefully-speeded pulleys.

In nine cases out of ten, where a screw has to be cut on work in the lathe, all that a respectable workman wants is a correct lead (such a lead, in fact, as shall not, like so many "friendly leads," be conducive to "drunkenness"). If he can get three or four threads correctly cut, he can trust to his eye, hand, and chasing-tool to do the rest.

Now, a screw is, of course, simply an inclined plane coiled round a cylinder; and there are three principal methods of originating one upon work revolving in the lathe.

(1) To have a series of inclined planes, each of different but definite angle (pattern screws, in fact), and to employ the appropriate one for guiding the tool in its traverse over the work, or the work in its movement under the tool.

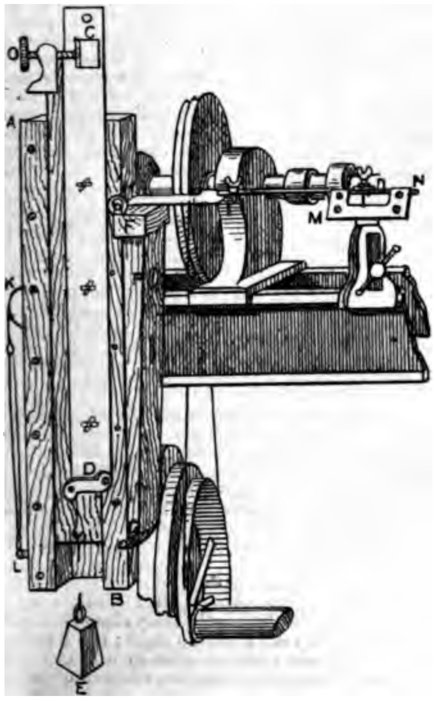
This is the principle of the traversing mandrel and of several other contrivances for guiding the tool which have appeared in the ENGLISH MECHANIC.

(2) To have a single inclined plane of definite, invariable angle, and make the tool travel along a definite fraction of it while the work makes a given number of revolutions.

This is the principle of the ordinary screw-cutting lathe with leading screw and change-wheels, and of the various contrivances for connecting the slide-rest screw with the mandrel by pulleys, &c.

(3) To have a single inclined plane, the angle of which can be varied at pleasure.

This is the principle of the old fusee-cutting engine, and of the contrivance described below.



A B is a block of sound, well-seasoned oak, about 24in. × 4in. × 2in., clamped firmly at right angles to the lathe-bed. It has carefully-planed, bevelled cheeks screwed upon it, between which a strip of oak slides up and down through a distance of about 15in. On the surface of this slide an ordinary flat steel straight-edge, C D, is clamped by thumb-screws working in slots, so that it can either be placed exactly parallel to the slide, or turned on a joint, D, at its lower end, and clamped at any determinate angle with the slide. This forms the variable inclined plane required.

In a mortise cut at the back of the oak block, just at the level of the lathe mandrel, is inserted a pulley over which runs a piece of steel pianoforte wire. This wire passes down a channel at the back of the slide, and is fixed to its lower end. The other end of the wire is coiled round the cylindrical part of the mandrel; and thus when the latter revolves the wire is wound upon it, and raises the slide. In order to keep this wire tight, a weight, E, of 4 or 5lb. is hung from the bottom of the slide.

On the right-hand side of the oak block is hinged a strip of wood, F G, nearly as long as the block (the hinge being at its lower end, G). At the top of this strip a flat bar of iron, H I, is jointed, which has at the end, H, a grooved roller bearing upon the edge of the inclined plane already described. In order to keep this roller pressed firmly against the plane, a cord is attached to the strip of wood near the top, and passes through the main oak block and over a pulley, K, on the left-hand side. It is then attached to one or more indiarubber door-springs, which latter are hooked to the block at L. The right-hand end of the flat bar is clamped by a connecting piece and screws working in slots (to allow for work of various diameters and various distances from the mandrel nose) to a short slide, M N (made, as a matter of fact, out of a large brass door-hinge; part of the outside tenons being cut away so as to allow about an inch of lateral play). This slide is attached, as shown, to an ordinary T rest, so that the table of the slide (formed by one flap of the hinge) moves to and fro over the top of the rest, and carries the V tool or graver, which is held steady between two studs against which it is pressed by the hand, and advanced as required against the work. At the front edge of the slide a line is cut, and just below it, on a fixed part of the frame (the other flap of the hinge, in fact), a fiducial mark is made, for a purpose to be described immediately.

Now, it is evident that, as the mandrel revolves and by winding up the wire raises the slide and inclined plane, the roller bearing on the edge of the latter will move from right to left, and by means of the connecting bar will cause the tool to traverse by an amount depending on the gradient of the inclined plane: thus a screw will be cut on the work attached to the mandrel. In my own apparatus, five turns of the mandrel raise the inclined plane from its lowest position to a point at which the roller ceases to follow it, and thus five threads of the screw are cut.

In order, then, to cut any given screw, the distance between five threads of the screw is taken by a pair of dividers (for instance, if a screw is to have 30 threads to the inch, $\frac{5}{30}$ or $\frac{1}{6}$ of an inch is taken); the slide is let down to its lowest point, where a stop arrests its descent; the straight-edge is brought into parallelism with the slide; the mark on the tool-slide is made to coincide with the fiducial line on the frame below it; and the connecting bar is clamped tight. Then, by means of the screw, O, the upper end of the straight-edge is thrown from left to right until the mark on the tool has been moved to the right of the fiducial line by a distance equal to five threads of the intended screw as given by the dividers (or the chasing tool itself may be applied to the lines), and the straight-edge is firmly clamped in this position. The connecting bar may then be unclamped, and the rest with tool-slide adjusted to the proper position for the work. If the mandrel is now caused to revolve slowly, the tool (brought into cut by the hand) will be pulled from right to left by the indiarubber springs as the roller follows the inclined plane, and a screw will be cut on the work which may be deepened to any extent required.

If only a very short screw is required, running close up to a shoulder, the roller is caused to leave the slide at any desired point by turning the stop-screw, P, and the tool then simply cuts a ring on the work.

In order to cut a left-handed screw the wire has only to be wound round the mandrel in the opposite direction, and the cut begun when the inclined plane is in its highest position. Then, as the weight drags it down, the tool will move from left to right, and trace, of course, a left-handed screw.

The materials for the apparatus did not cost more than 10s., and although I intended to have the main slide made of iron, the oak has hitherto answered so well that I have not taken the trouble to alter it.

H. G. Madan.

TABLE FOR LATHE CIRCULAR SAWS.

[27038.]—I SEND sketch of table for lathe circular saws, which I hope you will think sufficiently important for amateur readers to insert. It consists of a beech block on to which the leaf is hinged with butt hinges; this leaf consists of two pieces of thin hardwood, clamped together in such a manner as to leave an opening for the saw to work in. Two small brass attachments (for want of a better name), Fig. 2, are so fixed on the underside that they are exactly flush with the back face of the block; these may be fixed high or low as occasion requires, and are held in position by the set-screws. This is an affair that may be rigged up by any amateur in two or three hours, and is most useful for cutting rebates and for small ripping work. A guide, of course, is on the upper side of table (see Fig. 3). A wood key driven through hole in bottom of block keeps all firmly fixed on bed.

J. L. Gubbins.

FIG. 1.

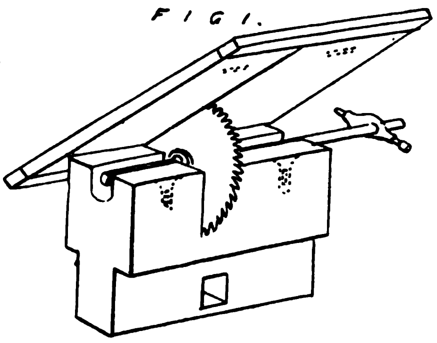


FIG. 2.

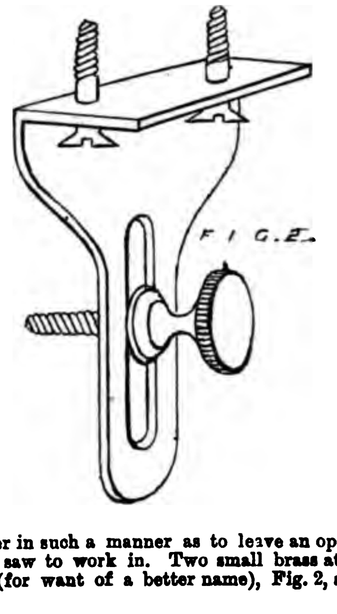
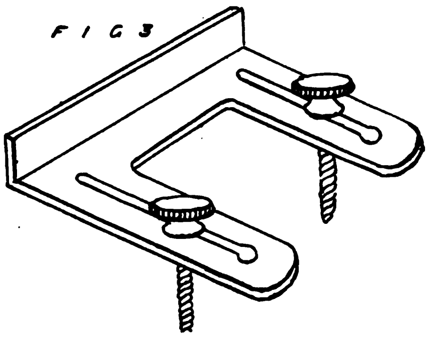


FIG. 3.



NIBLETT'S SCREWING APPARATUS—A PUZZLE FOR MATHEMATICIANS.

[27039.]—I HAVE been waiting to see what other correspondents would say to this most ingenious device; but probably they are still cogitating. My opinion is that it is one of the cleverest contrivances that has been brought before us for some time. I have been some time in coming to this conclusion, the drawing having been sent to me last year. At first sight one supposes that a swash-plate, or rather swash-ring, could not possibly give a regular pitch, since the angle would be greatest at the middle of the stroke, gradually diminishing to nothing at each end where it gently reverses the motion. Looking at Fig. 1, which represents the front of the ring, we see it is of the shape *a*, *b*, *c*, *d*; the parts *a c*, *b d* being the working parts, and *a b*, *c d* going straight across in such a way that the roller does not move while passing over them; thus, that part of the swash-ring which would give the worst result in a gradually diminishing and then increasing pitch, is practically cut away, and instead we get about three turns of the

FIG. 1.

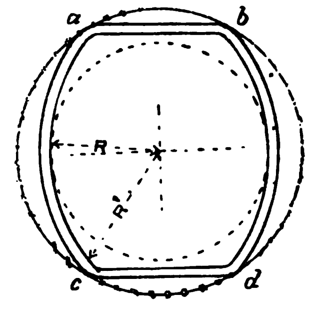


FIG. 2.

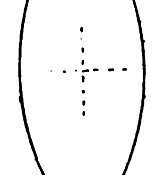
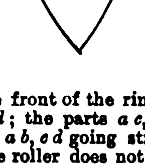


FIG. 3.



mandrel while the tool stands still before it begins to return for the left-hand thread. If this were all, we should still have an imperfect rate, a screw cut with the apparatus having a quicker pitch at the middle and slightly decreasing towards each end. To prevent this the working parts of the ring are not cut from the centre of revolution, but the radius R gradually increases towards the corners R', where the motion ceases at *a*, *b*, *c*, and *d*; this spreading of the ring tends to gradually increase the pitch as those points are approached, and so gives the needed compensation.

I believe Mr. Niblett arrived at this result by experiment, which only shows how much may be done by patience and perseverance. I have not myself been able to prove the possibility of this form of compensation mathematically; but I very much hope some of our more mathematical friends will take the puzzle in hand.

For them perhaps the problem might be stated thus: See Fig. 2. A B is an axis or centre of revolution; round this revolves an inclined ring *r*, which need not be round, but may be as Fig. 3; against the edge of the inclined ring *r* presses a rubber R: if then the ring *r* revolve equally round A B, what shape must it have to move equally to and from the rubber R? Also show whether it will do so at different inclinations.

F. A. M.

NIBLETT'S SCREWING APPARATUS.

[27040.]—WITH your permission I would like to ask a question or two about the above. It is, undoubtedly, an ingenious arrangement, and for box-lids, &c., should answer well. But it seems to me, for the following reasons, that it cannot cut a screw of equal pitch except of one particular pitch—i.e., that for which the swash plate is shaped. This may be better understood by an example. We will assume that the swash plate makes one revolution to twenty-four of the mandrel. Now suppose we want to cut a screw of twenty-four threads per inch. It is evident that the swash plate must be placed at such an obliquity that its acting part forms a portion of a screw of 1in. pitch, so that it may move the tool at the rate of 1in. for twenty-four revolutions of the mandrel. It is also evident that to cut a thread of equal pitch all along the acting part of the swash plate must be shaped exactly as part of a plate of 1in. pitch. Now this being the case, can it cut any other thread than that it is made for more than approximately correct? I think not. And if we consider the shape of plate required to cut the coarsest thread marked on drawings—i.e., eight per inch, which would require to be part of a screw of 3in. pitch, and then tilt it up till only 1in. pitch—it will, I think, be plain that it can't be right for both.

Of course this difference in pitch, or varying pitch in the same screw, may escape notice for the reason (which is a defect in the apparatus) that the screws cut are necessarily short, for the twenty-four per inch only ⅓ long, for the eight per inch 1⅓in., as the tool can't travel back and forth more than half the pitch the swash plate is set to.

Why is the acting part of the cam the peculiar barrel shape when looked at centrally with the mandrel? If there is any reason, it is not given in the text. I trust "O. J. L." will consider these as questions, not as criticisms, and kindly make these points clear.

In fine threads the chaser would be wider than the length of screw, and would probably correct a small variation in pitch. Will "O. J. L." kindly try a single-point tool on two or three different pitches, and report. **J. M. G.**

ELECTRIC BATH.

[27041.]—AS many of your readers are interested in this form of curative galvanism, the book I can most recommend out of my stock on that subject is "Harry Lobb on Galvanism," last edition: publisher, Baillière. There is another on this kind of bath by Dr. Casslin, but I no not possess it. "J. C. L." says that Pulvermacher's chain arrangement (as in my sketch) is the only suitable form of battery, and gives his reasons.

Eos.

NEW TEMPERING OF STEEL TOOLS.

[27042.]—NO. 1.—Immerse at red heat in water heated to proportional size of articles. Example: Needle gun springs at 55° Centigrade.

No. 2.—Harden drills and such small tools in hot pincers. When brought to a white heat, press the steel into a stick of sealing-wax for a second, withdrawing and repeating rapidly till cold, when it will not enter the wax. In using all such hard tools lubricate with oil of turpentine. Steel so prepared will cut all but the diamond.

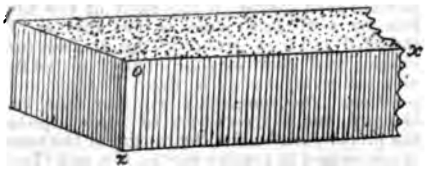
No. 3.—To restore burnt or over-heated steel, immerse at a red heat in sea-water, or a strong solution of salt.—*Practical Magazine* of 1874.

NOTE.—I like the first method, and have found it useful. I have failed entirely with the second in two or three trials (a lump of bar soap instead of sealing-wax I found successful). No. 3 is excellent. I added a little muriatic acid to my salt solution, and used the same pot for months. After quenching, the work must be cleaned and oiled.

Eos.

A SIMPLE HYGROMETER.

[27043.]—REFERRING to letter 26945, page 35 (11th March, 1887) may I ask "J. T. N." on which surface of the end grain wood the veneer should be glued? Suppose this to be a sketch, in perspective, of a portion of a strip of wood cut from



the end of a pine board. Expansion will occur, by access of moisture, along *o x*, and along *o y* (which may be neglected) but not along *o z*; that is, the strip will become longer, and if the expansion be partially prevented, it will bend or curl as described. But this will happen, more or less, whether the plane *z o x*, or the plane *y o x*, be made rigid: which is to be preferred? I am rather disposed to glue the veneer to *z o x*, so that both sides of the end grain may be exposed to the atmosphere.

Also, what is the "good, well-built hygrometer of the ordinary type" which he used for comparison—the wet-and-dry bulb?

There is a copious account of similar contrivances, and of others on analogous principles, in the excellent but neglected Rees' Cyclopædia articles, "Hygrometry" and "Hydraulics." Unfortunately, such instruments decrease in sensitiveness. **Antares.**

BURNING OF COILS IN ARMATURES.

[27044.]—SEVERAL queries have appeared as to the cause of individual coils becoming heated and burnt up in the armatures of dynamo machines, which have not been decisively answered. The following statement of facts will perhaps be interesting:—At the works of a friend of mine, a dynamo which runs an arc lamp was observed to have smoke coming from it directly after being started. It was immediately stopped; but on a cursory examination nothing particular could be seen to account for the smoke. It was started again, and a sharp look-out kept for a recurrence of the phenomenon; in a few seconds a smell of burning was apparent. The machine was again stopped and examined; one coil or section on the armature was found to be of a darker colour than the rest, indicating partial burning of the insulation. The next thing was to find the cause. Various conjectures arose, such as short-circuiting in the core, &c.; but a close examination showed that there was a short circuit between two consecutive bars of the commutator (the wires from the armature to the commutator were secured by a washer and a screw, and one of the washers touched the next bar on the commutator; it may be here stated that the commutator was one having 24 bars); but this did not appear to be a sufficient explanation, because one would conclude that when two neighbouring bars in a commutator were in metallic connection, the inclosed coil would therefore be cut out of circuit—as it were electrically ignored. It was resolved to test whether this was or was not the cause, and on another dynamo two neighbouring wires from the armature were directly connected with a piece of copper wire (this exactly corresponding to two consecutive bars of a commutator being in metallic connection); the machinery was started, and in a few seconds the smell of burning insulation showed, and subsequent examination proved, that the cause of individual or consecutive coils or sections becoming charred was the short circuiting between the next wires of commutator bars. The machine on which this experiment was tried had 16 divisions on the commutator. This is the practical cause; the theory may be discussed.

Middleton, Lanc. **F. L. Striffler.**

AN enormous pre-historic necropolis has been discovered, and is now in course of excavation, at Santa Lucia, near Trieste. The remains appear to belong to the "Hallstatt period," or rather to some part of it.

AT a recent meeting of the Paris Biological Society an apparatus was shown made of iron and glass, in which a pressure of 1,000 atmospheres can be developed for the purpose of studying the influence of pressure on animal life.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

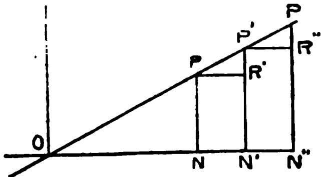
[61173.] — **Varnishing Fishing-rods.** — At home and abroad for many years I have given up "varnish" as a mere "eye-wash" for embellishment. Should the wood be naturally dark, I only rub in with some woollen rag some old linseed oil (raw) two or three times in a season; should the material be white or pale, I dye it as soon as possible after the joints are finished, then smooth with fine sandpaper and apply the oil as before. The "bindings" must be varnished, of course. Copal is as good as any.—EOS.

[61402.] — **Electric Bath.**—TO "EOS."—In gratitude to "Eos" for his interesting papers in "Ours" for 25th ult., I will try to explain to him his difficulty as to zinc being positive. Zinc is the positive plate in the cell, and so the current flows from the zinc to the other (say copper) plate, through the solution. Consequently, outside of the solution, that is, in the external circuit, the current flows from the copper to the zinc. Hence the copper connection is the positive pole, whilst the copper plate is the negative plate.—ELECTRICIAN.

[61452.] — **Electrical Apparatus.**—"Electrician" says he knows I am mistaken in saying that with secondary batteries charged from primary batteries, a week's charging is necessary for a few hours' lighting. I should have thought it hardly necessary to point out that my remark, which I have no occasion to modify, referred as a matter of course to the ordinary primary battery sets that the manufacturers of these articles are in the habit of constructing. Of course if a sufficiently enormous primary battery were made, a set of accumulators could be sufficiently charged in a few hours to give even a week's light; but I referred to the ordinary sizes of primary batteries in the market. The matter, however, of size is of secondary importance, the question of cost being far more important; and, as regards this, I entirely disagree with his assertion that it is cheaper to charge a secondary battery from a primary than to light from a primary direct. I should like to hear what some of our other correspondents say. There must be many who have had experience of both. On the question of economy of first cost also in anything bigger than a toy battery, the first cost of a set of accumulators (which are very expensive articles to buy) to produce a given light, and the primary battery to charge them would certainly be not less, but more, than that of a primary battery to produce the light direct, especially if the latter were employed with certain recent inventions; or to speak more correctly, more perfect apparatus for the transformation of electrical energy, by means of which the necessity of a long string of cells in series to produce the requisite E.M.F. for lamps is avoided. I had hoped to be able to give this week details of the dimensions, first cost, and working cost of a large primary battery that lit ten 16c.p. lamps every night for two or three hours in a business establishment in London with which I am well acquainted, but have been unable to see the engineer who purchased the battery, so must wait till next week. The battery was in use about eight months, and was then changed for an engine and dynamo on the installation being enlarged. About the convenience of accumulators, of course there can be no question.—EDWARD CONBY.

[61538.]—**Straightening Wire.**—This operation is well described and illustrated in a special chapter of "Harrison's M. Tool Book," a cheap and practical "guide to the workshop"—author American—can be obtained from "Spon, Charing-cross."—EOS.

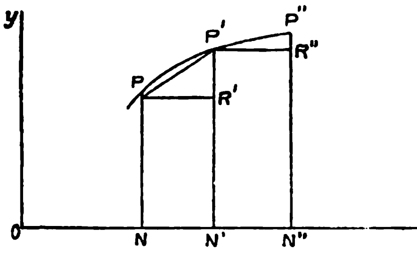
[61574.]—**The Calculus.**—In answer to the question of your correspondent, "Tyro," I give the following, taken from Bell's "Illustrations of the Differential Calculus" (Deighton, 1850). $P P' P''$



is a curve referred to $o\,x$, $o\,y$ as axes; $O N = x$: $N P = y$. Let x receive the small increment $N N' = dx$, then $dy = P'N' - P N = P'R'$ and $\frac{dy}{dx} = \tan. P'PR$, and $PP' =$ ultimately tan. at P.

Consider now the geometrical meaning of the quantity represented by d^2y. It is the increment which dy or $P'R'$ receives when x becomes $x+dx$.

Take $N'N'' = d\,x$, and draw the corresponding ordinate $P''N''$ and $P'R''$ parallel to $o\,x$. $P''R''$ is what $P'R''$ or $d\,y$ becomes when x becomes $x + d\,x$, and $d^2\,y$ is therefore the difference between the lines $P''R''$ and $P'R'$. This may very easily be constant. Thus, to take the simplest possible case, as it will explain the principle equally well, let the curve be a straight line passing through the origin o at angle 45°. Then we have the equation



$y = x$. Make $N\,N' = N'\,N''$, and make x the independent variable. $P''R'' - P'R' = P'R'' - P\,R' = o =$ const.—T. W.

[61574.]—**The Calculus.**—Owing to the unusual length of my former reply, I was induced to withhold a few additional observations which I may now supply, particularly as they seem to me to concern "Tyro's" latest statements. The successive differential coefficients of functions can all be obtained by the theory of limits from the expansion of $f(x + \triangle x)$ in a manner precisely analogous to finding the first differential coefficient. Let $f(x)$ be the proposed function of x. Imagine, for the sake of demonstration, $f(x + \triangle x)$ to be expanded in a series according to the powers of $\triangle x$. Then $f(x + \triangle x) = f(x) + P\,.\triangle x + Q\,.\triangle x^2 + R\,.\triangle x^3 +$ &c. In proceeding to find the first differential coefficient, we transpose the first term $f(x)$ of this expansion to the left-hand side, divide by $\triangle x$, and take the limiting ratio, which is equal to P. Now, similarly, in order to find the second differential coefficient, we may transpose the two first terms, $f(x)$ and $P\,.\triangle x$, to the left-hand side, divide then by $\triangle x^2$, and take the limiting ratio as before, and this limiting ratio (equal to Q) will give us the second differential coefficient of the proposed function. With regard to the query of "Another Tyro" concerning what portions of the calculus are generally required to be known in its application to physics, I consider there could be no better selections than what are contained in the "Differential Calculus" of T. G. Hall, written, as the author himself states, with a special view to that requirement. Any further knowledge of the science necessary in the study of physics may be looked for in works on the particular branch of physics to which the learner applies himself, for authors should be reasonably expected to explain beforehand all the recondite mathematical principles necessary to be known for understanding their works, or at least to give reference to some other accessible works in which such principles will be found explained. In physical astronomy, the "Mathematical Tracts" of Sir G. Airy is a work very suitable for acquiring the necessary mathematical knowledge. A third correspondent, "J. R. C. C.," has expressed himself on the merits of works on the calculus in a manner with which I do not agree. My idea of Todhunter's treatise is that it serves particularly to unfold the methods of analysis, but that it does not give due regard to the practical applications of the science, especially as it contains nothing on the integration of differential equations. The "Integral Calculus" of Homersham Cox is indeed an interesting little work, but the author has rendered it almost an impracticable one from the extraordinary idea he adopted of founding his methods of operation on integration considered as summation. The summatory idea of integration is no doubt very important in its applications, and, in finding certain definite integrals, is indispensable; but it must only embarrass the student to introduce such a cumbersome method of finding the general integrals of functions where the best method must be the readiest one for obtaining practical results. I am unable altogether to see any reason for the reputation which the treatise of Ritchie has obtained for lucidity of explanation. Gregory's "Examples on the Calculus" is really an excellent work, and the works of Thomson are both clear and interesting, notwithstanding a remarkable parsimony in regard to economy of space. An author whose works on the analytic mathematics I much approve, is Professor J. R. Young, of Belfast, amongst which, particularly is his treatise on "Algebraical Equations of the Higher Orders," still the most practical work of the kind. A very learned treatise on the "Theory of Equations" has been published of late years by Messrs. Burnside and Panton, of Dublin University, in which, with regard to the long-sought problem of the general solution of equations above the fourth degree, it is stated that a transcendental solution of the general equation of the fifth degree has been obtained by means of elliptic integrals—a very abstruse principle of solution without any room for doubt, and probably an embarrassing method even for those who have been at the pains of wading through the entire course of Cayley's treatise on "Elliptic Functions."—VLADIMIR.

[61710.]—**Speed Indicator.**—Mr. Stroudley's speed indicator for locomotives was described and illustrated in No. 957.—W. X.

[61715.]—**Faulty Organ.**—This querist, after tracing the action throughout, and seeing that the pipes stand steady, and that there is nothing loose on the soundboard, should open the windchest, as it will be almost certain then that the pallets are out of order.—J. B.

[61729.]—**Estimating.**—Dobson and Tarn's "Guide to the Practice of Measuring and Valuing," Crosby Lockwood and Co. (9s.), is a standard work; but the Editor has himself answered this query, and your choice must, I think, rest between the above and the work he referred to.—F.R.I.B.A.

[61731.]—**Injector.**—Depends on the construction of the injector, to a certain extent; but it ought to work at the higher pressures.—W. X.

[61733.]—**Oils and Tallow.**—Surely "Tester" does not imagine that there is a simple recipe which will enable him to detect adulterations in oils? He should read an article on p. 314, No. 1082, and look through the papers on "Exercises in Technical Analysis" which have appeared recently.—NUN. DOR.

[61738.]—**Shirt Buttons.**—Demurring to the "low price," as "B. H." says, the method of making pearl buttons is much as follows:—The shells are operated upon by cylindrical cutters (tubes) which cut out pieces nearly to the diameter required. These are then split, and the laminæ finished on both sides while held in a spring chuck, the holes being drilled at the same time. The buttons are afterwards polished by the aid of rottenstone on a revolving table. I have an indistinct recollection of an article appearing some years ago descriptive of the machines employed in the work.—NUN. DOR.

[61743.]—**Winking and Blinking.**—Generally caused by an excessive sensitiveness to light; but no good advice can be given until after examination of the patient.—M. D.

[61747.]—**Moss.**—Dried in hot sand as a rule, and dyed, if necessary, afterwards.—J. S. M.

[61753.]—**Sympathetic Vibrations of Jet.**—Permit me to suggest that for all details about the graphophone, the querist should procure the specifications of the patents. There are three, I think, and one of them is rather expensive, as the claims alone make it almost a small volume. I am afraid that, interesting as the phenomena are, they are of little practical utility.—SAML. RAY.

[61755.]—**Medical Battery.**—If the querist with the battery before him cannot see how to connect it up, it is almost hopeless for anyone to attempt to teach him by means of a reply.—FARAD.

[61768.]—**Battery for Lamp.**—From time to time there are constant inquiries from readers of the "E. M." for particulars of some primary battery that has been in use for lighting on something approaching to a large scale, and has been permanently used. The following particulars may be interesting. They are of a large battery that was in use for eight months at the establishment of Messrs. Rowlands and Fraser, jewellers, Regent-street, and was put up by Mr. E. G. Craven, of 22, Great George-street, Westminster:—Nine cells, which ran ten 5c.p. lamps (used for the windows) for twelve hours—i.e., about six hours each night, the battery being recharged three times a week. The dimensions were as follows: Outer jars of glazed earthenware—outside 13in. deep by 6in. wide, 12in. long; inside, about 1in. less each way, except length, which was about 1½ less, owing to a slight curve in of the ends, natural to this class of pottery; porous cells, outside, 11¾in. by 9½in. by 2¼in., and about ¼in. thick. In each cell were one carbon, 8in. by 10in. by 1¼in., and two zincs a little larger, about an inch every way. The current given was about 8 ampères. The prime cost of the battery was about 16s. per cell. The solution was a special one which Mr. Craven reserves, and cost about 12s. per week; but the following may be used: Outer cell, sulphuric acid and water, 1 to 10; inner, equal parts saturated solution of bichromate of soda and hydrochloric acid. The battery did not fume at all.—EDWARD CONRY.

[61777.]—**Ferro-Chrome.**—Having treated the alloy of chromium and manganese, &c., in the first instance with HCl, evaporated sol. to complete dryness, and fused the chlorides with an excess of fusion mixture (1 part Na_2CO_3 to 1 part KNO_3), converting the iron into insoluble oxide, the Mn, Si, Cr, respectively into alkaline manganate, silicate, and chromate, detach the fused mass from the crucible in which the fusion was conducted by boiling out with water, remove crucible, and add three or four drops of alcohol to decompose the manganate, and allow the iron and manganese oxides to settle thoroughly. When the liquid is clear, filter through a double filter, disturbing the precipitates as little as possible, wash filter well before pouring on precipitate; when washed, wash precipitate twice by decantation with hot water; when this has run through filter, the filter need not be washed again. Precautions not to wash or disturb the precipitate when on the filter are absolutely necessary, as the ferric oxide is in such a fine state of division that any attempt to do so would cause some of it to pass through filter into chromium sol. The clear yellow liquid contains the chromium and silicon (if the chromium be alloyed with iron or steel), to it add 20cc. HCl; take precaution to prevent projection of the solution from beaker, by the CO_2 which is evolved; boil sol. well until all CO_2 and nitrous fumes are driven off. The colour of the solution should now be green, owing to reduction to chloride; dilute ammonia is added in the least possible excess, and the sol. heated nearly to boiling. Collect the resulting precipitate on a filter (previously well washed with hot dilute HCl to free it from iron) and wash slightly. The precipitate is now dissolved off filter with hot dilute HCl. The sol. is now evaporated to dryness to render the SiO_2 insoluble. The sol. chromium chloride is taken up with 10cc. HCl, and about 90cc. H_2O, and is filtered through a washed filter, and carefully washed with hot water. The precipitation of the chromium is repeated as before, with dilute NH_4HO, and chromium hydroxide comes down free from SiO_2 and alkaline salts. It is filtered, washed, dried, ignited, and weighed as chromic oxide. I have used this method for determining amount of Cr in iron and steel, and have found it to give very accurate results, if the precautions mentioned are carried out.—W. H. S. S., Steel Works Chemist.

[61777.]—**Ferro-Chrome**—The following is an excellent method for the determination of chromium in the presence of iron and manganese:—Dissolve 1 gramme of the sample in a mixture of 3 parts nitric acid (sp.gr. 1·20) and 5 parts hydrochloric acid (sp. gr. 1·10), using about 20cc. of the mixed acids. Evaporate to dryness, take up with hydrochloric acid, dilute somewhat with water, and filter from silica. Place the filtrate in a porcelain basin, add ammonia solution in the least possible excess, and digest the mixture on a sand bath until the supernatant liquid is colourless. Filter off the precipitate, wash well, dry in water oven, detach from filter paper, mix well with 4 grammes of sodium carbonate and 2 grammes of potassium nitrate. Burn the filter paper and the adhering portions of the precipitate, and add the resulting ash to the mixture. Place the mixture in a large platinum crucible and fuse at a full red heat for about half an hour. Boil out the fusion with water, add a few drops of alcohol, and digest gently for some hours. Filter from the precipitated oxides of iron and manganese, and wash well with hot water. Acidulate the filtrate containing the alkaline chromate with hydrochloric acid, and then add excess of alcohol, which boil off. The solution changes from yellow to green; this is due to the alkaline chromate being reduced to chromium chloride by the alcohol which is oxidised to aldehyde. Having boiled until no smell of alcohol or aldehyde is perceptible, add ammonia solution in the least possible excess, and boil in a porcelain basin until the liquid above the precipitate is quite colourless. Filter off the precipitate of chromium hydrate, wash, dry, ignite, and weigh as chromium sesquioxide Cr_2O_3. Calculate to chromium. One part of the Cr_2O_3 contains 0·68661: hence by multiplying by this number we get the corresponding weight of metallic chromium in the weight of sample taken. By using the corresponding logarithm, which is —1·8367101, a saving in the calculation may be effected.—HENRY J. HARDY, F.C.S., Sheffield.

[61777.]—**Ferro-Chrome.**—Since writing my previous reply to this query the thought has suggested itself that probably "Games'" ferro-chrome may be rich in chromium, in which case *aqua regia* would not thoroughly decompose it, and recourse must be had to fusion with bisulphate of potash. The metal must be in as fine a state of division as possible, best obtained so by crushing in a steel crushing mortar and sifting through fine muslin. One gramme of the ferro-chrome is taken for the analysis, and treated with 15 grammes of potassium bisulphate in a large platinum crucible. The silt is melted, and allowed to cool until it becomes syrupy, whilst in this state the metal is placed on the tap. The mass is then heated very slowly; after which it is heated more strongly. When all effervescence has ceased, the mass is raised to bright redness for about ten minutes. The crucible is allowed to cool, and the fusion, which should be homogeneous, removed. If any black particles are seen, all the metal has not been decomposed; in which case, the application of heat must be prolonged. When decomposition of the alloy has been effected, the cold mass is coarsely pulverised and digested until dissolved with about 70 to 80 cubic centimetrès of water. Ammonia solution is then added in the least possible excess, and the excess boiled off. The precipitated oxides are then filtered off, and washed several times with hot water. The precipitate is then dried in the water oven, removed from the filter paper, and mixed in a platinum crucible with four grammes of potassium nitrate and two grammes of potassium carbonate. The filtering paper and adhering portions of precipitate are burnt and added to the contents of the crucible, and the mixture fused at a red heat for about half an hour. By this treatment the chromium is converted into potassium chromate, which is soluble in water and alkalies. The fused mass is then treated with water, and the oxides of iron and manganese separated by filtration. The filtrate is acidified with acetic acid, and heated to boiling for a few minutes. Should any ferric oxide be observed in the solution which may have come through in the washing, it is filtered off. The solution is accurately neutralised with a solution of potassium hydrate in alcohol, and mercuric nitrate added to precipitate the chromium. The chromium is precipitated as mercuric chromate. The precipitate is allowed to stand for some hours and filtered through a Swedish filter; it is then dried, ignited in a platinum or porcelain crucible, and weighed as chromic oxide (Cr_2O_3), the weight obtained multiplied by 0·6862 gives the corresponding weight of metallic chromium.—HENRY J. HARDY, F.C.S., Sheffield.

[61829.]—**Resistance Coils.**—You seem to have copied one of Elliott's R. boxes. As regards the incremental Rs., the wires are wound on double, as you say, but in one piece.—VINCENT.

[61829.]—**Resistance Coils.**—I notice that "K. C. B." recommends as a standard ohm 11 of No. 30 G.S. wire. This is really no use whatever, as the value of such a length and size of wire may easily vary 10 per cent. for one ohm. If the querist will advertise his address, I shall have pleasure in making him an ohm. I may say my first ohm coil was obtained in same way through these pages. —OHM.

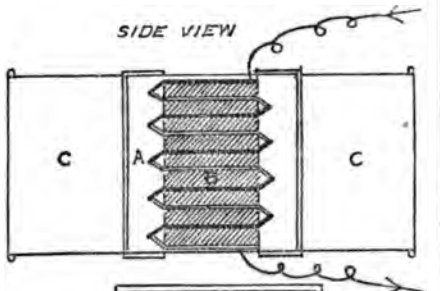
[61830.]—**Galvanometer Coils (Q. and I. Detectors).**—Quantity coil = ·2w. of 25 mils d.c.s. wire, intensity = about 2½oz. of 7 mils s.c. wire. Now, questions 61826, 61827, 61829, and 61830, you could easily have answered by taking the Rs. so as to see how the coils were grouped, especially as you have had considerable electrical experience. The gauges could have been taken at the coil stumps with a gauge. What I wish to impress is that you need not have troubled the members of the MECHANIC; as you have all the information at your finger-ends simply for the sake of looking for it.—VINCENT.

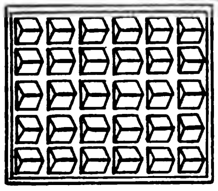
[61839.] — **Twist-Drill Apparatus.** — I am much obliged to those readers who have replied to my query *re* the above. I do not know where I could get a look at "Harrison's Mechanics' Tool-Book"; but if that work gives instructions for making twist-drills satisfactorily with the lathe, even though the process be "laborious and slow," I hope "Eos" will send particulars; it would, I am sure, be interesting to many readers of "Ours." I do not find grinding the point of broken drill a difficulty, but want, if possible, to make new ones from steel wire. I do not quite understand "Lumsie's" instructions. Does he mean that the grooves in drill would be cut out with a slide-rest tool, as in screwcutting? Drills so made would hardly come up to my requirements. Will "Lumsie" kindly explain and give rough sketch? My lathe is 3in. centre, back-geared, and screwcutting. I only require drills from ⅛in. downwards. Surely some of our readers must know of an appliance for such a simple thing as cutting twist-drills with a screwcutting lathe. Many of us would gladly give £10 or £15 for such an apparatus.—A COUNTRY PARSON.

[61845.]—**Softening Cast-Iron.**—I have succeeded in doing this by making the casting red-hot, and placing it in a box of sawdust until cold. (Memo.—Put it out in the open air, or you will be stifled.)—A., Liverpool.

[61869.]—**Fleas.**—A good remedy for fleas (or bugs) is to wash the floors with lead water—that is, water which has stood on white lead (to be obtained at a colour shop). The water is somewhat poisonous, but does not smell badly, like carbolic acid. Also, paint the bedsteads every spring time with lead paint (mixed with any colour you like) all round the rails under mattress, also sprinkle spirits of turpentine all round the edge of mattress, and the "friends" will soon disappear. I was once very much troubled with these pests, but got rid of them. We now get about two or three fleas in one year—of course, they are brought in. I keep no cat, dog, chicken, or pigeon.—W.

[61870.]—**Thermopile, &c.**—The construction of an ordinary thermopile is a very simple matter. They are usually made up in this way:—30 pairs of antimony and bismuth bars about 1¼in. long and $\frac{3}{16}$in. square, are bent and bevelled off at both ends. They are then soldered together in series, as shown in the sketch, alternately a bismuth and then an antimony bar. The interstices are then filled up with some insulating material, such as paraffin wax, pitch, or shellac, taking care to leave the joints protruding and free from insulation. It will now be seen that we have 30 small thermo-electric cells joined up in series. Now each junction, when subjected to the influence of radiant or conducted heat, undergoes a slight chemical change, due to the action of the two dissimilar metals. As a result, a small current of electricity coming from the bismuth to the antimony is obtained. When the poles of the above battery are joined up to a very sensitive galvanometer, whose coil is made up of many turns of fine wire, it will be found that the radiant heat of the hand held some inches off is quite sufficient to produce a considerable deflection on the registering instrument. One of Sir William Thomson's reflecting galvanometers is perhaps the best instrument to use with a thermopile. It is usual to inclose the thermopile within a rectangular brass case, and having two movable covers as shown in the sketch. About one clear inch of air space is allowed between the surface of pile and end of cover. This air space acts as a medium for shutting off the heat rays where no action is required. The thermopile is perhaps our most sensitive method of detecting small variations of temperature. (2) The electric railway running between Portrush and the Giant's Causeway, in the North of Ireland, and Volk's Marine Electric Railway in Brighton, Sussex, are the oldest, if not the only, electric railways running in the British Isles.—J. T. N.




END VIEW

[61881.]—**Tangent Galvanometer.**—The coils are placed in magnetic meridian, and the force acting on the needle is perpendicular to the plane of the coils. Let δ be the deflection of the needle, $2l$ the length of the needle, μ the strength of each pole, and H the horizontal component of earth's magnetism. Hence we have a "couple" due to the earth's magnetism, formed of two forces parallel to the magnetic meridian tending to turn the needle into the meridian. Hence moment of couple—

FIG 1

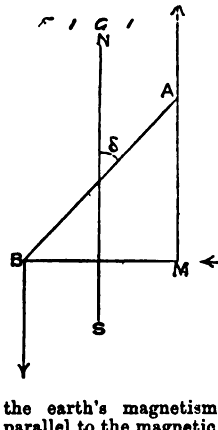
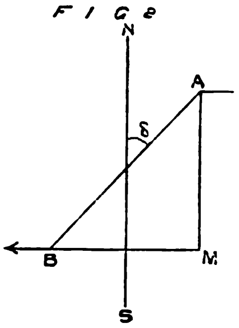


FIG 2



$$
\begin{aligned}
&= H\mu \times BM \quad \text{(Fig. 1)}\\
&= H\mu \times AB \sin.\,\delta\\
&= H\mu \times 2l \sin.\,\delta\\
&= M H \sin.\,\delta
\end{aligned}
$$

where ($2l\,\mu =$) M = "magnetic moment" of needle. Now, the force exerted by a current c flowing round a coil of radius r, with n turns upon a needle $2l$ in length, and μ strength of pole, is $\frac{\mu \times c \times 2\pi r \times n}{r^2}$ acting perpendicular to the plane of the coil. But this force forms a "couple" tending to turn the needle east and west, whose moment is—

$$
\begin{aligned}
&\frac{\mu c 2 \pi n}{r} \times AM \quad \text{(Fig. 2)}\\
&= \frac{\mu c 2 \pi n}{r} \times AB \cos.\,\delta\\
&= \frac{\mu c 2 \pi n}{r} \times 2l \cos.\,\delta\\
&= \frac{\mu c 2 \pi n}{r} \times M \cos.\,\delta
\end{aligned}
$$

But the moment of this couple exactly balances that of the first couple.

$$\therefore\ MH \sin.\,\delta = \frac{\mu c 2\pi n}{r} M \cos.\,\delta$$

whence

$$C = \frac{Hr}{2\pi n} \tan.\,\delta$$

This gives the strength of the current in absolute measure—

$$\therefore\ C\ \text{(in ampères)} = 10\,\frac{Hr}{2\pi n}\,.\tan.\,\delta$$

This would give in your case as the strength of the current—

$$
\begin{aligned}
&10.\ \frac{\cdot 17 \times 13 \times \cdot 7}{2\pi}\\
&= \frac{7{\cdot}735}{\pi}\ \text{ampères}
\end{aligned}
$$

= 2·46 ampères approximately.—L. B. and S. C. R.

[61895.]—**Stencilling on Glass.**—I fancy the reply to this query will not be of much service. I don't think, from what I remember to have seen in a glass works some years since, that it is done in this way at all. The glass is covered all over (evenly) with the colour, and allowed to dry, the stencil plate is then placed in position, and the excess of colour brushed out with a badger or camel-hair brush; any powder which may get under the plate can be easily blown off.—Os.

[61898.]—**Hard Water.**—The hardness of water consists of two kinds—temporary and permanent. Permanent hardness is that which cannot be removed by boiling. To determine the total hardness proceed as follows: Take 50c.c. of the water, place in a stoppered bottle of about 10oz. capacity, and run in standard soap solution until, after well shaking, allowing the bottle to lie at rest on its side for four or five minutes, the lather does not break up; or, in other words, until a permanent lather is obtained. Sometimes a false permanent lather appears, but by always adding another c.c. of soap solution, when the process is thought to be finished, this error may be obviated, as the lather will at once commence to break up if it is not permanent. Should the water be a magnesia water, the entire solution must be so regulated that only about 8c.c. of the soap solution is used. If 50c.c. of the sample takes more than 10c.c. soap solution, dilute 50c.c. of the sample with 50c.c. of distilled water and work in half, doubling of course the number of c.c. of soap solution used. For every 50c.c. of water used, whether sample or distilled water (for dilution) 1c.c. must be deducted for absorption. Magnesia may be estimated by precipitating the lime and applying the soap test to filtrate. Multiply result by $\frac{4}{13}$, and it will give grains of magnesia per gallon. The permanent hardness may be estimated by taking about 0·5 litre, placing in a flask connected with an inverted condenser, and boiling for an hour. The water is then filtered from deposit, 50c.c. of the filtrate taken, and the soap test applied as before. This gives permanent hardness. The total hardness less the permanent hardness gives temporary hardness. The following is the method for preparing the standard soap solution, which, on the authority of Tichborne, requires no setting against a known quantity of $CaCo_3$. Take 5c.c. of as pure as possible oleic acid, add about 50c.c. of proof spirit and two drops of phenolphthalein. Run in a normal solution of NaHO until the colour is just struck. Since it is found that 15·5c.c. $\frac{N}{1}$ NaHO require the solution to be made up to 820c.c. with proof spirit, therefore n being the number of c.c. of $\frac{N}{1}$ NaHO used $\frac{n \times 820}{15{\cdot}5}$ = number of c.c. it is to be made up to. Working on 50c.c. of the sample, each c.c. of this soap solution equals one grain of calcium carbonate per gallon. Another method, and one which I have found to give very good results, is as follows. Temporary hardness: Take 70c.c. of the sample; make hot in a porcelain dish; add a few drops of phenoacetoline, and titrate with fiftieth normal sulphuric acid. Each c.c. $\frac{N}{50}$ H_2SO_4 used equals grains per gallon of temporary hardness. Permanent hardness: Take 70 c.c. of the sample; add about as many c.c. of fiftieth normal sodium car-

ɔn as there are grains per gallon of
ɔlatile); transfer to a platinum dish,
ɜ to dryness over a water-bath. Take
ently boiled distilled water, which
ectly cold, filter, wash residue well,
trate up to about 70c.c. Make this
add a few drops of phenoacetoline,
ɾith $\frac{N}{50}$ H_2SO_4. The number of c.c.
ted from the number of c.c. of
previously added, equals grains per
ɪnanent hardness. There is no hard
as to how much lime must be added
er; all depends upon the nature of
Permanently hard waters cannot be
ʜe mere addition of lime, as this only
arbonates, and does net affect sul-
ɒe and magnesia. The best medium
waters is a composition prepared by
ɜn, of London, and known as "Anti-
wder. It consists of quicklime, car-
da, and alum, in proportions which
ɪg to the composition of the water to
I can personally testify as to the
f the above mentioned softening
ving used it with every success in
ich water, I may say, has a hardness
.5°. — HENRY J. HARDY, F.C.S.,

Harmonium.—TO "ORGANON."—
e to 16ft. reeds is 7in. long by 1⅛in.
opens ⅜in.; well, 2in. deep; valve
ɪick. I have tried raising the tongues,
:; I have not got a case for instrument
be better with more wood about?—

Soldering Lamp.—Portable Sol-
ɔaratus for Line Wires.—This is
: riveted together or overlapped and
ogether. It measures about 3½in. by
:eep. It has a groove running length-
top for the wire joint to lie in. It is per-
ɤayup from the bottom and bottom also.
.ges at the bottom with a sliding bolt;
l by filling with waste and saturating
-oil—spirit is better, but dearer. It
the top, or where the wire may be on
ɜ joint being previously well twisted
:d off, and lighted. They may be
an ironmonger's not far from the
Tottenham Court-road, London.—

Brazing Bicycle Head.—There are
of brazing such. I think C. M'Carthy
following to suit him:—First clean
brazed, make them a nice fit, so that
give them a light rap with hammer to
see that you have got both forks on
a small hole through for you to hold
ɟetting your heat, take out, get some
ɾater, rub on parts to be brazed, get
and borax, put inside fork, and insert
.n. Now you are ready for your braze.
ɟe is the best you can have, make your
.y, let flare burn out, so that you have
place your part to be brazed on fire,
:ntly; take care not to burn bottom
little while you will see a blue flare, as
ɜame out of the forks; take off im-
and turn over for a few seconds till
you will find a solid braze.—ONE WHO
IT.

-Lamp Oils.—Perhaps my experience
use to "Dimlight." In former days
pair of "moderators," burning colza.
.ered to a "Silber," burning kerosene.
ɔvement. Then No. 2 was altered to a
Still further improvement. No. 1
ɟain altered to match No. 2. I now use
Safety Lamp," and like it so much that
ing of having both the old lamps fitted
urner if possible. I also formerly used
s" reading lamp, burning colza; but
:rimming and cleaning rather trouble-
ink the shadow depends much on the
ɔbe used. I should recommend either
ɪttom green glass shade, with white
a shade somewhat in the shape of an
wer-pot, with the upper part opal and
clear glass. I burn kerosene, costing
lon. Of course, the more light you get
ɜat you must put up with.—D. G.

—Induction Coil.—Try again with
olution for battery:—2oz. bichromate
one pint of boiling water, to which,
add 2oz. of sulphuric acid. If this makes
r of contact-breaker vibrate all night,
in the secondary wire. Try the above
ɪd if you still get no results let me
AUSTEN.

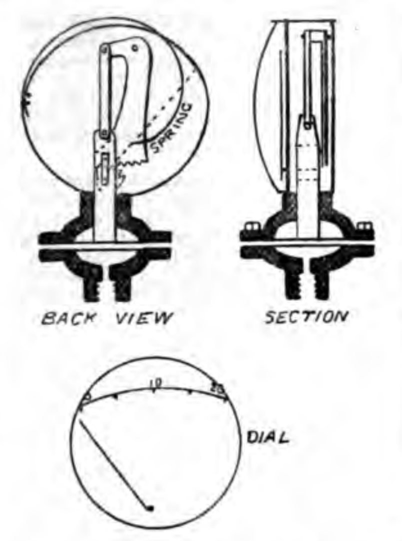
-Boiler Gauge-Glass.—I have already
ntion in these pages to the fact that to
scratch) the inside of a glass tube with
brass wire, or even tinfoil used upon hemp thread with a wooden piston and piston rod, will, as often as I have tried same, result in the fracture of said tube within 24 hours. My experience has been with tubes up to 1⅛in.—A., Liverpool.

[61951.]—**Legal.**—I think "Dens," in his reply to this query, is wrong. "Dens of Peckham" cannot possibly be a regular dentist, however many apprenticeships he may serve, as no one can be, or call himself, a regular (or any other) dentist till he has been registered as such, and "Dens of Peckham" ought to know that the Dentists Act is very likely to trouble him; and, further, that no registered dentist would give him employment as an assistant while he was acting in the manner he suggests. Let him get the Act: it will only cost a few pence. I don't see that he has any particular grievance because the Act came into operation just before he commenced. He might just as well blame the railway company if he missed his train by ten seconds or so.—OS.

[61960.]—**Boiling Oils.**—"Fabrication of Volatile and Fat Varnishes," Andres, published by Sampson Low, is reputed a standard work; it is rather dear—12s. 6d., I think. One ounce of borate of manganese tied in a linen bag and suspended in a bottle of linseed oil containing 2½ gallons, and kept in a warm place, say in a water-bath on the hot plate of a kitchener, will make a quick drying varnish in ten to fourteen days. I have been shown the oil dried into a stiff jelly, by leaving it thus too long.—W. A. S. B.

[61965.]—**Boiler.**—I am much obliged to "T. C., Bristol," for noticing my query as to boiler; but he does not say if there is steam space enough. Should be glad to know, as I am rather afraid it will prime. I also should be glad if he will notice my query as to pressure, No. 61967.—R. A. L., Devon.

[61967.]—**Pressure Gauge.**—Two years since I made a small gauge 1in. diameter to indicate to 20lb.; but it is a very fiddling job. I tested it by attaching to a large boiler, and marking the dial to agree with that of the boiler as steam was raised. I append sketch. It consisted of a piston resting on a diaphragm of thin rubber connected to a bell crank, having a rack at one end, taking into part of pinion to move pointer.—T. C., Bristol.



[61968.]—**Woodward's Spongy Lead.**—I think this is made by pressing molten lead through a metal plate perforated with very small holes.—H. AUSTEN.

[61968.]—**Woodward's Spongy Lead Battery.**—The Woodward plates are prepared under two processes. One is a honeycomb plate of spongy lead having very great surface, and the other a compressed plate of the earlier lithanode type. The former, which is the positive plate of the Woodward system, is prepared by splashing or pouring molten lead into a mould containing granulated salt, which forms the reticulations and cavities in the plates, after which a second layer of salt is sprinkled, and the process repeated until the plate has obtained the required surface. For the negative plate the inventor prepares a dough-like composition consisting of a mixture of specially-prepared polarised litharge, to which is added a saccharine and alkaline solution in combination with sugar of lead and a little sodium carbonate, which serves to bind the compound together, and prevents sulphating and scaling of the plates. This composition is then moulded and cut into strips, or rather into the desired form, over which a layer of prepared molten lead is distributed or scattered, which layer or coating presents an undulated surface, and into these depressions or cavities a chemical solution is washed prior to forming the plates. These two electrodes are then made up into batteries of any desired form or shape, for lighting or power purposes. It may be mentioned that owing to the great surface of these plates they are easily and quickly formed, which is a great advantage in the manufacture of storage batteries, as it reduces the cost of production. The above is a condensed description of the Woodward process, which is fully protected by royal letters patent, and therefore could not be manufactured by "W. E. H." without a license from the inventor. However, to get over this, "W. E. H." had better order his plates ready prepared, as it will not answer his purpose to lay down special plant, costing probably a few thousand pounds, to make the few cells he may require for private use.—SHIPPEY BROTHERS.

[61969.]—**40-c.p. Dynamo.**—Wind as much No. 20 B.W.G. on armature as it will hold (probably about 1½lb.), and 5lb. of No. 22 on each core of magnets. Get 30-volt lamps.—H. AUSTEN.

[61971.]—**Gramme Dynamo.**—Wind 3lb. on each limb, the same size as you have on armature, for a shunt machine, which I think will answer your purpose best.—H. AUSTEN.

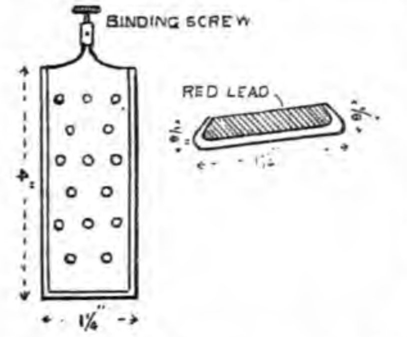
[61972.]—**Safes.**—There is a method of joining the plates for a safe by dovetailing them, inserting the dovetails into a kind of tube at the corner of safe, and then filling the joint with molten cast iron. I should say this would make a very serviceable affair. I would not give much for an amateur-made safe, however clever the construction might be.—OS.

[61972.]—**Safes.**—Mr. Conry's reply may mislead. The secrets of safe-making are fine workmanship and powerful machinery. The construction adopted by the leading firms is usually patented, therefore not secret; and furthermore, most of them give very full structural drawings of every part in their illustrated price-lists. There is no difficulty in obtaining these lists. Chatwood's list would, at all events, give a very fair idea of the elements of the problem. The fire-resisting chambers are not air spaces, but water spaces; that is, they are filled with salts containing a large quantity of water of crystallisation; the result being that the safe is, in event of fire, filled with dense steam. For information as to locks, see Beckett's article in "Encyclopædia Britannica." It has been republished separately; but I fear it is not in print now.—W. A. S. B.

[61972.]—**Safes.**—If "Plumber" wants to make a burglar-proof safe of, say, 3ft. high, he must make the sides and ends and back out of ¼in. plates put together with 2in. angle-iron. The frame should be made with 3in. by ¾in., with lugs welded on for the pivots of the door to swing on. The frame is dovetailed together, and then riveted on to the ends together with the angle-iron. You can then put your safe together and rivet up the sides. You must then make your inside body with 12 gauge plates, putting what drawers or shelves you require, and make it 3in. smaller all ways than your outside body. This is put on the frame resting on angle-iron screwed on to the inside of frame ⅛in. deeper than the thickness of your door, so that when the door is shut it is ⅛in. inside of the frame. You then fill your safe with fire-proofing. The best is hard wood ashes or whiting, or fine oak sawdust and alum rammed in tight. Then put the back on with counter-sunk headed screws not too deep, so that when you trim your safe off you file off the slot in the head of screw: that prevents the back from being got out. Any good lever lock is unpickable; but if "Plumber" will publish his address, I will inform him how to go on as he proceeds with the building of his safe.—C. B.

[61980.]—**Two Puzzles.**—The second query, "how to get a 'band' to go through every room in the house, and not through one room twice," is, to say the least, vague. What kind of "band" is intended? A band of musicians? Such a band might "go" through the rooms. A band of leather could not, but it might be carried through. Does she mean how to arrange a continuous band of something, so that part of it is made through every room? If so, how is it to be allowed to pass?—only through the doors and windows, or may a hole be cut in a wall? And lastly, when she indicates the house—what house? Surely it must make some difference whether the house is, say, Buckingham Palace or the gatekeeper's lodge.—GAMMA SIGMA.

[61981.]—**Pocket Accumulator.**—It certainly is advantageous to cover the plates with red lead, inasmuch as they will not be so long forming; there is a difficulty, however, in making the red lead adhere to the plates; but if the accumulator is only wanted to do small service, such as lighting a fairy lamp, the following will be found to answer well:—Cut two plates out of about 3lb. lead, size about 4in. by 1½in.; now turn over the edges of the two sides and bottom to the depth of about ⅛in., as shown on sketch, and perforate with holes about ⅛in diam.; now thoroughly clean the lead and fill up to the top of the small flanges with red lead made plastic with dilute sulphuric acid (1 to 10 of water); when quite dry wrap them in parchment or canvas, and form in the usual way. After a few days' forming the red lead will be found to be quite hard. The covering may now be removed, and the plates put in their permanent case; of course, the two plates will only make one cell, having an E.M.F. of about 2 volts; two such cells will light a 3½-volt fairy lamp admirably. Of course, Harry Frivoli is aware that the use of red lead in accumulators is the subject of a patent.—E. E. VAUGHTON.



[61987.]—**Bore Holes.**—If "Miner" will get the *Engineering* of March 13, 1885, he will find described a surveying instrument for finding the wandering and deflection of bore-holes. A simpler method I have used for bore-holes, which must be perfectly round, is to make a wire double cone that will just go down the bore-hole, suspend it from a point, say, 50ft. above mouth of boring, with a fine wire. Get two cords and fix them across the top of the bore-hole, so that their intersection marks the centring bore-hole. The centre of cone wire, as the cone is lowered down the bore-hole, shows whether the boring is perpendicular or not, and by measuring how much the centre of wire deviates from intersection of cords at, say, every 10ft, a proportion sum will show where the cone is; the bore-hole can then be scaled down on paper.—RIFLE RUNCORN.

[61997.]—**Moulding.**—All large cylinders are moulded and cast in a vertical position. Small ones are moulded in a horizontal position, then put up on end to be cast. Feeding is to make heavy parts solid. Cylinders don't require feeding, as it is better to allow the runners to cool, then the expansion of the cores will feed it. If you feed, the metal will come out of casting.—CAST IRON.

[62011.]—**Falb's Predictions**—(and letter 26923).—The future critical days are as follows:—March 22 and 23, April 7 and 8, May 5, 6, and 7, June 3, 4, 5, 21, and 28, July 20, 24, and 25, August 8, 19, and 20, Sept. 17 and 18, Oct. 15, Nov. 6, 14, and 15, Dec. 12, 13, and 14.—DENS.

[62011.]—**Earthquake Predictions.**—It is easy to predict earthquakes—if one is allowed the whole world to seek for verification. They occur about once a month in Japan and at such places as Manila. Falb simply made a lucky guess—that is all; he did not specify the locality. It reminds me of a well-known gardening writer who some years ago used to depend on the "changes" of the moon as weather guides, and took two days on each side of the date of the phase as a "margin." Of course he was invariably right. With such conditions changes of weather would of necessity occur with the "changes" of the moon—in the majority of cases.—VIDEO.

[62016.]—**Preserving Food in Tins, &c.**—Meats, &c., are put into tins raw and soldered up. A small hole is then made in top of tin, and they are placed in a boiling solution of calcic chloride. After boiling until the steam escapes freely from the tins, the holes are closed with a drop of solder. For fruits, bottles are best; pack fruit in carefully; fill up with cold water. Don't add sugar, except to pears, peaches, or strawberries. Support bottles on laths clear of bottom of copper, and fill with water half-way up bottles. Put cover on boiler, and leave in proper time. Then take out gently, and tap lightly till all bubbles rise. If not full, fill with boiling water, and cork them. Length of time to boil fruit:—Cherries 5 minutes, strawberries 8, raspberries 6, gooseberries 8, currants 6, rhubarb 10, plums 10, peaches 15, pears 30, apples 20, quinces 20, tomatoes 30, peas and beans 3 to 4 hours. Pears need 8oz. of sugar to the quart, peaches 4, and strawberries 8.—ELECTRICIAN.

[62017.]—**Odic Force.**—Further experiments have rendered me very sceptical as to odic force and the odometer. I have at times found that it refuses to move, as "Triton" says it does with him too, though, once started, I have found no difficulty in changing motion by applying other finger, &c. I fear odic experiments and od-subjects, so appropriately named by Dr. Mayo, require more credulity than "Triton" seems to possess, or than I can now give. I find odometer moves very slowly at first; but, especially when rotating, motion increases to a certain limit. I now think the increase, at any rate, is due to unconscious muscular action. On repeating experiment with magnet, I got a precisely opposite result to that mentioned in letter—i.e., odometer rotated against watch-hands over S. pole, and with watch-hands over N. Perhaps more readers would try these experiments, and report results.—ODOMETER.

[62020.]—**Incandescent Lamp.**—By practice a practised eye can tell when a lamp is properly incandesced. A voltmeter does the rest. For accurate work a photometer is used.—ELECTRICIAN.

[62020.]—**Incandescent Lamp.**—To ascertain how much current and at what voltage is required to run a given glow-lamp, proceed as follows: Prepare a number of pint chromic-acid cells, one zinc and two carbons, about 6in. by 3in. Twenty-five will be enough for most lamps, as very few are made over 50 ohms resistance. Arrange the elements so that they can be lifted out of the solution when not in use. Connect the elements in series, having wires out from each pair of elements, so that any desired number can be coupled up to the lamp. In testing any lamp, begin always with one pair, and go on adding pairs until the desired effect is attained. Remembering that each cell gives two volts very nearly, it will be easy to calculate the voltage of any lamp.—S. BOTTONE.

[62020.]—**Incandescent Lamp.**—Connect it on to some source of electricity, the E.M.F. of which you have the means of varying, as a primary battery, dynamo, or accumulator cells, which are best of all, and gradually raise the E.M.F. (e.g., by adding one cell after another) till the lamp is fully lit—that is, roughly speaking, until the filament is the same colour as the brightest parts of an ordinary gas burner, or a little less bright; then note the E.M.F. of your source of current, which, with primaries or a dynamo, will require a voltmeter; but with accumulators you can reckon it very closely, counting two volts per cell. This is near enough for most ordinary lighting; for exactitude you will require a voltmeter and photometer.—EDWARD CONRY.

[62021.]—**Liability.**—As sub-tenant you are not liable should the principal tenant fall in arrear (see Act 34 & 35 Vict. c. 79). In the event of distraint the lodger should serve a declaration with the bailiff setting forth that the goods so distrained are his property, and also setting forth whether any or what rent is due. He should also pay such rent to the superior landlord, and it will be deemed a valid payment to the immediate landlord.—B.SC., Plymouth.

[62022.]—**Photographs.**—When bright and crisp prints look quite flat and bad coloured after toning and fixing, no doubt the toning and fixing are at fault. Try another formula. For instance, if at present you use the gold and acetate, change to the gold and chloride of lime.—B.SC., Plymouth.

[62022.]—**Photographs.**—The toning solution is either poor, or the hyposulphite of soda contains too much free sulphur. Try the acetate toning bath, with a fresh sample of hypo., as I think hypo. deteriorates very much by being mixed any length of time before use.—LANCE CORPORAL, 2nd L.N. Lancashire Regiment.

[62022.]—**Photographs.**—I guess this is a pretty general complaint amongst beginners. If the prints get the right colour in the toning-bath, and come to grief in the fixing-bath, it is probably owing to the fixing-bath being acid. Remedy: Make it alkaline with a few drops of ammonia before putting in the prints. I should recommend you to use Edwards' "X L" (B. J. Edwards, The Grove, Hackney), and between toning and fixing put the prints into a bath of common salt, 2oz.; ammonia, 2 drops; water, 1 pint. This prevents loss of tone in the fixing-bath.—R. A. R. BENNETT.

[62023.]—**Dynamo for Gas Engine.**—Six accumulators would be needed. The dynamo should be shunt wound, to give about 15-18 volts., according to the resistance of the armature. It should give five or six ampères with one man power. I do not know the E.M.F. of your dynamo; but you would probably have to get one specially wound to suit. I shall be pleased to help you.—ELECTRICIAN.

[62023.]—**Dynamo for Gas-Engine.**—If the power of your dynamo be anything like proportionate to that of the engine, you will have power enough to charge accumulators and to spare; but
you do not give any details, and a "small d
may mean anything. Cannot you give so
of its powers, or a description of its app
size, gauge of wire, and number of div
commutator? Also say what size of pl
have in your cells (any one cell), and
immersed, as this will give an idea of th
required by your dental engine. — E
CONRY.

[62025.]—**Evaporation of Boiler.**—
page 17 (Answers to Queries, 61766) and
see this calculated. The answer is 8·7lb
case.—T. C., Bristol.

[62026.]—**Steam.**—Of course, your boil
in brickwork, and this is not cooled down
the fire is drawn, and so continues to gener
of the steam. Again, the water is heat
point due to the higher pressure, and gives
of its heat to generate more steam as the
falls.—T. C., Bristol.

[62026.]—**Power of Engine.**—To get a
out of this, the ports should be larger tha
usually have, say 5/16in. by ⅛in., and run i
revs. a minute with 60lb. steam. Sheet
copper, well riveted, and 16 gauge, for boi
by 6in. diameter.—T. C., Bristol.

[62027.]—**Black-Bronzing Brass.**—
in a solution of 5dr. nitrate of iron in on
water, or else 5dr. perchloride of iron to
water. Either of these will give brown a
mediate shades to black, according to trea
EDWARD CONRY.

[62027.]—**Black-Bronzing Brass.**—
some scales of wrought iron at any black
and dissolve in hydrochloric acid. Coat th
work with this. Let it dry, and then cove
coat of blacklead and polish. Finally lacq
pale gold lacquer, which can be procured
gasfitters.—LANCE CORPORAL, 2nd L.N.
shire Regiment.

[62027.]—**Black-Bronzing Brass.**—A
must be carefully removed, then with g
your hands, apply dilute chloride of plat
corrosive sublimate, and vinegar afterwar
nish lightly with black japan; but I pr
mode of a scientific microscopist, who ga
stick of pure asphalte, sent to him by an
I was mounting a small microscope of
make and used it; the coating, though
old, is as black as jet. You may be able t
liquid black, which dries instantly, being
asphalte dissolved in Gurgein balsam, and
I think copaiba would do equally well as a
—EOS.

[62028.]—**Recovery of Mercury.**—W
mercury at all? Gold chloride can be red
heat alone. Ferrous sulphate or chloride
reduce it. The salt you use is mercurous
The salt you obtain by dissolving the
nitric acid is mercuric nitrate, which wil
duce the gold. Stannous chloride, or
sulphate in excess will, when boiled with
chloride, reduce it to grey metallic merc
you want it in globules, pour off the solut
boil the precipitate with hydrochloric
ELECTRICIAN.

[62029.]—**Resistance of Armature.**—
always measured between the brushes, and
fourth of the whole length of wire on the a
—OHM.

[62029.]—**Resistance of Armature.**
the resistance of an armature is almost in
measured between the brushes; and, there
the case of a two-pole machine, the resista
be ¼ of that of the entire circuit of coils
latter resistance could not be measured in
without cutting one of the coils somew
W. E. H.

[62029.]—**Resistance of Armature.**
resistance, when the armature is standi
will be one-fourth of the entire circuit of t
in the case of any Gramme-ring wound m
and this is the resistance given by the m
describing such a machine. When the ar
however, is at work and spinning, the re
is raised, by complications of induced curr
almost exactly double the resistance when
ary—i.e., half of the resistance of the ent
I have found this to be the case by actual
ments, and the difference must be borne
in adjusting the external and internal resi
E.L. installations, and in designing dynamo
drum-wound armatures, where each coil
lated from the rest, the resistance when st
is that of the whole of one coil. Whet
resistance in drum-wound armatures rises
work, as it does in Gramme rings, I do not
EDWARD CONRY.

[62032.]—**Iron Turning.**—It is tolerab
cutting to reduce one inch in diameter
cuts; but the feed was about right for su
on such a mandrel. In the second job the
have been something slack—probably
travelling stay—as it should have done it

but I like a light cut to finish with.— ristol.

.]—**Iron Turning.**—The turning de- by "Verdant" is what I call rough turn- rough work. I should not have trusted ts to reduce 7in. diameter to 6in. diameter n. mandrel, 2ft. long, with the fast traverse ndrel turns to 1in. traverse of carriage, as drel would be liable to spring out of truth. uld have done better by taking four cuts osses, three heavy cuts with a slower feed, a light finishing cut. He does not state d of the lathe by which he turned the that would make a difference. With regard second query, turning the shaft oval, you ave avoided that by taking two cuts up the ne rough, with a feed of 50 mandrel turns raverse of carriage, the other a light finish- with a feed of 76 to the 1in. and besides travelling stay, fixed a stay or steady on the the about 3ft. from headstock.—KNIGHT kdale, Salop.

.]—**To Mr. Wimshurst.**—It seems to "J. B." has wrongly fitted his driving- ence, the discs revolve in the wrong direc- he again reads the description of the published in the "E.M.," from which he r worked, he will find it stated that the nds which drive respectively the first, nd fifth, and eighth discs are fitted to run while the two bands which drive the nd third and the sixth and seventh discs sed. Remember, with this, the top brush ront disc is to the left hand, while the brush is to the right hand. This is shown picture; the remaining brushes are, of arranged to suit this. The glass tube cases the upright rod from the conductor stand 6in. above the top of the case, only the glass tube is of proper quality glass; uching the wooden ball is of no conse- Use any size Leyden jars to suit your ut long small-diameter jars give propor- quicker sparks. You may make them length of glass tube, sealing up the end of your blowpipe; all else seems to be right. ear how you get on. I am always glad to lping word.—J. W.

.]—**Power of Engine.**—The engine de- would not run a 15c.p. dynamo. There is a ine well suited for electric lighting made l sizes. It is on a new safety principle, ery low in price. I shall be pleased to l particulars if you write to me. Sizes f-man power.—ELECTRICIAN.

.]—**Pity the Sorrows of a Poor Old** This poem, commonly called the "Beggar's ," forms one of a small volume of poems d in 1769 by Thomas Moss, who was of Trentham, Staffordshire, and who died 1808. (From the "Book of British Poesy," y the Rev. George Gilfillan).—D. G.

.]—**Brass Foundry.**—Core sand should et at all. If you have been using it wet, ficiently accounts for your cores sticking king. The sand should be damp or moist, is all; and then if the box is properly requires no coating except the ordinary or blacklead. The box is taken from the nediately after making. None of the cast- p. 405 are figured for definite sizes, being a general character; but in each case the are drawn fairly proportionate, so that you ale them. Or if you give me the size of a which you wish to make, I will tell you e to make the runner.—J. H.

.]—**Electrical.**—The medulla oblongata the nerve centres presiding over circulation iration, and also a cardio-inhibitory centre. entres are of the highest importance to life, querist should be careful how he passes currents through the organ, unless he is o introduce a new and improved method of ing suicide.—WM. JOHN GREY, F.C.S., tle-on-Tyne.

.]—**Cost of Electro-Motor.**—An electro- o give one-man power, if home-made, need more than from £2 to £2 10s., according to Six gallon-size chromic-acid cells should loyed, and the cost would be about 2s. BOTTONE.

0.]—**Electro-Motor.**—You can get a lecent 1-man power motor for about £10— that will return about 75 per cent. of the ut into it, and will, with proper gearing, a shaft about the power of an average man; gearing necessary to reduce the high speed r, if this be desired, will, of course, cost probably about £5 extra, according to tances. As to battery, see my answer, 61768, for Lamp, in same number with this.— D CONRY.

1.]—**Dynamo Coils.**—It is not possible ou the size and quantity of wire required e data you give. Suppose we take the resistance of your armature as ·287w. (which for wire of 98 per cent. would be about right), then the resistance of your series should not exceed ·215w., and the resistance of your shunt should not be less than 150w. To find the size of wire you must first find what magnetising power or ampère turns you require, both in the shunt and series, when, from the above data, you can easily find the proper size of wire. This can, of course, only be done by experiment, using temporary coils on the field magnets, with a known number of turns on each coil.—OHM.

[62041.]—**Dynamo Coils.**—I presume that your dynamo is to be compounded for constant potential; then, according to Prof. S. P. Thompson, the resistance of the shunt coil should be about 1,000 or 1,500 times that of the armature, and the resistance of the series coil about ⅗ that of the armature. And, again, the number of series turns must be to the number of shunt turns as the sum of the resistances of the armature and series coils is to the sum of the resistances of the armature and shunt coils. The actual number of turns on your machine will depend on the number of volts it is to give, and on the speed at which it is to run. This is best determined by experiment with temporary coils and separate exciting current running at given speed until required potential difference is reached.—W. E. H.

[62042.]—**Soldering Fluid.**—Weaken the soldering fluid by dilution with water, half and half, or a little less, or use powdered rosin instead, or you might try tallow; it will do for copper and lead, and, I should think, for zinc also.—EDWARD CONRY.

[62047.]—**Waterwheels.**—According to Molesworth, the speed of this wheel should be 5⅝ft. per second. You would consequently require to increase speed to, say, six turns per minute.—T. C., Bristol.

[62048.]—**Boiler Plate Furnace.**—If R. Smith will advertise his address in these columns, I shall be glad to send him working drawing of a plate furnace similar to the one he requires.—LANCE-CORPORAL, 2nd L.N. Lancashire Regt.

[62049.]—**Antidote for White-Lead Dust.**—I have heard of a few drops of sulphuric acid put into drinking water (just sufficient to make it slightly sour) doing good.—OHM.

[62049.]—**Antidote for White-Lead Dust.**—You will find mixing a little sulphuric acid with water—sufficient to make the drink rough to the mouth—a most effectual drink. This is used in most white-lead works. In some cases a little common syrup is added, to make it more pleasant. —T. C., Bristol.

[62049.]—**Antidote for White-lead Dust.**—Get a respirator made to cover all the lower part of the face, bulging out well in front of the nose and mouth, and fitting on tightly, so that air is not admitted at the sides. It could be made of two plies of wide-meshed wire gauze, leaving a space of ¼in.; insert between the plies of gauze cotton wool, and you will find this a perfect remedy.—B.SC., Plymouth.

[62049.]—**Antidote for White-Lead Dust.**—Take sulphuric-acid lemonade as soon as possible. Lead poisoning has disappeared in all the lead factories owned by respectable firms since the discovery that thereby the noxious oxide is turned into sulphate of lead—its only harmless salt. Jugs of this pleasant acidulated beverage are placed in all the workshops for the free use of the operatives. For grown persons about one wineglassful purest sulphuric acid to an imperial quart of soft water (rain or distilled). At first, it will be well to take half a wineglassful when going to work and on leaving it. Being injurious to the teeth, they should not be touched by it. Have a glass sucking-tube, or a rubber one, and rinse your mouth every time with plenty of water. Let a respectable chemist make up this remedy, and you can take it weaker when you feel better.—EOS.

[62049.]—**White-Lead Poisoning.**—The usual antidote in white-lead works is dilute sulphuric acid, for the simple reason that it forms with lead an insoluble salt—viz., sulphate of lead, which is easily passed from the system. If the querist will mix, say, 1oz. of pure sulphuric acid with 9oz. of water, and add a few drops of that to the water he drinks, he will, I think, find a decided change for the better. He should *always* wash before meals, using a stiff brush to remove particles of lead from beneath the nails. I would also recommend him to eat brown bread and clean his teeth regularly.—A WHITE-LEAD WORKS CHEMIST.

[62053.]—**Engine Cylinder.**—4in. by 6in., if with an average pressure of 80lb., will give 5 I.H.P.; but I suppose you intend 80lb. boiler. If the latter, I should advise 4in. by 7in., and cut-off at ¾-stroke. Shaft, 1½in. diam. in smallest part; flywheel, 2ft. 4in.; piston-rod, ¾in. You had better buy a 5-horse vertical boiler, or else a Cornish. These small boilers are quite a speciality, and cheap.—T. C., Bristol.

[62054.]—**Electric Motors.**—Motors of this pattern are mere toys, and about as inefficient as they can well be made, having no power to speak of. A motor capable of driving a sewing machine only costs 30s. If you will write to me telling me what you want it to do I can help you.—ELECTRICIAN.

[62054.]—**Electric Motors.**—I have made an electric motor in the following manner:—A central driving-wheel like your Fig. 1, about 6in. diam., with seven armatures. The magnets are placed one on each side, so that when the poles of one magnet are opposite an armature, the poles of the others are just between two armatures. The magnets then receive the current alternately by a contact-breaker somewhat like the one in your Fig. 2, but with a small spring on each side, which breaks contact with first one magnet, then the other, as their respective poles come opposite to the armatures. This arrangement allows each magnet a fraction of a second more time to become saturated, and therefore, to have more power on the driving-wheel. The wire on the magnets should be proportionate to the iron core, &c. The following is taken from a back number of the "E.M.":—Size of wire No. 24, diam. of iron core ⅝in., length of poles 2¼in., diam. when wound 1⅛in. My motor will work at, I should think, quite 300 revolutions per minute, with a couple of small bichromate cells, and has plenty of power to drive a small model, &c. Any more information with pleasure. —CHROMOS.

[62057.]—**Photographic.**—"Orthochromatic" has had the same experience as a writer in the *British Journal of Photography*, who finds that dipping plates is no good—the emulsion must be stained. Further, a yellow screen must be also used to produce the orthochromatic effect.—B.SC., Plymouth.

[62057.]—**Photographic Orthochromatic Plates.**—TO MR. BOTTONE.—Have you printed from your orthochromatic plates? If not, do so, and I think that you will find that there is a truthful rendering of tone not to be found in the ordinary plates. But please bear in mind that the stained plates are much less sensitive than the others, and are generally used with a yellow glass before the lens, to equalise even more the power of the different rays proceeding from the coloured bodies.—S. BOTTONE.

[62058.]—**Ornamental Table-Top.**—Vol. II. Holtzapffel's book contains much about this kind of work. The pieces of any shape, regular or irregular, are all prepared by the circular saw in the lathe, the patterns having been first carefully designed, measured, and fitted. When this ornamentation has been cemented to the table top it will have to be rubbed as smooth as glass before French-polishing. I have seen marine glue used for lasting adherence, though its dark colour is objectionable, any transparent waterproof cement is better. A humid atmosphere seriously affects this sort of work, and there are two or three woods full of volatile oil, as camphor, cedar, &c., which throw off French polish and become dull.—EOS.

[62061.]—**Lining Brasses with White Metal.**—TO T. C., BRISTOL.—I have not had much experience in this matter; but I think if you will smoke your mandrel before pouring it will leave easily enough.—T. C., Bristol.

[62063.]—**Wheels and Axles.**—"Novice" will find his query was answered in No. 1,132, page 306. I would give him the same advice now if he is a novice. Get a catalogue from a firm that supplies machinery for making wheels, then you will see every part of the wheel ready to go together. You do not say what weight you want the wheels to carry nor the kind of cart you are about to make, as cart wheels vary in height. Have made them 3ft. to 4ft. 10in. for carts. If you will give the height of wheels, dish on the spoke, length of box, I will give you the set of your axles. You will find that there are many things that must be seen to for wheels to run well, such as being square, the height the horse will carry the shafts and the wheels, taking their bearing on the ground, and especially if it is wide tires. As "Novice" should not misunderstand me, I will tell him candidly that setting axles is a trade secret. Wheels will tell themselves by the noise they make whether they have the right set.—J. C.

[62064.]—**Lathe Matters.**—Yes; a pitch chain will do very well. I should advise you to get the malleable cast chain from a Derby firm. It is an American idea, and every link can be detached when at a certain angle, so that you can take it away, or insert or take out a link at any time, and cannot come undone when at work. It is called "Ley's" chain.—T. C., Bristol.

[62064.]—**Speeding-up of Lathe.**—The speeding-up of a lathe can be done similar to the Britannia Company's patent saw machine, and for some work it would be a great economy of strength. I have fitted flange chucks on the mandrel on which saw and also the drill chuck runs, drill chuck plate, and then, by clamping a rest upon the table, I can very speedily turn up table-tops, or turn articles which can be fixed in a chuck while in motion. But when once the lathe is well started, so great is the power that you cannot stop it without considerable exertion. I have used the patent saw machine for a long time; and as an instance of stored-up force, after giving six good tread pressures with the foot, I can stand on the treadle, and it will lift me bodily up 18 times before it stops. This great momentum is of service in a saw, but might not be convenient to individual turners who want to stop quickly.—H. R.

[62069.]—**Miniature Battery.**—TO MR. H. AUSTIN.—You may use manganese and carbon if you wish: it won't matter much, as there is plenty of carbon surface in these cells. Put an alternate layer of manganese and carbon, about ½in. deep each layer; use fine grain, about the size of corn, and free from dust.—H. AUSTIN.

[62070.]—**Cleaning Heads of Brass Figures.**—It is just possible that if the colour were moistened slightly with turpentine it would adhere. The colour should not be wet, but just moist. Turpentine dissolves wax, and it might act on the surface of the wax (without in any way altering the outlines) and so make the colour adhere.—OS.

[62071.]—**Boat Carriage.**—Employ a rough, cheap sledge, with rollers for hard ground, easily removable. "Mud boards" to replace them (on the principle of the wild fowler's mud pattens), when going on the soft. Not an expensive experiment. A "cradle" of iron wire to keep boat upright.—EOS.

[62076.]—**Salt of Mercury Solution for Cell.**—Mr. Schanschieff's solution is patented, so it would hardly be fair to tell you how to make it; besides, he sells it at a cheaper rate than you could make it. Why not try chromic acid solution, which I have used successfully for three hours at a stretch?—ELECTRICIAN.

[62077.]—**Electrotyping.**—Rub them over with plumbago dust, and electroplate them to any desired thickness by Daniell cells, using a bluestone bath and a copper plate for anode, and the article itself for cathode. Dipping in nitrate of silver and drying will also do with some objects, instead of plumbago.—EDWARD CONRY.

[62077.]—**Electrotyping.**—A satisfactory reply to this query would take up more space than the Editor might be willing to give. Besides, it would be necessary to know the material of which the ornaments are made, and whether they are medals, busts, insects, or flowers. The whole subject is very fully treated in Watt's book on "Electro-Metallurgy," and if the querist consults it he will get fuller directions than could be given here.—BOBADIL.

[62077.]—**Electrotyping.**—For making moulds of metal objects, use either of the following:—Beeswax 1lb. and rosin 1lb.; or beeswax 1lb. and white lead 1oz. Do not pour the wax too hot on to the object, as you will have a difficulty to remove it from the mould (a skim should be just visible on the melted wax). The battery power depends on the metal to be deposited; copper deposit (in acid bath) requires about 1 or 1½ volt at the rate about two amperes per 100 square inches of surface.—W. E. H.

[62077.]—**Electrotyping.**—If the article mentioned by "A. K. H." is at all difficult to mould, I should strongly advise him to use the elastic composition patented by Mr. Parkes, of Birmingham. For plain work, plaster of Paris or beeswax, guttapercha, and many other substances may be used, the guttapercha being the best and easiest to handle. The battery may be Grove's, Daniell's or Smee's, the former being the best. The amount of the deposit will depend on circumstances, and should be determined by experiment. As the process would not be novel to most of the readers, and would occupy a considerable space, "A. K. H." should purchase Urquhart's work, which will give him every information.—LANCE-CORPORAL, 2nd L.N. Lancashire Regt.

[62079.]—**Paste with Acids.**—The addition of alum prevents, by its styptic action, the fermentation of the paste. The addition of nitric or acetic acids has a twofold effect: Firstly, it converts a portion of the starch into dextrine, hence renders the paste more sticky and rather more fluid; secondly, it causes the paste to adhere more readily to metallic surfaces, as it rusts them slightly, thus giving a hold to the paste.—S. BOTTONE.

[62081.]—**Medical Battery and Coil.**—There are two solutions which may be used in the chloride of silver cell, either sal-ammoniac or chloride of zinc. The most commonly used is the former. The sizes of wire for a coil 3in. long might be No. 24 or 26 for the primary, and No. 36 for the secondary, both silk-covered. Two layers of primary will be enough; then fill the reel with secondary. To avoid the pricking sensation to the skin, regulate the current by means of the sliding tube, or use a weak battery.—BOBADIL.

[62082.]—**Exploding Gas Burners.**—The Prince Rupert's drops you allude to are made by dropping molten glass into cold water. You have done something similar. You have possibly been in the habit of turning out your light suddenly when burning full power; consequently, the glass has received a sudden chill, and so made a Prince Rupert's drop of it.—ELECTRICIAN.

[62083.]—**Speed of Water-Wheel.**—Undershot wheel should go a trifle faster than one-half the natural speed of current. You can easily ascertain this; but I should think about 4ft. per second for wheel.—T. C., Bristol.

[62085.]—**Electrical: Volt and Ammeter.**—TO S. BOTTONE.—A single bichromate cell gives, when freshly made, nearly 2 volts. Hence, if your voltmeter reads 22 volts instead of 2, and you wish to cause it to read correctly, you must measure its resistance, and add in the circuit 10 times what you find the original resistance to be. With regard to the ammeter I can say nothing, as its readings may have been correct. A single bichromate of the dimensions named would give probably 100 ampères during the "spurt."—S. BOTTONE.

[62086.]—**Legal.**—If you did not buy and pay for any ground in front of your front railings, it may be left out of the question altogether; then if the parish made the pavement they can claim a proportion of the cost commensurate with your line of frontage. If the builders made it, I don't think they can claim; but the terms of original lease and also of the sale to you would be required to be seen before an opinion could be given on this point.—B.SC., Plymouth.

[62087.]—**Waterproofing Fishing Lines.**—Soak the lines for a week in raw linseed oil, pressing out the bubbles from time to time. Then drain for an hour, and run the lines gently through the fingers. Next, hang up the lines from two nails for a period of ten weeks. Finally, wipe with a soft cloth. All this should be done in hot weather. Perhaps, however, "Aqua" would do better with an un-waterproofed line of 8-plait silk, not too tightly twisted. This is the kind of line used by the Nottingham angler.—WINCH.

[62087.]—**Fishing Lines.**—Here is the old trade recipe for waterproofing; such tackle used to be very dear. I paid six guineas each for eight-plait silk lines 250 yards, to Bond, of London, 40 years ago, and they lasted several seasons' hard work. The friction of the wire top and rings, with heavy fish in boiling rapids, alone destroyed them. I did two lines of 150 yards each some time back; they look and smell like the shop goods. Make up in loose coils, after stretching between two trees in a field, then soak in a metal pot of boiled linseed oil (cold) and gold-size (one pint of the first to one wine glassful of the last) stirred together; cover up for a time till quite saturated. Then stretch as before, and rub dry with a piece of old silk. Fish blood is used at Madras for sea-lines; though made of cotton, they last long.—EOS.

To Cure a Sheepskin with the Wool On.—If the skin is dry, first soak it in soft water until pliable. Take a straight piece of an old scythe, 1½ft. or 2ft. long. Dull about 4in. or 6in. of each end, insert them in wooden handles, or wind them with cloth, so as not to injure the hands. Lay the skin upon a bench or inclined board with the flesh side up, and remove all flesh and fat with the above instrument; also trim off the skirts or rough edges. Mix together pulverised alum 1lb., salt ½lb., wheat bran 1 pint. Add sufficient water to make a thick paste, which spread over the flesh side of the skin as evenly as possible; fold it, bringing the flesh side in, roll up closely, and lay away where it cannot freeze for about four days; then unroll, brush off the paste, work the skin with the hands until pliable. The skins of deer and calves or fur-bearing animals generally can be preserved in the same manner.

Cheap Method of Platinising Metals.—In this new process, the metallic object is covered with a mixture of borate of lead, oxide of copper, and spirits of turpentine, and submitted to a temperature of from 250° to 330°. This deposit, upon melting, spreads in a uniform layer over the object. Then a second coat is laid on, consisting of borate of lead, oxide of copper, and oil of lavender. Next, by means of a brush, the object is covered with a solution of chloride of platinum, which is finally evaporated at a temperature of not more than 200°. The platinum adheres firmly to the surface, and exhibits a brilliant aspect. If the deposit be made upon the first coat, the platinum will have a dead appearance. Platinising in this way costs, it is said, about one-tenth the price of nickel plating.—*Le Genie Civil.*

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

61443. Ebullition, p. 464.
61446. Lead Waste, 464.
61448. Sulphocyanide of Barium, 464.
61453. Lacquers and Dips, 465.
61457. Orsat's Apparatus, 465.
61469. Lantern Slides, 465.
61484. Metallic Hone, 465.
61488. Brass Tubes, 465.
61496. Wooden Tubes, 456.
61498. Battery, 466.
61500. Lens, 466.
61501. Battery Plates, 466.
61502. Gilding Solution, 466.

61701. Gas-Engine, p. 552.
61706. G. and S.W. Locos., 552.
61708. Superphosphate, 552.
61713. Ferrules, 552.
61717. Chemical Precipitate, 552.
61718. Leeds Parish Church Organ, 552.
61723. Moulding Rubber Goods, 552.
61734. Iron v. Steel, 553.
61736. Harp, 553.
61744. Emery Wheel, 553.
61749. Lathe Matters, 553.
61758. Legal, 553.
61760. Fan, 553.
61761. Table of Sizes, 553.

QUERIES.

[62088.]—**Utilisation of Slag.**—To what uses is this turned now, besides the manufacture of slag-wool? How is the slag pottery made, and how is it rendered homogeneous? Could slag be remelted easily?—and, if so, in what manner, and of what, should moulds be made to cast it in?—MURANO.

[62089.]—**Surveyor's Chain.**—I have one broken in several places. I want to find whether I have all of it and where the brass labels should be. Will someone say?—MURANO.

[62090.]—**Estimation of Nitrogen and Phosphoric Acid in Manures.**—Will any chemical friend kindly oblige me by telling me the easiest and best mode of estimating the nitrogen and phosphoric acid in manures? Can the former be ascertained accurately by Kjeldhahl's method, as I could then avoid buying a furnace for the soda-lime process?—A. M. M.

[62091.]—**Softening Cast Iron.—Titles to Queries.**—TO "GLATTON," page 86.—"Jack of All Trades," a well-known correspondent of some years back, asserted that small castings could be softened by putting them into an iron box, and filling up with chalk, exposing to a bright red heat for some time, and the fire then allowed to go out, and castings gradually cool. Castings so treated, "Jack" said, would be found "as mild as that tiger breakfast bacon." I am quoting from memory, for I haven't time to look up the vol. I wish the Editor would do as "Glatton" has done, and alter unsuitable titles; such titles make the hunting up a subject in back vols. a most unsatisfactory task. For example, anyone wishing to read up Deluge, would wish to read letters 26974 and 28985, both of which are headed 'The Catastrophe of Fifty Centuries Ago.' I beg to propose, Mr. Editor, that you add to the notes under "Letters to Editor," a permanent one on this subject.—KENSINGTONIAN.

[62092.]—**Microscope Stages.**—Advice wanted. A mechanical stage costs more than a simple rotating stage with object carrier; but in what respect is it better? Does not the slow movement by rackwork preclude a rapid cursory view of the object as a whole?—OLD STAGER.

[62093.]—**Immersion Condensers.**—If I buy an oil-immersion condenser, will it be suitable also for dry front objectives, or is its use restricted solely to immersion objectives?—BAPTIST.

[62094.]—**Bacteriology.**—I can get a one-sixth dry objective, 70°, second series, for £2; and a one-eighth of of 100°, for £3. Would either of these be satisfactory for studying bacteria, or would it be better to buy a one-twelfth oil immersion, which, I believe, can be bought for £4?—VACILLUS.

[62095.]—**Midland Single Engines.**—How many of the new Midland single 7ft. 3in. express engines are out of the shops? Are they to work the North expresses?—LOCO.

[62096.]—**The Crumlin Viaduct.**—Can any reader say when the Crumlin Viaduct, near Newport (Mon.), was built, and if it is over 200ft. high? Any other details will oblige.—INQUIRER.

[62097.]—**Brakes.**—In the Society of Arts *Journal* for 18th March, I observe Mr. Harold Brown said, or is reported as saying, that the Westinghouse pressure brake was first used in 1873 on the District Railway; that the automatic was used on the Midland 1873, and that there was the automatic vacuum brake of Westinghouse, at Newark. Would Mr. Stretton, or other reader, say if these dates are correct; also how are the forces of various brakes shown on a diagram by representing various degrees of incline?—LOCO.

[62098.]—**Dholl, Rob, and Lentils.**—Is there any difference between Indian dholl and lentils? The seed (husked) looks exactly alike to me. What is rob? It is eaten in Egypt.—MURANO.

[62099.]—**Electro-magnet.**—I want to make an electro-magnet to go down a 2in. rock drill hole, to pi p the broken pieces of drill; will anyone tell me hether the following would act? Make a piece of iron ts a bolt with a round head, shank ⅝in. diam.; head in. by ⅜in. thick; screw the sides of head, and after mapping the shank with wire, take the two ends through e head, then screw over the wire on the head a piece f tube about 1⅝in. diam. outside, or ⅛in. thick. Any ggestions would be of special interest to me, because, f the thing was a success, it would be capable of elaboration for practical use.—RIFLE.

[62100.]—**Perambulator.**—Will any reader tell me w to renovate a red-stained basket perambulator—both llows and leather hood?—SHEFFIELD IMPROVER.

[62101.]—**Willing to Learn.**—I have made two injectors (a forcer and non-forcer) for model boiler, but aving failed to get them to work, I shall be glad if "T. C., Bristol," or any other subscriber, would kindly xamine same, and inform me what to do to it?—E. M.

[62102.]—**Hose-pipe.**—Having 150ft. of 1in. three ply indiarubber water-pipe, I would like some of our practical readers to give me their experience as regards the best way to keep it; I will have to cover it during the summer months with 3in. or 4in. of soil, as it would be a great trouble to lift it every time it was used. I saw in "Ours" some months ago, that the best way to keep it was to cover it with water. Any hints as to preservation will much oblige.—JOINER.

[62103.]—**Heating by Hot Water.**—I wish to heat my printing office and machine-room by means of hot-water pipes. What would be the most effective apparatus for doing so, by means of a coil, tubular boiler, r what? The sizes of the two rooms are as follows:—omposing-room, 70ft. by 20ft.; machine-room, 35ft. by 6ft. About what length of piping should be laid down n each room, and what diameter pipe? As the apparatus or heating the water is to be in a workroom, any kind hat gives off noxious fumes cannot be used. I shall be ery thankful for any information on the above subject.—V. S.

[62104.]—**Frying Potatoes Brown.**—My wife has ied to fry sliced potatoes that beautiful golden brown, s we get them in the London and Manchester, &c., chop-houses. She has failed. Can any reader who knows the ethod adopted in the chop-houses, help by giving details f the method? How is the brownness got, and how are ey kept so dry and mealy?—PHONOSCOPE.

[62105.]—**Titanium Ore, Titanite, Rulite, anakite.**—Mr. Allen would confer a favour by saying here the titanium ore exists in quantity, which he used a few years back in "Ours." What, also, are the se minerals above named, and where are they found? s any commercial use made of any form of titanium now? saw it mentioned, somewhere, that a blue glaze was ade of it for chinaware.—MURANO.

[62106.]—**Watson's Problem.**—Watson's problem f the man with a perfectly spherical head, surmounted y an infinitely high conical cap. What was this? It is entioned in letter 356, page 610, Vol. XI. of ENGLISH ECHANIC.—Z.

[62107.] — **Engine Power.** — Will one of the echanics kindly say what power may reasonably be expected from a vertical engine cylinder, 2½in. bore, 4⅝in. troke, steam admitted full length of stroke; steam inlet, in.; exhaust, ½in. What candle-power would it develop ith good dynamo and lamps?—QUÆSITOR.

[62108.]—**Pollak's Battery.**—In Vol. XLIV. page 1, there is an account of the above for lighting, which as struck me as being convenient and simple. I should ke to try it to drive a motor. Now what is the proportion of coppered surface to the size of the zinc, and must he zinc come up through the carbon, and how would it tand for quantity in proportion—12 Smee cells, plates in. by 4in., in series; or can any of our friends recommend anything better? I have thought to take Judson's orrugated cell, pierce a number of holes in the bottom, nd copper the bottom out and in, and fill it up with ubble carbon. Has this anything to recommend it?—OAK ERRY.

[62109.]—**Submarine Light.**—It is, I believe, a fact hat fish are attracted by a strong light on the water at night. I have an idea they would be more attracted by an lectric or other powerful sub-marine light. I wish to ry this in connection with a graving dock where, at times, large numbers of fish are taken, without any other attraction than may perhaps exist in the form of marine animals on the bottoms of the vessels docking. I have a team launch engine (cylinder, 4½in. diam., by 6in. stroke) easily disconnected from the screw, which would, I think, with gearing, drive a dynamo, and I ask our readers for information as to dynamo lamp, &c.—SUBMARINE.

[62110.]—**Arrangement of Organ Pipes.**—I have just bought the remains of an old barrel organ, in which are some sweet-toned pipes. I find the pipes in it are arranged thus:—On pressing a note, say C, the two diapasons and principal sound C; the 12th sounds the octave, and 5th G; the 15th sounds the second octave C; the 3rd sounds E; so each note, when pressed, sounds the common chord, 1st, 3rd, and 5th. Is it the ordinary arrangement of pipes in a chamber organ? My reason for asking is: I have made a new soundboard, bellows, &c., and intend using some of the old pipes in conjunction with others I have made. I have looked over many Vols. of "Ours," from 1871 to date, and don't find it mentioned at all. If any of our amateurs have finished their organs surely they must have come to that difficulty when putting their parts together; but that may be my stupidity. I have never received any assistance but from the MECHANIC, and am miles from any organ. I have made some very nice-toned diapasons and other wood pipes. My organ is of E to E, 48 notes compass, and is placed in recess of room, 7ft. high, 3ft. 3in. wide, and 2ft. 3in. deep, and it is altogether satisfactory. Also will any of our contributors please say if the wind-way is cut in the cap or block of the stop diapason, whose blocks are cut so that a wedged-shaped piece is taken out?—G. H.

[62111.]—**Medal.**—Can any reader inform me as to the value or rarity of a French medal which I possess, which is described below? Size, 1⅝in. diam., ⅛in. thick. Obverse: Bust of Liberty, with hair dishevelled. Across the background, a pike, having on the end a Phrygian cap. Name of engraver on base of neck, "Galle." Inscription round upper half, "Liberté Française." Inscription across lower half, "L'an I. de la R.F." Reverse: A wreath of oak leaves. Inscription within, "A la Convention Nationale par les artistes reunis de Lyon. Pur metal de cloche frappe en MDCCXCII." Both obverse and reverse are surrounded with a raised moulding, composed of oval dots, set close together. Condition, almost as good as the day it was coined, quite unworn. It is a very striking and beautiful medal, the woman's head being especially handsome. The lettering is rather slovenly, but the artistic part of the work is extremely good. Can anyone give me any information about the engraver "Galle," or of any event in the history of Lyons at that time with which the medal might be connected?—MEDALLION.

[62112.]—**Weight of Tubes.**—Can any of your readers inform me what would be about the weight of an iron tube 27in. long, ½in. in diam. inside, and ⅛in. thick equally throughout, so that the external diam. would be ¾in.? Also, is there any great difference of weight between steel, iron, gunmetal, and bronze? If so, what is their respective specific gravity, considering the bimetals to be made of equal weights of their components? What would be the weight of an iron disc 5in. across and ⅛in. thick?—BAD JUDGE.

[62113.]—**Legal.**—Will either of your legal correspondents kindly answer the following? I leased a house to a gentleman for a 14 years' term, determinable at any year of the term by the lessee at six months' notice. On the said term expiring, I inquired whether he intended leaving the house. He replied that he did not wish to leave, but did not intend to take another lease on it, but to continue on the same terms at the same rent, which was specially low. At commencement of lease, the house was put into the most substantial and decorative repairs, and he, the lessee, covenanted to keep all the interior in substantial repair in all respects as the same shall be in at the commencement of said term, and at the end of term to surrender so, well and substantially repaired, reasonable use and wear excepted. Having full faith in the lessee, I did not at any time look over the house, which I now find has been very much neglected. The lessee continued to hold the house for five years over the term on the same conditions verbally agreed upon only, and he is now just dead. Can I claim legally to have the interior of the house put into good reasonable condition from his executors according to the terms of the lease, he, the lessee, holding it over for five years?—H. K.

[62114.]—**Dynamo and Continuous Current.**—I thank "Ohm" and others for answering query 61613. I have finished dynamo. It is of the H pattern, laminated armature. Shall be glad of information how to regulate the current. At present I cannot take current from it, driving it at the slowest possible pace. I have tried inserting resistances in main circuit, but still it is too powerful. I always thought you got no shock from continuous current batteries without a contact-breaker in circuit.—F. G.

[62115.]—**Electrical.**—Will Mr. Bottone, "Hornsey," "Nun. Dor.," "C. L.," or some other intelligent practical worker, kindly state his experience of the ampère current to be got from the following four batteries: Bichromate (single cell), chromic (double cell), nitrate of soda (double cell), and Schanschieff sulphate of mercury (single cell), under the following circumstances? Two negative plates, carbons outside, one zinc plate, and separated from it ¼in. Both for bichromate and Schanschieff are immersed in the fluid, so as to give 16sq.in. surface on each side of the two plates, or 64sq in. in all (all the plates being 4in. by 6in. and immersed 4in. deep). What Am. current on first closing circuit, what after one hour, what after three hours, and how long would they continuously work for before being exhausted? Amount of fluid used, 1½ pint. Also the same if immersed plates are 8 by 8, giving 256sq.in. on both sides of two plates, with a proportional amount of fluid in the chromic and nitrate of soda double cells. The surface of negative plates immersed are the same, but the zinc would be rather smaller and immersed to the same height in dilute sulphuric acid and water, 1 to 10. The best porous cells being used in these latter two, the amount of fluid in contact with carbon plates would be reduced by space occupied by porous cell and solution. I should be much obliged in replying if your correspondents will also state the proportions in the mixtures for positive and negative plate solutions, as I find they are varied by different workers.—OWN.

[62116.]—**Safe-Working Current of Wires.**—Will any practical man kindly inform me the safe working current without any heating of the following copper wires in ampères, for one yard—viz., B.W.G. Nos. 20, 18, 16, 14, 12, 10, 8 of the copper usually sold for electrical purposes?—OWN.

[62117.]—**Rebronzing Statuary.**—I have a large pair of bronze Murli horses, which I recently sent to a professional bronzer to rebronze. He has returned them of a very dark and ugly colour, as if they had been black-leaded. Will someone kindly instruct me how to get rid of this colour and the varnish or lacquer, and how to rebronze them of a genuine copper colour? I saw some instructions on page 54 of the current "E. M." (No. 1,147), but I can hardly follow them, knowing nothing of "pickling" and the quantities for the solutions, &c.—W. C.

[62118.]—**Ammeter.**—TO MR. BOTTONE.—In letter 26916, page 13, No. 1,145, you say: "These results are, &c., &c. The copper strip, 1½in. by ⅛in. by 1-20in., which forms the conductor in all ammeters of this price (5s.)." In the ammeter tested by me (letter 26891) I find, in addition to the above copper strips, there are two copper wires, each 2½in. long by ·036in. dia., leading to the binding screws, to which latter they are connected, but not soldered. Are these wires not used in all your ammeters, and, if so, please say how it would be possible to have a resistance so low as ·00032w., and if you don't consider the resistance measurements concordant (greatest differences being only ·0018w.) when two soldered connections and two unsoldered connections are included in each instrument?—OHM.

[62119.] — **Ammeter Calibration.** — TO MR. BOTTONE.—At p. 48 in our last, you say 17·35 grains of copper are deposited per ampère hour. Is not this wrong? Rayleigh's latest values, which are now universally accepted amongst electrical engineers, is 18·238 grains per ampère hour.—OHM.

[62120.]—**Wheel Gearing.**—I have two wheels (bevel), No. 1, 16in. diameter, ⅝in. pitch; No. 2, 2½in. diam., ⅝in. pitch. These two bevel wheels were made to suit one another, and I now require another bevel wheel to work with No 1, 13in. diameter. Will any reader inform me how to set this wheel out, or kindly refer me to any book which thoroughly explains the system of bastard wheels?—P. H. S.

[62121.]—**Saw Bench.**—I have a saw bench which has been used in a bookbinding establishment, which I wish to use for metal. There are a half-dozen 6in. circular saws, which can be adjusted on the spindle any distance apart as required. I wish to use it for sawing thin ⅝ iron tube. The teeth of the saws are only cut. What can I do with them to make them fit for iron, as they give no clearance now and bind when cutting? I wish to use three or more at once. Also, what speed should they run at, and, if they will not do, what are the best saws for iron, and where can they be got? Also give a simple arrangement to push the tube to the saws, as I find too much pressure is required to use your fingers; and how much are they likely to cut off without being resharpened, and, when blunt, how can I sharpen them myself?—E. M.

[62122.]—**Caen Stone.**—What is the best way to clean a carved font made of this stone which has become slightly soiled on edges and corners from being rubbed against?—F. C.

[62123.]—**Mounting Small Emery Wheels.**—What is the best way of doing this so that they will run true without having a separate spindle for each? What rate should they be driven at, and whether best wet or dry?—F. C.

[62124.]—**Sluice Gate.**—The door of a wooden sluice gate does not shut close against the case, so that much water passes bank. Is there any cement with which the deficiencies in case might be made up, so as to make it staunch? Cement must set quickly, as flow of water can only be stopped for a short time, say an hour, and not completely even for that time.—F. C.

[62125.]—**Pinny Brass.**—Is there any way of freeing brass from iron filings after being cast? It was not known they were in it till attempting to turn it. Can anything be done now or if recast?—F. C.

[62126.]—**Legal.**—A. dies, making a will, which is invalid through not being properly witnessed. Children are satisfied, and have signed a consent to agree to the division of the property in accordance with wishes expressed in writing by A. Is this a lawful arrangement, or can anyone in future call in question such a settlement? Should the consent be stamped? If it is not stamped, does the limited time within which it may be stamped without fine count from the date of the first or the last signature? Some of the members having to sign it live in the colonies, so that it would be impossible for them to sign within the 14 days allowed. Is there any special provision for such a case?—F. C.

[62127.]—**Finishing Repousse Work.** — How should repousse work in brass be finished? If the brass is not polished before the matting or texture punching of leaves, &c., is done, will it not remove the greater part of it, especially if the matt be very fine, as it should be in such a case? What kind of a scratchbrush is most suitable for the purpose? Should the wire be coarse or very fine? A fine one I have—wires about thickness of horsehair—seems to have no effect. Is a fast or a slow motion required to work it in lathe?—F. C.

[62128.]—**Rear-driving Safety Bicycles.**—Many thanks to "Sardonyx" for his interesting reply. I have a few more questions, which perhaps he can help me to answer. Should the front fork be straight or curved (see "E. M." March 4, p. 5)? Should it have a spring attachment to lessen vibration? I understand the advantage of the saddle being straight over the seat, but I should think it would give one a tendency to round shoulders, having to reach so far forward to handles. When referring to free pedals and no chain in my query, I was thinking of an action like the "Merlin" or "Omnicycle." If some such driving gear were fitted to a rear-driver, the wheels could be brought 5in. or 6in. closer together, and therefore the handles, if desired, 5in. or 6in. nearer the seat. Although I have particulars of many different makes of these bicycles, I do not find that any are made with "Morgan's" chains. That, or a similar chain, has always seemed to me so much superior to the ordinary make. Can "Sardonyx" tell me why it is not more used?—QUIS EST.

[62129.]—**Driving Clock for Telescope.**—Will "F.R.A.S.," or any other reader, kindly tell me where I can find a description of a good driving clock?—ST. AUBYN.

[62130.]—**Compound Launch Engine.** — I am desirous of designing a pair of compound launch engines to indicate 10H.P.; but I do not quite understand the method of calculating the sizes of cylinders. I wish the high-pressure cylinder to indicate as near as possible the same power as the low-pressure. The stroke of the engine is to be 3½in., and the revolutions to be 450: pressure, 90lb. I should be exceedingly obliged if any of "Ours" would answer this question, and explain the method by which they arrive at the required result.—CREOLE.

[62131.]—**Hard Water.**—Many thanks to correspondent for replies. I find the water to be 15° total hardness, 12 being temporary, and three permanent. I should now be glad to know the amount per gallon of a saturated solution of lime to be added to remove the 12°. I assume that the lime should be slaked before using.—ROSICRUCIAN.

[62132.]—**To Mr. Stretton.**—Will Mr. Stretton please supply us with diagram and particulars of Midland 30 class of "singles"?—ROVER.

[62133.] — **Screw-cutting Apparatus.** — TO "O. J. L."—Could not Niblett's swash-plate arrangement be made to take the place of the screwed thimbles on the traversing mandrel?—A. F. SHAKESPEAR, Dresden.

[62134.]—**Steel Screws.**—What is the best kind of steel for making screws that require their points hardened? Cast or blistered steel is too difficult to work, and mild steel won't harden.—B. J.

[62135.]—**Gas-Engine.**—I should esteem it a favour if any of our readers will kindly inform me which is the and instrument to use to find the maximum re of the exploded mixture in the cylinders of s, and also that of the exhaust products.—

Cutter Frame.—To "J. H." OR OTHERS ing to make a universal cutter frame to suit page 444, Vol. XXXVIII. "E. M.," and should now dimensions of a pattern for cast iron. cutter frame described in last vol. do?—

-**Encaustic Cerate.**—I shall be much one of your chemical readers will inform me ke the above.—AMATEUR.

– **Heliotype.** — In Spon's "Workshop directions are given for the heliotype process, cise quantity of bichromate of potash, gelatine, e alum are left out. Will any of "ours" come of?—A. E. W.

-**Dynamo Commutator.**—I have a made 16c.p. dynamo, sometimes used as a motor. as a motor, the friction of the springs pressing mmutator, greatly impedes its motion. When oducing current, to get full effects I have to essure on the brushes that the commutator n the spindle. Could I have discs revolving in rcury troughs, doing away with the half-rings s? It is a Siemens laminated armature. Any uch oblige.—EXHAUSTED PATIENCE.

-**Earth's Magnetic Force.**—Can one of men who so ably dealt with the tangent ter assist me with this? What is the earth's at a place where H = ·223, and the angle of Letting I denote total intensity, and V nd H horizontal forces, I understand that. δ, and V = I sin. δ. Also that $V^2 + H^2 = I^2$. ow me how an example like the above would out, explaining the method used? Can you also airly simple method of measuring the value of angle of dip at different places?—CARNFORTH.

-**Hardening Cast Steel Cutters.**—ader inform me the way to harden wood-workle cutters, steel on one side and iron on the eir size is about 6in. by 14in., and less; and aring chisels? I have tried to harden them es in warm water, but somehow they get d twisted in the water. Also a method to cutters to file them?—TANGO.

-**Dynamo, 5 volt.**—I have a cog ring rmature, 6in. diam., 4in. wide, 24 sections, ½in. in. wide, which I wish to wind for plating, to . Will some of our friends oblige with size and vire, and speed?—T. L. H.

-**Legal.**—A and B are two houses, with back ntrances, and were at one time occupied by one ring his occupation of both, he erected a shed of house B, the roof of which is projecting nto the yard of house A. In the said shed a s made, facing the yard of house A. During ime he also made a door in the wall which he houses from each other, so as to enable him m one yard to the other. The houses have old, and are occupied by two different persons. ner of house A the rights of having the wall Also, can he make them take the projecting roof off?—E. M. R.

-**Clasp Nut.**—Will "Vulcan," or some other nt, favour me with sketch of clasp nut, with ovement for locking the same? The nut to that I have got is not satisfactory. It is a n.—ONE IN THE DARK.

-**Ammeter Constant.** — "Iota" (letter ks me for information *re* movement of needle nd goes on to say that he knew all this before. does he take up space by putting queries which e ridiculous. He speaks of friction spoiling the wing to the smallness of moment. Now, I ad to know how he accounts for the change of which he found in his instrument after using ith. "Iota" has either made a gross mistake, ave a very great deal to learn yet about the of our apparatus, and it would appear even current galvanometer is subject to the same vered changes.—OHM.

-**Lifting Crab.**—The barrel of a crab is he handles having a radius of 15in., and two ployed, each exerting a constant force of 15lb. les. They raise 1 ton. Find the purchase of —STUDENT.

H.P. of Locomotives.—What must be e H.P. of a loco. engine which moves at the ed of 40 miles per hour on a level rail, the being 15lb. per ton. If the rails were laid at of 1 in 100, what additional H.P. would be STUDENT.

-**Pyrotechnics.**—Wanted to know, with r material are the asbestos fireballs mixed? l be the right length and diam. of lances for a y, 15ft. by 10ft.? Wanted, a good recipe for a blue Bengal fire.—AMATEUR PYRO.

-**Platinum in Filings.**—Will any readers inform me how to extract the platinum from g filings: brass, platinum, and soft solder?—

-**Leaky Portable Engine.**—Kindly how to repair a portable engine that leaks at es under the shoulders. The difficulty is in the heads of the bolts to take out and replace.

-**Mechanics.**—Find the direction of projec- [illegible] when the greatest height reached by $\frac{1}{n}$ the part of the range on a horizontal [illegible].

-**Coins and Tokens.**—Would some corre- [illegible] kindly inform one who [illegible] (except current British [illegible] are, and their worth, if [illegible] 1723, with inscription that [illegible] with six ships only."

Portrait of the admiral and view of the siege. (2) A small piece, apparently brass, with the inscription "Geo. III., 10s. 5d. 2dwt. 16gr., 1772." (3) Farthing, 1793, with head of Sir Isaac Newton, cornucopia and branch. Another smaller, with head of Sir Isaac and figure of Britannia. (4) Exeter halfpenny, 1792. (5) Medal of "London Corresponding Society," "United for a Reform of Parliament." Dove and olive branch, 1795. (6) Cinque Port halfpenny. —ARTHUR MEE.

[62153.]—**Long Train-Runs in the United States.**—Can any of your readers kindly inform me what is the longest run, without a stop, of any train in the United States?—G. A. G.

[62154.]—**Rhubarb.**—Wanted to know what are the acids existing respectively in forced and mature rhubarb, that is, of course, in the leaf stems? Is it really a fact, or only a popular fallacy, that the forced and red stalks are better for children and people of weak digestion; this being the reverse of what is known to be the case in unripe and ripe fruit? In what books of reference can information thereon be obtained?—A. LLOYD.

[62155.] — **Acoustic Telephones.** — Can I use several of these in a system like electric telephones, so as to be able to speak from one part of a factory to another? I should want four of them, each one to speak to the others. If so, will you kindly tell me how to connect them?—TOP FLOOR.

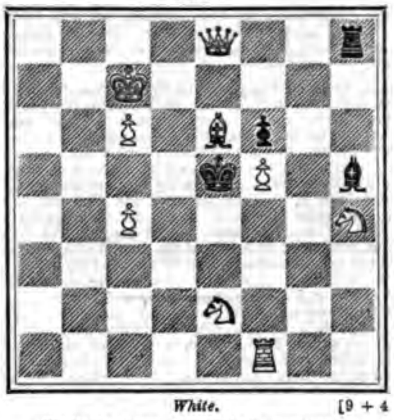
[62156.]—**Sub-sizing Paper.**—In sizing some paper lately, it seemed all right till it was dried and lay for a day or two; but then we found that it was useless, having turned to a dirty-brown colour and become very brittle. Now in our pulp we have very little alum, 4½lb. per 2cwt.; but in the animal size we have a great deal, nearly as much as it would dissolve, in fact. Several lots were spoilt in this way till I reversed the quantities of alum, and put 20lb in the 2cwt. Eng., and only 10lb. to the 100 gallons of gelatine. This effected a cure. Now will any expert kindly explain this, and tell me the reason why the gelatine should spoil the paper in this way? Any hints as to the practice in hand mills would greatly oblige.—PAPERMAKER.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXXVII.—BY REV. E. L. HOPKINS.

Black.



White. [9 + 4

White to play and mate in two moves.

SOLUTION TO 1,035.

White.	*Black.*
1. Kt takes K P.	1. Anything.
2. Kt or Q mates.	

(Four variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,035 by J. Mackenzie, E. C. M. (Ipswich), A Beginner (very easy, though good), Cotswold, Major, A. Flawn, J. W. Hamill, A. Bolus (very good indeed and very difficult), V. S. Pochin, F. Krasser, Black Pawn, A. Dean, Snowdrop, G. A. A. Walker, James Palmer; to 1,034, by Snowdrop, G. A. A. Walker, A. Bolus, James Palmer, and Black Pawn.

BLACK PAWN.—Thanks for the new problems. One (K-Q 1) we have examined, and it appears sound and good. The other two shall be reported on shortly.

E. L. HOPKINS.—Problem very acceptable. We shall be glad to hear from you again.

MAJOR.—We are much obliged for the problems. Correction noted.

L. C. W. (Canada).—Solution to 1,032 correct. That to 1,031 has been given.

W. HEWSON-KILBEE.—You have missed 1,035. If

$$1. \frac{\text{R takes P}}{\text{B takes Kt}},\ 2. \frac{\text{R-K 6, dis. ch.}}{\text{K-Q 2}}.$$

WE shall be glad to have some more problems.

ACCORDING to the official report of the German Patent-office, just published, the number of applications for patents rose from 5,949 in 1878 to 9,991 in 1886; but whilst in the former period only 25 per cent. of the applications were disallowed as not patentable, they increased in the latter to 60 per cent. In 1886, 4,008 patents were sealed, whilst 5,983 were disallowed.

ANSWERS TO CORRESPONDE

*** *All communications should be addressed to th of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put for illustrations on separate pieces of paper. 2. to queries, and when answering queries put the as well as the titles of the queries to which t refer. 3. No charge is made for inserting letter or replies. 4. Letters or queries asking for add manufacturers or correspondents, or where tool articles can be purchased, or replies giving such tion, cannot be inserted except as advertisement question asking for educational or scientific in is answered through the post. 6. Letters sent spondents, under cover to the Editor, are not f and the names of correspondents are not giv quirers.

*** Attention is especially drawn to hint No space devoted to letters, queries, and replies is the general good, and it is not fair to occupy it tions such as are indicated above, which are onl vidual interest, and which, if not advertisements selves, lead to replies which are. The "Sixpe Column" offers a cheap means of obtaining such tion, and we trust our readers will avail themselv

GOOD FRIDAY.

NEXT week the ENGLISH MECHANIC will ha press some hours earlier than usual in order to publication before Good Friday. All adver must, therefore, reach the office before 5 TUESDAY NEXT, instead of by 1 p.m. on W as usual.

BACK NUMBERS.

WE receive so many queries asking for directio make many instruments and appliances which fully described in back volumes, that we have c list, which we shall insert in this column at int those most frequently sent, and as the number in stock, new subscribers should consult the l sending their questions.

Bookbinding : No. 613.
Electric machines : Nos. 1,009, 1,025.
Electro-magnets : Nos. 772.
Lacquers : No. 866.
Pattern Making : Nos. 938, 941, 943, 945, 948, 950 955, 956, 958, 959, 962, 963, 969, 974, 978, 986. 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,0
Silver-plating : Nos. 1,009, 1,010.
Varnishes : Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters t to Wednesday evening, March 30, and unackn elsewhere :—

S. GIBSON.—A. Ledger.—W. Barbour.—W. F. S Sullivan and Co., Ltd.—A. J. Pool.—H. G. B.- Countryman. — Hereward.—Bagot.—Shunt.— G. Fryer.—F. H. Wenham.—E. Holmes.—E. C. —W. J. R.—Silke.—W. A. W.—A Fellow of Astronomical Society.

OUIDA. (Answered on p. 69. No one cares to responsibility of advising in such matters; but find information in back volumes, and can obta answers to questions from the agent of th selected. The Australian Handbook, publi Gordon and Gotch, St. Bride-street, London, tains a great deal of trustworthy information Colonies known as Australasia.) — DUBITAN appear to have misunderstood. The actual ployed will depend on the key, and at Westmi is E. The famous chimes are well known, arranged in 1793 by Dr. Crotch for Great St. Cambridge. See pp. 356, 400, Vol. XXXIX.)— (We do not think there is; at all events, we ne of one for circulating technical books.)— (There is either a hole in the pan or it does not so as to retain the water. It is a matter for tion, not for expression of opinion.)—PHOTO. sible to answer such a question without know the lenses are.)—CAM. LINEMAN. (Surely it enough. Examine a bound book and procure needle and thread. Make a little frame so port three or more vertical strings, and sew t to them. Cuts are made in the backs to let in.)—J. W., Newcastle. (Sketches of several gas-engines will be found in back numbers. 1011, 1071 contain sectional drawings, and many others in back volumes.)—CASH. (M on for shop described in several forms in Nos. 1 1025. Any turner could make suitable balls.)- PRINTER. (The process has been frequently d See No. 1115, the indices generally, or procur work by W. T. Wilkinson, North Parade, J. I. S. (We know of nothing more than described in back volumes, though possibly "Playbook of Science" might be useful. can be done with the apparatus you have.)- TERS. (Do you mean the mechanical telephon other is the subject of a patent, and you must the company. See indices of back volumes.)— LOVETT. (Thanks; but the difficulty in the that the amateur "physician" wanted it for else. Amateurs can practise on themselves as they please. We will utilise some of the note EXPERT JOINER. (You will find two capita on French polishing in Nos. 814 and 816. Y appear to give sufficient time, nor sufficie After bodying in, a floating coat should be pu when thoroughly dry be worked down with f paper. Then the foundation coat is put if necessary that is rubbed down wi paper, when the finishing coat of half p half spirit is put on. Rubbing up is the amateurs find. Look up the indices, as all th usefully said in print will be found in back vo JOINER. (Particulars in No. 964. The cost application, and £3 with the complete specifi

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 8, 1887.

A SCREW-CHASING ARRANGEMENT ADAPTED TO AN ORDINARY FOOT LATHE.

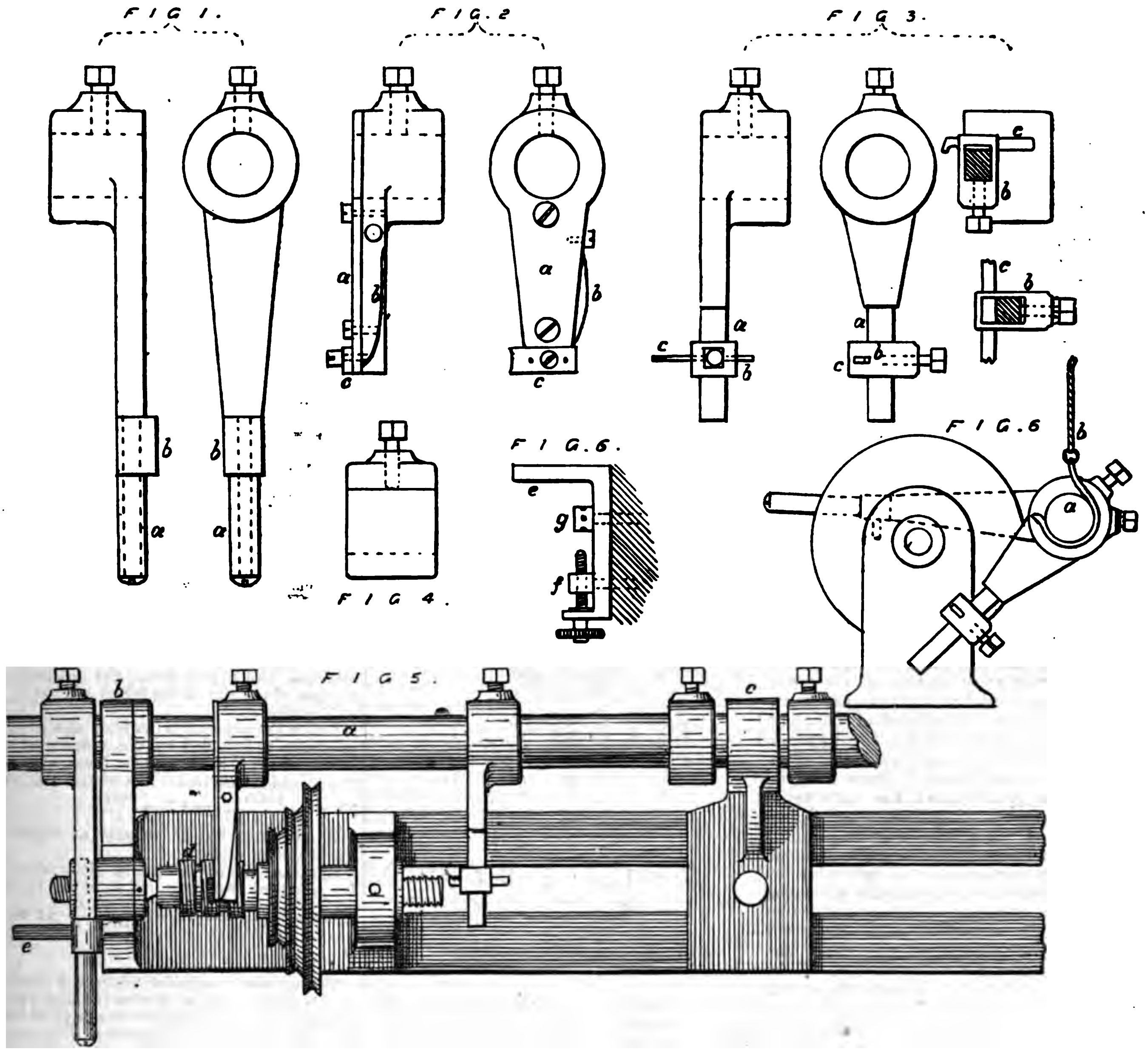
By F. H. Wenham.

THE description of Niblett's arrangement appearing in the "E. M.," Nos. 1146 and 1147, for this month, has reminded me of my nearly forgotten promise to describe in this journal an arrangement that I was called upon to design about ten years ago. This has been in constant use ever since for chasing screw-threads in the most delicate work, such as optical instruments. The conditions were that no operative skill should be required to use it—that after having been set for one piece of work, it should chase consecutively any number of screws of exactly the same diameter and length—that the arrangement should always be ready for use, without interfering with the slide rest or T-rest if required to be in place for finishing the work.

The apparatus is based upon the well-known plan of copying a standard thread on the tail end of the mandrel and transferring it to the work by means of a kind of beam compass arrangement held in the hand; but this arrangement is so clumsy and unsatisfactory in use, that the best that can be said of it is that it may enable an unskilled turner to avoid cutting a drunken-threaded screw. A skilled optical workman would prefer to use the ordinary hand-chaser without this appliance.

In the illustrations, I will first describe the detail portions as they are to be placed, begining at the headstock end of the lathe, each figure, including different views, is one-third full size. Fig. 1 is the handle; the eye of this is bored out to fit a spindle 1¼in. in diameter, with a clamping screw for fixing it thereto. The end of the handle is turned down to fit into a sheath *a*, which turns easily, and is kept in place by an end screw. This sheath has an eccentric or snail piece *b*, which buts against a stop, when the highest part is brought uppermost. Fig. 2 is the arm for carrying the die. The eye is similar to Fig. 1. On the face of the arm is a plate *a*, bored out to match. The plate is kept in loose contact with the face by means of two flat-headed screws, having the through holes enlarged so as to allow a rise and fall of about ⅛in. The plate *a* is pressed down by a flat spring *b*, screwed on to edge of arm; *c c* is a strip of gun-metal having its projecting end cut with a screw-thread to match the particular guide screw required. There must be several of these dies to suit the number of threads. They are fitted with two steady-pins, and fixed to the plate *a* by means of a screw so as to be easily removable. Fig. 3 is the tool arm and holder: the arm has a binding screw and similar eye as Figs. 1 and 2.

The end of the arm at *a* is cut square and parallel; *b*, in the four views, is the tool-holder: this is a block of steel cut out so as to fit sideways on the square of the arm; but lengthways the hole is elongated so as to allow some play for clipping the chasing tool *c*, on any one of the four sides of the arm as may be found convenient. The tool *c* is passed through a small transverse slot at the end of the holder, and bound fast against the arm by the opposite set-screw. In the end view figures, the upper one shows the tool *c* as held transversely for cutting inside screws, and the lower one with a tool held vertically for cutting outside screws. The best position on the circle, according to diameter, is obtained by clipping the tool the right distance on the square. Fig. 4 is simply a collar and set-screw to match the eye of the arms: two of these collars will be required. Fig. 5 is a plan of the lathe, one-fourth size, showing the above detail pieces in place; first is a steel rod *a*, 1¼in. in diameter of any suitable length, according to the lathe bed; this should be turned exactly



VOL. XLV.—No. 1,150.

to diameter, and polished. It is supported behind the lathe and parallel thereto by two standards; the one, *b*, fixed to the end of the headstock, the end one, *c*, bolted down to the lathe bed at any convenient distance. The detail pieces, Figs. 1, 2, 3, 4 are shown in their proper places on the bar *a*. Fig. 6 is an end view of headstock, showing bar *a*, tool-holder, and handle in place. A ferrule, *d*, is driven over the tail end of the mandrel, divided into sections, each having a different screw-thread cut on it. This must be done very accurately with a good screw-cutting lathe; the spaces between each screw must be cut below the thread, and be sufficiently wide to allow the die, *c*, Fig. 2, to drop in easily. If a large assortment of screw-threads is required, several ferrules will be needed to slip on and off; but if the mandrel has the tail end projecting, it would be convenient to place the screwed ferrules thereon outside. The handle bears from its eccentric part on a rest adjustable for height, shown separately by Fig. 6. This is attached to the headstock, and is fitted with a raising screw and milled head, and clamping screw, *g*, for setting fast after the adjustment for depth of cut is made.

When the arrangement is all set in place, a wire hook, shown at *b*, Fig. 6, is passed under the bar *a*, attached to a cord running over a pulley at the ceiling of the room, with a counter-weight equal to that of the bar, and arms which balanced by this means floats to and fro in the bearings almost without friction.

In order to cut screws, the mode of procedure is as follows: First turn the eccentric of the handle upwards to the stop-pin, so that it may find its lowest point on the rest *e*, and clamp the eye fast on rod; next press the die arm down, with the proper die in the groove behind the selected screw, and clamp on rod. Next adjust the tool-arm and tool, setting this at the end of the run of the screw, whether inside or outside, letting the point of the chaser just rest on the work, and clamp fast; next bring the outer collar to rest against standard C, and clamp it there; then clamp the inner cellar a sufficient distance away for the withdrawal of the tool; oil the parts, and by raising and lowering the arm with the left hand on or off the guide screw on mandrel, see that all goes right, then lower the rest *e* by means of the screw *f*, Fig. 6, and continue to chase the screw till it is cut deep enough and of the right diameter; then clamp the rest fast by screw *g*. Of course, it will be understood that after the die passes the thread, it drops into the intermediate groove, and the traverse of the chaser stops, cutting a concentric groove at the end of the screw. For thin optical tube work, where a shallow thread of about 30° is used, a single-point tool will serve for the chaser; but for deeper threads, where the top has to be rounded, a chaser having two or three teeth should be used. This will make a wider groove at the end; but this is generally of no consequence. Now, putting fresh pieces of work in the chuck, the chasing may go on with the greatest rapidity, only by working the handle at the end to and fro, first raising it by the eccentric on the end, and at every run giving this a slight turn till it comes to the stop; the work is then finished to size. It is impossible that anything can go wrong, and if the T or other rest is required to finish the work, the handle can be raised and the arms thrown back out of the way till the next piece of work is chucked for screwing. It is perhaps needless to state that if the screw is required to have either a regular or irregular taper, this may be obtained by giving the proper incline or contour to the rest *e*. There is no difficulty in cutting the edge of the die *c* to any screw on the ferrule, as a temporary die of hardwood may be adapted, while the die proper is clamped to the tool-arm, and the end scored out by a V-cutting point from an arbor revolved in the lathe.

The whole of this arrangement is easy to make, being mostly turned work without troublesome slides. As some difficulty might be found in boring out the bearings of the standards *b* and *c* for carrying the bar *a*, this may be overcome by setting the bar in place, and running in white metal; but a better plan would be to turn out a pair of split brass dies with holding-screws like a plummer-block, clamping these on to the bar *a*, face their flat bases with reddle on to a corresponding face on the top of the standard; but once well fitted, the bar *a* is not likely ever to work shaky in the bearings.

THE THEORY OF MACHINES.—VI.

By FRANCIS CAMPIN, C.E.

Limiting Velocity of Wheels, Belt Gearing, and Friction Gearing.

THERE is a matter in connection with the theory of wheels which, as far as we have observed, does not seem to have attracted the attention of other writers, and that is the centrifugal force set up in the rims as determining a limit to their velocities. This is not a question to deal with in common with others respecting the strength of wheels, as it is not one which can be met by altering the quantity of material employed in forming the rim of the wheel, for the strength of the rim varies as its sectional area, so does its weight, and therefore its centrifugal force, so that in adding strength by increasing the area the centrifugal force is at the same time increased in the same ratio. There must, therefore, for every wheel be a ratio of number of revolutions per minute to the diameter or radius of the wheel in feet, at which the rim will be on the point of flying to pieces, and this will limit its velocity, and, of course, in practice this limit should have a safe margin. In former years this was not a point of such vital importance as it has assumed recently, when some types of rotary engines are proposed to be run up to thousands of revolutions per minute.

FIG. 23.

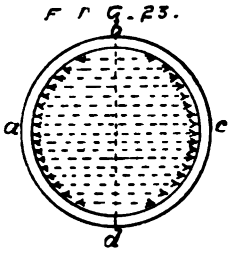


FIG. 24.

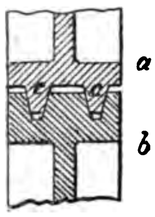
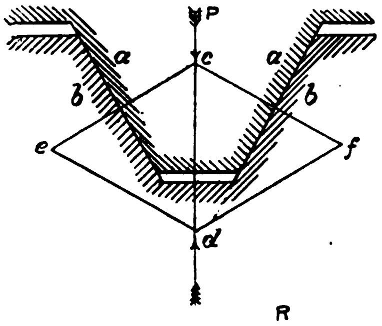
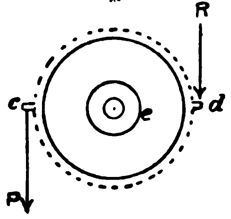


FIG. 25.





Let r = radius of the centre of gravity of the rim of the wheel in feet; A = its sectional area in square inches; N = number of revolutions per minute; v = velocity of rim in feet per second; w = weight of rim in pounds per foot of circumference; C = centrifugal force in pounds per foot of rim; T = the tangential or bursting force on any section of the rim; and U = the total ultimate tensile resistance of the section of the rim, which is assumed to be of uniform weight in the first case dealt with.

When a radial force, either internal or external acts, as the pressure in a steam boiler or the load upon an arch, that force will give rise to another acting tangentially upon the ring or arch exposed to it, and we must determine in the first place the relation existing between the radial and tangential forces.

In Fig. 23, let *a b c d* represent a section of a pipe subjected to internal pressure radial in its action—that is, as of a liquid pressing equally in all directions. The tendency of the internal forces will be to tear the ring asunder. Take any two diametrically opposite sections, as at *b* and *d*, and let *a c* be a straight line at right angles to a line joining *b d*.

Now, the force tending to rupture the ring at *b* and *d* will be the sum of the contained forces acting parallel to *a c*. Let the depth of the ring be one foot and its diameter in feet = D, and radius in feet = r, and let the internal pressure per square foot be P, then this multiplied by D must be the sum of the parallel pressures between *b* and *d* acting parallel to *a c*; therefore, the force acting upon the two sections *b* and *d* will be = D × P, and the force acting on one section will be = r × P, and this will obviously apply to any other section of the ring. Hence, on any ring the tangential force corresponding at a given point to a given radial force acting at the same point will be equal to the radial force multiplied by the radius at the given point, or $T = P \times r$.

In the case now under consideration, the radial force is the centrifugal force; therefore, $T = C \times r$.

From the usual formula we have, $C = \frac{w \times v^2}{32{\cdot}2 \times r}$

but $v = \frac{N}{60} \times 2\,r \times 3{\cdot}1416 = 0{\cdot}1047\,N\,r$; therefore, $C = \frac{w}{32{\cdot}2\,r} \cdot \left\{ 0{\cdot}1047 \,.\, N \,.\, r \right\}^2 = 0{\cdot}00034 \,.\, w \,.\, N^2 \,.\, r^2$.

Cast iron weighs 0·262lb. per cubic inch; therefore, a bar one foot in length and one inch square will weigh 3·15lb., and the weight $w = A \times 3{\cdot}15$; therefore, replacing w in the previous equation by this value, we find $C = 0{\cdot}00107 \,.\, H\,N^2 r$; but, as shown above, $T = C \times r = 0{\cdot}00107\,A \,.\, N^2 \,.\, r^2$.

The ultimate tensile resistance of fairly good cast iron is 16,000lb. per square inch of sectional area; therefore, the ultimate resistance of the rim of the wheel will be U = A × 16,000lb.

But at the moment of rupture the ultimate resistance is equalled by the tangential force arising from the centrifugal force, wherefore U = T, and thence $16{,}000\,A = 0{\cdot}00107 \,.\, A \,.\, N^2 r^2$; $N^2 = \frac{16000}{0{\cdot}00107 \,.\, r^2}$; and $N = \frac{3867}{r}$.

N will then be the velocity at which the wheel will be ruptured.

Let the factor of safety determined on for practical working be 4, then 16,000lb. becomes 4,000, and $N^2 = \frac{4000}{0{\cdot}00107 \times r^2}$; and $N = \frac{1933}{r}$.

This expression applies where the sectional area is uniform, as in flywheels, plain pulleys, railway, and other similar wheels; but where cast iron is not used, another constant for tensile resistance must be inserted in the equation.

Let t = the ultimate tensile resistance per sectional square inch of the material, and f = the factor of safety adopted; then the general expression will become $N^2 = \frac{t}{0{\cdot}00107 \times r^2 \times f}$; and $N = \frac{1}{r} \cdot \sqrt{\frac{t}{0{\cdot}00107 \times f}}$.

When the section is not uniform throughout, as in the case of toothed wheels for instance, this formula will not apply, as the centrifugal force will be greater than that due to the running section. Let A = the average area of the section (including teeth) and a = the nett section which runs uniformly round the rim.

The centres of gravity of the two sections A and a will, of course, be at different distances from the centre of the wheel; but the difference will not, in comparison with the diameter of the wheel, be of sufficient importance to practically affect the issue; hence the radius of the outside of the running section will be taken as the value of r.

From one of the foregoing equations we have for the centrifugal force $C = 0{\cdot}00107\,A\,N^2\,r$, and $T = C \times r = 0{\cdot}00107\,.\,A\,.\,N^2\,r^2$. But $U = a \times 16{,}000$; therefore $16{,}000\,a = 0{\cdot}00107\,.\,A\,.\,N^2\,.\,r^2$. From this—

$$N^2 = \frac{16{,}000\,a}{0{\cdot}00107\,.\,A\,.\,r^2} \text{ and } N = \frac{1}{r}\sqrt{\frac{16{,}000\,.\,a}{0{\cdot}00107\,.\,A}} = \frac{3867}{r}\,.\,\sqrt{\frac{a}{A}}.$$

Taking 4 as the factor of safety for cast iron N becomes $= \frac{1933}{r}\,.\,\sqrt{\frac{a}{A}}$; and the general expression for any material will be $N = \frac{1}{r}\,.\,\sqrt{\frac{t\,.\,a}{0{\cdot}00107\,A\,.\,f}} = \frac{30{\cdot}571}{r}\sqrt{\frac{t\,.\,a}{A\,.\,f}}$.

We will now proceed to consider pulleys and band-gearing. The whole power thus communicated from one shaft to another must evidently be transmitted from the driving-pulley to the band in the first instance by aid of the frictional resistance of the band or strap to slipping on the surface of the pulley, and in order that the band may be in proper contact with the pulley, it is necessary that both of them should have smooth surfaces. The force or pressure conveyed by the band will be equal to the difference between the tensions of the band entering and leaving the pulley. The radial pressure upon the pulley due to the tangential stress upon the band will be equal to that stress divided by the radius of the pulley, and the whole force of the bearings upon the pulley will be equal to the sum of the tensions upon the band.

Let it be required to transmit a force of 5,000lb. through a band from one pulley to another, then the radial pressure must be such that the strap will not slip on the surface of the pulley under such force, and this must be secured by the initial force given to the strap in stretching it over the pulleys in the first instance. The co-efficient of dry tanned leather upon cast-iron is 0·56; hence the radial pressure upon the pulley to transmit a force of 5,000lb. will be 5,000lb. ÷ 0·56 = 8,929lb. nearly.

Let R = the radial pressure in pounds upon the pulley per foot of circumference; r = radius of pulley in feet; l = length of peripheral contact in feet; a° = angular contact in degrees; E = force to be transmitted by band, and T = initial tension of band in pounds; i.e., the tension given to the band in stretching it upon the pulleys before any *working strain* comes it; and let c = the co-efficient of friction of the band upon the pulleys.

$T = R \times r \therefore R = \frac{T}{r}$. If R' = total radial pressure upon the surface of the pulley, $R' = R \times l = \frac{T\,.\,l}{r}$. But $l = \frac{r \times 3{\cdot}1416 \times a^\circ}{180^\circ}$; therefore $R' = \frac{T}{r} \times \frac{r \times 3{\cdot}1416 \times a^\circ}{180^\circ} = \frac{3{\cdot}1416\,.\,T\,.\,a^\circ}{180^\circ}$. But, as shown above, $R' = \frac{E}{C}$; therefore, $\frac{E}{C} = \frac{3{\cdot}1416\,T\,.\,a^\circ}{180^\circ}$

whence $T = \frac{180^\circ\,F}{3{\cdot}1416\,.\,c\,.\,a^\circ} = 57{\cdot}295\,.\,\frac{F}{c\,.\,a^\circ}$.

Let the two pulleys be of the same size, then the two sides of the band will be parallel, and one half of the pulley periphery will be in contact with the band, so that $a^\circ = 180^\circ$ and $T = \frac{F}{3{\cdot}1416\,.\,c}$.

In the above example it is found that $\frac{F}{c}$ = 8,929lb.; therefore, the initial tension on the band to enable it to transmit a force of 5,000lb. will be $T = \frac{8929}{3{\cdot}1416} = 2842{\cdot}18$lb., and this will be the initial tension requisite to produce sufficient friction for the transmission of 5,000lb. force under the conditions described.

The maximum tension that can come upon the band will be the initial tension plus the force transmitted through the band, and this it is necessary to know in order to decide upon the size of strap required.

The relative velocities of the pulleys will be peripherally the same, and therefore their angular velocities will be inversely as their diameters; the portions of the peripheries covered will be in relation to their diameters and the distance apart at which they are placed, except in the case of pulleys of equal diameters.

As the length of periphery in contact with the band comes in as a factor in determining the initial tension requisite for the transmission of a given force, it follows that this tension should be settled on data taken from the smaller pulley, as that will have least angular contact with the band.

Driving by band is especially suited for moderate powers, and affords a very convenient and steady mode of transmitting power: but it is not adapted to machinery requiring the angular velocities of its several shafts to be maintained with great exactness, as this cannot be absolutely secured on account of the difficulties of turning the pulleys dead-true as regards diameter.

We shall now refer, but briefly, to what is termed friction gearing. It consists of wheels driving by frictional contact with each other.

If two plain pulleys are running in contact there can only be a line of contact between them, and this would afford but a very insufficient hold; but we have also to consider the amount of additional friction put upon the bearings by gearing of the description now under consideration, and that between the wheels themselves.

In Fig. 24 is shown a section through the line of contact of the peripheries of a pair of grooved friction wheels. a and b are the rims of the wheels, which are so grooved that the ridges and grooves fit together, and being pressed together, have a sufficient frictional resistance to allow of the transmission of power.

It will be seen that from the form of the elements there must be considerable abrading action, for the tops of the ridges will be moving at a velocity different from that of the lower parts of the grooves with which they are in contact, the ridges are shown by the letters $c\,c$. There is, as will be observed, a clearance allowed in order that the wheels may be closed up to allow for wear.

View this any way we will, there must be a loss of power in the grinding friction upon the sides of the ridges, and the wear thus caused will also be very unequal, unless those sides are carefully formed to an antifriction curve which shall insure equal abrasion all over the surfaces in contact.

We shall now consider the additional friction brought upon the bearings of these wheels by the pressure forcing them together in order to obtain the necessary resistance for the transmission of power.

In Fig. 25, let a and b show surfaces of contact of two ridges, and let P be the force pressing the wheels together necessary to obtain friction for the transmission of F pounds force from the driven wheel.

Let the inclination of the sides of the ridges to each other be 60deg., and let $P\,c$ be the direction of the closing force. Produce $P\,c$ to d, making $c\,d = P$; then complete the parallelogram $c\,e\,d\,f$, making $c\,e$ at right angles to the surfaces of contact at one side, and $c\,f$ at right angles to those on the other side.

Then because the sides are at an angle of 60deg. to each other, the triangles $c\,e\,d$ and $c\,f\,d$ will be equilateral triangles, and the pressures $c\,e$ and $c\,f$ on the surfaces of contact will each be equal to the pressure P.

Taking the co-efficient of friction for iron at 0·25, the total pressure on the surfaces of contact necessary to insure the transmission of the force F will be $F \div 0{\cdot}25 = 4\,.\,F$. But the sum of the pressures put upon the surfaces of contact has been shown to be $= 2\,P$, because $c\,e + c\,f = 2\,.\,P$; therefore, $P = 2\,.\,F$, and this will be the additional force pressing upon the bearing to cause friction. This can be shown by comparison with a toothed wheel.

Let c and d be two opposite teeth on a wheel supported upon the axis e, and let P be the driving, and R the resisting force. Now these must be equal, and will, therefore, throw upon the bearings at e a force equal to 2 P, which corresponds to 2 F in the friction gearing: hence, in this particular, there is nothing to choose between the two systems, and in both cases the diameters of the wheels do not enter into the calculation.

This, however, furnishes the item of additional friction for the toothed-wheel, but not for the friction-wheel, as there is abrading friction to be considered in the grooves.

At the pitch circles, where the velocities are equal, there is only rolling movement; but this is on an indefinitely narrow surface, and on either side of it the abrading action is set up, increasing to its maximum at the external peripheries of the ridges.

If the wheels have diameters = D on the pitch-line (they are, for convenience, taken as being equal), and the depth that the ridge of one wheel enters between those of the other = d, then the greatest difference of velocities between the rubbing surfaces will be that between those corresponding to the diameters $D + \frac{d}{2}$ and $D - \frac{d}{2}$, so the mean distance through which the friction of these rubbing surfaces is overcome in one revolution will be

$$= \frac{3{\cdot}1416}{2}\left\{D + \frac{d}{2} - \left(D - \frac{d}{2}\right)\right\} = \frac{3{\cdot}1416\,.\,d}{2}$$

the divisor 2 being brought in in order to get the *mean* distance through which the friction is overcome, which is $= 1{\cdot}5708\,.\,d$. Hence, this quantity is dependent only upon the depths to which the ridges are entered. Still, they have the whole pressure upon them, and the work thus wasted in one revolution will be $2\,P \times 0{\cdot}25 \times 1{\cdot}5708\,.\,d = 0{\cdot}7854\,.\,d\,.\,P$.

For the sake of an example, let d = 1in., and F = 800lb., then P = 2, F = 1,600lb. Let the diameter of the wheel be 2ft. at the pitch circle.

The amount of work done in overcoming the injurious friction between the ridges will be $= 0{\cdot}7854\,.\,d\,.\,P = 0{\cdot}7854 \times \frac{1}{12}\quad 1{,}600 = 104{\cdot}72$ft.-lb.

The total amount of work done in one revolution will be $3{\cdot}1416 \times 2 \times 800 = 5026{\cdot}56$ft.-lb., so that in this case there is a loss—very small, it is true, in comparison with the work—but yet one which does not occur at all when toothed wheels are used.

THE AMATEUR WORKSHOP.—XXXVI.

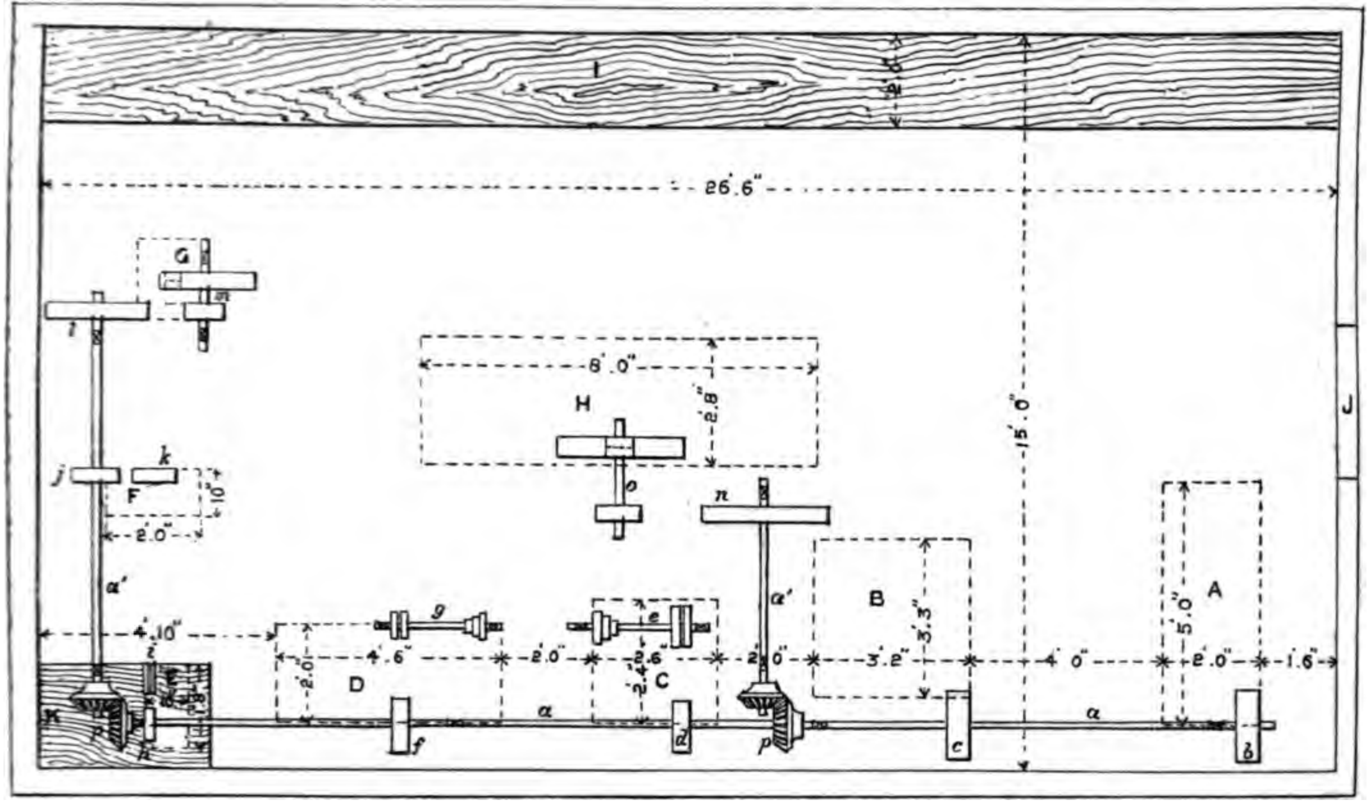
(Concluded.)

Shop Arrangements.

WE have now reached the final stage of our task—namely, the fitting up of a suitable building for the reception of the machines and tools already considered. Fig. 438 shows the plan view of a building designed specially for these precise tools. It is given, of course, rather as typical of what might or should be erected, than as it would probably be in fact, as in those instances, for example, where a workshop is utilised out of an existing building. And even if built specially, circumstances might cause it to be desirable that it should be either somewhat larger, or considerably smaller—preferably the former—according to the number of machines possessed, or the space available, or the length of purse. Still, if I describe this particular shop with its arrangement of machines and shafting, &c., I shall have described that which is of general application to all shops alike, and which can be subjected to modifying details according to individual circumstances.

The machines we suppose we want to dispose of are as follows:—Planer ("E. M.," Vol. XLI. p. 250); shaper (Vol. XLIII. p. 226), with stepped drum modification to fit it for power driving as there described; one drilling machine (Vol. XLIII. p. 498), with pulleys substituted for the handle; one lathe (Vol. XLIII. p. 546); a circular and band saw in combination (Vol. XLIV. pp. 232, 277); an emery wheel (Vol. XLV. p. 27); a grindstone, and an engine to drive, together with a bench for wood and metal work. Taking the dimensions of these by the space which they will occupy measured *over all*, and allowing room to move about between them, I find that the smallest-sized shop which will contain them decently measures 26ft. 6in. × 15ft. (See Fig. 438.) Such an arrangement as that is compact without being crowded. The machine are ranged along the sides, except the saw which are placed in the centre as most co venient for cutting long boards, and the eme wheel and grindstone, which are placed at o end as far away from the machines as possib. The forge and brassfoundry, if such there are I should suppose to be placed outside th building under a separate lean-to shed; and also the boiler, if a steam-engine is used. But

FIG. 438



A, engine; **B**, planing machine; **C**, shaper; **D**, lathe; **E**, drilling machine; **F**, grindstone; **G**, emery wheel; **H**, circular and band saw; **I**, bench; **J**, doorway; **K**, bench to carry drill; *a*, line shafting; *a'*, cross shafts; *b*, main driving pulley; *c*, planing machine driving pulley; *d*, shaping machine driving pulley; *e*, countershaft for shaping machine; *f*, lathe-driving pulley; *g*, countershaft for lathe; *h*, drilling machine driving pulley; *i*, pulleys on drilling machine; *j*, grindstone driving pulley; *k*, pulley on grindstone; *l*, emery-wheel driving pulley; *m*, emery-wheel countershaft; *n*, saw-driving pulley; *o*, countershaft for saw; *p*, mitre wheels for driving cross-shafts.

a gas-engine would be preferable for any small workshop kept going only at irregular intervals. I suppose a bench ranged along the whole of that side of the shop opposite to the machines, one half being used for wood working, the other half for metal work. Shelving is placed round as required.

Leaving the question of the prime mover itself to be decided according to fancy and convenience, let us see what arrangements are required for driving the various machines. Taking our line of main shafting, we will run it, say, at 90 revolutions per minute. This will be driven directly from the engine, and the size of the first or main driving pulley will depend upon the number of revolutions of the engine, and the size of the pulley on its crank shaft. Taking the machines in order—we suppose them all now to be driven by power—the planing machine will not require a countershaft; but the shaper will require one and the lathe also, but not the drill, nor the grindstone. The emery wheel will want one to get up its speed. The circular saw also will require the intervention of a countershaft to drive it fast enough. So that what we have to determine is the sizes of the pulleys in each case, the fixing of bearings, the lining of the shafting, and the striking gears.

Respecting the shop itself, there is no hard and fast type of design. It can be built of stone or brick, and may have a floor of stone or of wood. A stone floor is preferable always for a shop where much heavy work is done, but for light amateur work a good stout wood floor on deep joists is warmer and more comfortable. If the floor is made strong, these light machines can be bolted directly to it, but if flimsy, it would be necessary to lay down foundation stones under the machines. In any case these things are essential: rigidity, so that there shall be no tremor when the shafting and machines are running; freedom from damp, plenty of light through windows of sufficient area at the two sides; and good height, 10 to 12ft. under the principals, not less than 10ft.

The planing-machine speeds have been already given in Vol. XLI. p. 250, referred to, and we may put a 16in. pulley on the line shaft to drive 8in. pulleys on the machine.

We propose a stepped cone to be attached to the shaper in place of the hand wheel (Vol. XLIII. p. 226.) Assume the diameters of the steps to be 4in., 5in., and 6in., and those on the countershaft the same, and the shaper to make 40 cutting strokes per minute with the belt on the middle step. There are in round numbers three revolutions of the pinion on the driving spindle to one of the spindle which carries the slotted wheel. (See Vol. XLIII. p. 362, Fig. 225.) Hence we get 3 × 40 = 120 revs. of pinion, and 120 revs. of the 5in. cone step both on machine and on countershaft. Assume a 12in. pulley on line shaft, then $\frac{90 \times 12}{120} = 9$in. diameter of fast and loose pulleys.

To drive the lathe, we may put a 12in. pulley on the line shaft and 6in. fast and loose pulleys. Putting a stepped cone on the countershaft identical in size with that on the lathe, whose sizes are 2½, 3⅝, 4¾, we shall get $\frac{90 \times 12 \times 2{\cdot}5}{6 \times 4{\cdot}75} = 94{\cdot}7$ revs. per minute, the slowest speed, and $\frac{90 \times 12 \times 4{\cdot}75}{6 \times 2{\cdot}5} = 342$ revs. per minute, the quickest speed, the latter quick enough for turning the softest metals or wood of large diameter, and the former and the intermediate speed suitable for turning the harder metals in small diameters, while by putting in the back gear the speed is made nine times slower, so that the lathe can be driven at 10½ revs. per minute, slow enough for turning a piece of iron 8in. or 9in. in diameter. For turning soft wood of small diameter a much quicker speed and a special turning lathe are desirable.

The drill figured in Vol. XLIII. p. 498, has double gear, so we will assume the minimum speed as 100 revs. per minute. In the gear shown on p. 498, there is a difference of 3·1 in speed, the drill spindle being driven in the one case $\frac{28}{18} = 1{\cdot}55$ slower, in the other 1·55 faster than the flywheel spindle. Also wheel H of 34 teeth drives wheel E of 20 teeth, increasing the speed of the latter 1·7 times over that of the driving spindle in boss B. Assuming 100 revs. as the minimum of speed for ⅜in. or ⅝in. drills, that would give us for the slow gear $\frac{100 \times 1{\cdot}55}{1{\cdot}7} = 91{\cdot}5$ revs. of spindle in boss B, and being the same, of course, if reckoned by the wheels—

$$\frac{100 \times 20 \times 28}{34 \times 18} = 91{\cdot}5 \text{ revs.}$$

We do not want large pulleys on the machine, so we assume an 8in. pulley on line shaft, then $\frac{90 \times 8}{91{\cdot}5} = 7{\cdot}86$ diam. of pulleys on machine, or, say, 8in. pulleys.

The grindstone may be put down at the same speed as the line shafting; hence two equal pulleys are required of, say, 10 in. or 12in. diameter each.

The emery wheels have a circumferential speed of 5,000ft. per minute. Say they are 12in. in diameter, then

$$\frac{5{,}000 \times 12}{37{\cdot}6} = 1{,}595 \text{ revs. per minute.}$$

Having 3½in. pulleys on the wheel spindle, we should want $\frac{1{,}595 \times 3{\cdot}5}{90} = 62$in. pulley on the line shaft to drive directly, which is inconveniently large; hence we have a countershaft. Putting, say, a 24in. pulley on the line shaft, and driving the countershaft at 250 revs. per minute, we shall get $\frac{90 \times 24}{250} = 8{\cdot}6$in. pulley on the countershaft. To find the pulley which shall drive from the countershaft to the wheel spindle pulleys:

$$\frac{1{,}595 \times 3{\cdot}5}{250} = 22{\cdot}3$$

pulley driving from countershaft.

We will run the circular saw at 2,000 revs. per minute. Having 5in. pulleys on the spindle

$$\frac{2{,}000 \times 5}{90} = 111\text{in.},$$

a pulley much too large. Hence, as with the emery wheel, take, say, a 2ft. 6in. pulley driving on to a countershaft, the latter running 300 per minute:

$$\frac{90 \times 30}{300} = 9\text{in.}$$

pulley on countershaft.

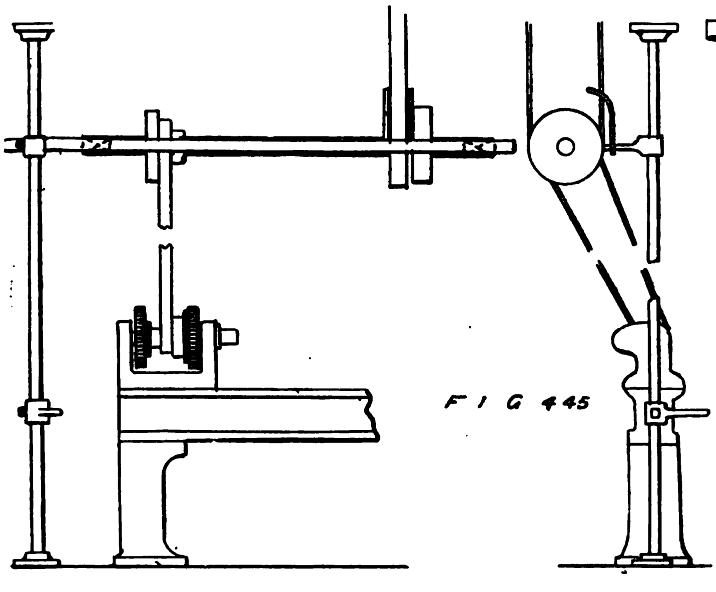
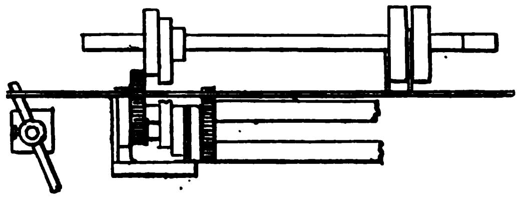


FIG. 445



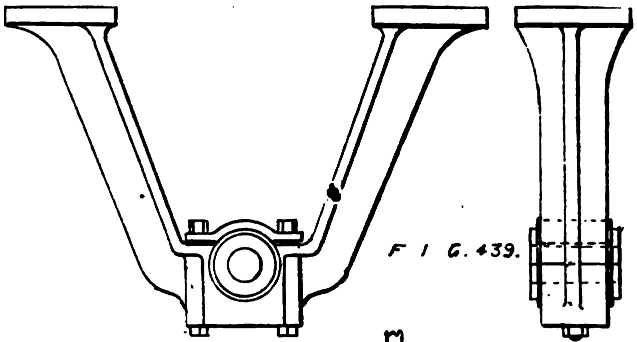


FIG. 439.

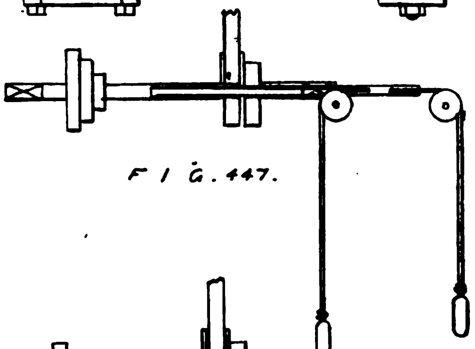


FIG. 447.

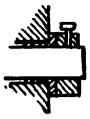


FIG. 443.

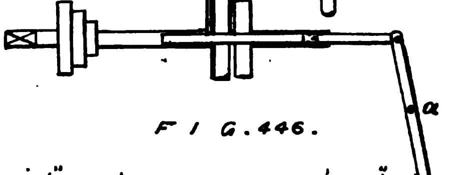


FIG. 446.

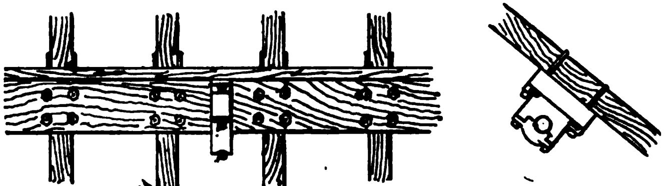


FIG. 440.

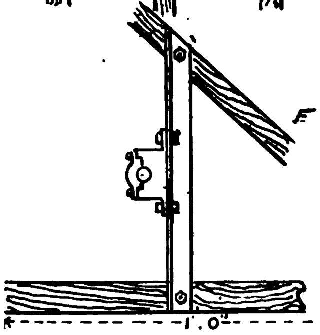


FIG. 441.

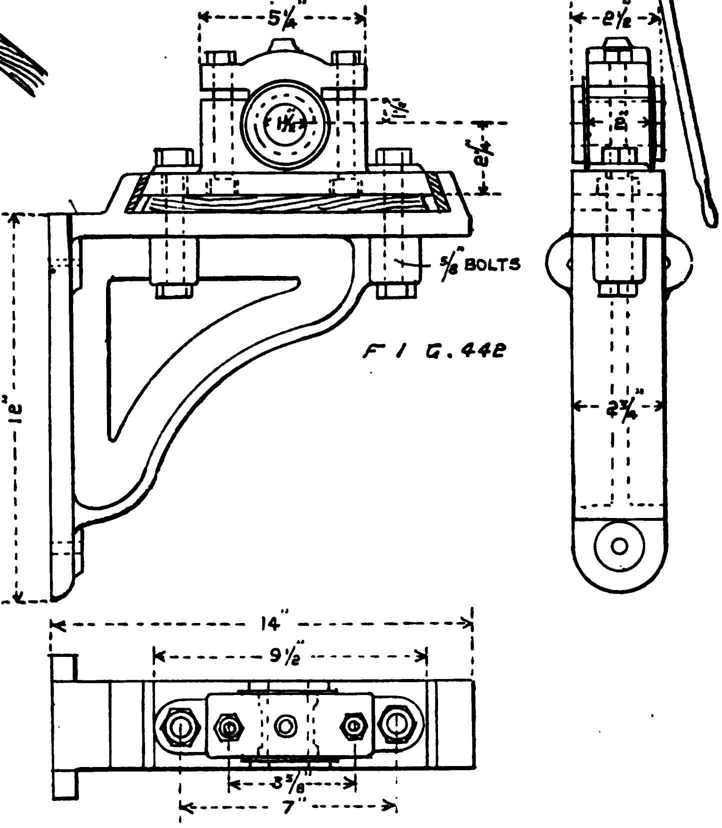


FIG. 442

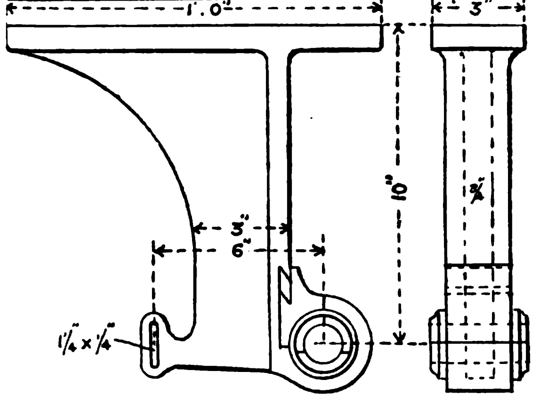


FIG. 444.

Driving from this shaft again to the saw pulley:

$$\frac{2{,}000 \times 5}{300} = 33{\cdot}3\text{in.}$$

We will put, therefore, a 33in. pulley on the ountershaft.

The mode in which the bearings for the hafting and countershafts will be attached vill depend upon the nature of the roof or other art which has to carry them. If the roof rincipals are suitably situated, brackets like ig. 439, of cast iron, will do. Wrought-iron rackets of similar shape, carrying plummer locks, are likewise used, but are not so stiff as hose of cast iron. But it is not always that a ood surface for attachment is to be obtained. Beams may be too low, and the rafters be most suitable as regards height or situation. But since a rafter is not stiff enough to take the stress on a bearing, a beam of timber can be bolted to several rafters, and the bearing or bearings bolted to the beam (Fig. 440). For a rough and convenient way of bolting up a bearing, a piece of angle iron can be carried from the principal to a rafter, and the bearing bolted to the angle iron (Fig. 441). These and other dodges are suitable in a small shop carrying light shafting.

Leaving makeshifts, however, to those who may find them of service, I will show how the fitting up should be done in an orthodox fashion. First take the line shafting. For this, which I should make 1¼in. or 1½in. in diameter, four bearings will be wanted, one at each end, and two intermediate. Also tw shafts at right angles driven with mitre wheel (see Fig. 438), the one for the saw, the othe for the grindstone and emery wheel. We shal want eight bearings, indicated in Fig. 438 b the crosses, shown at Fig. 442. These are ad justable, the brackets being first bolted to th wall, and the precise height of bearings be afterwards given by means of thickness p of hard wood. Starting at one end, w upon the height for the shafting, and bol bracket to the wall at that height, passin bolts through a wallplate without the b ing. Bolt down the plummer block to bracket, the wood packing intervening, tak the cap and top brass; take the next brack in order, with its block, also with the cap and brass removed, sling it, and get a labourer to steady in place; level from one to the other with parallel straightedge and level, mark the bolt holes through the bracket against the wall, bore them, and bolt in place. Try now the straightedge and level again, and very probably there may be a variation of ⅛in. or more in height. The bracket being, therefore, firmly bolted, there will be no risk of its shifting, and the necessary adjustment for height, as gauged by the spirit level and parallel straightedge, will be made by planing down the packing piece, or by inserting a thicker piece as required. This operation will be repeated for each bracket and bearing in succession, the straightedge, being laid from the one last set. When levelled for height, strain a line down one edge of the brasses, and correct for inequalities of the wall.

To fix the end bracket and block next the centre wheel over the drilling machine at *a*, Fig. 438, place a short parallel strip in its bearing, and a similar strip in the bearing which terminates the main shaft next it, and lay the parallel straightedge and level along these. To get the shafts square with one another, lay down chalked lines geometrically on the floor, and plumb down. The cross shaft over the saw will be supported on hangers, and their bearings will be set in a similar manner. Should the walls sink at any time, readjustment of the bearings can be made by means of the wooden packing pieces. The endlong movement of the shafts is prevented by collars with set screws shown at Fig 443.

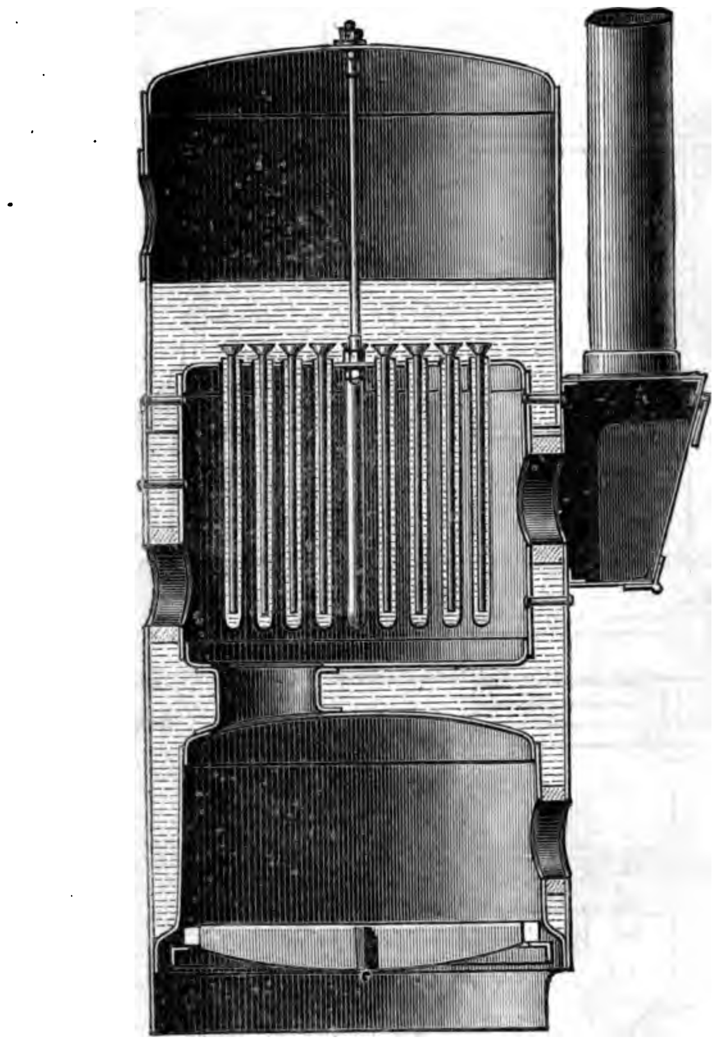
The neatest form of bracket for the countershafts is that shown in Fig. 444. Countershaft bearings are best bolted to a single piece of timber, and this attached to the underside of the floor joists or rafters, or other suitable base, not necessarily horizontal. In this case it would be convenient to assume that the roof principals are an available point of support. Then the timber which carries them can be bolted underneath.

The forms of countershafts are shown in Figs. 445, 447, the sizes of pulleys alone varying. The pulleys on the line shafting will be twice as wide as those on the countershafts which they drive. The pulleys should be ⅜in or ½in. wider than their belts. The driving and driven pulleys are set in line by means of a strained string or a light straightedge.

The striking gears are those arrangements by which the belts are shifted from fast to loose pulleys, and *vice versâ*. These are modified according to circumstances. Three common arrangements are shown. Fig. 445, in which the striking bar and forks are moved by means of the lever turning the piece of gas pipe pivoted between the floor and overhead beams beside the machine. Fig. 446, in which a lever pivoted at *a* is made to actuate the striking gear, which in this case is placed above and behind the machine. Fig. 447, showing two cords passing over pulleys, and by pulling whose respective handles the bar is slid in alternate directions.

THE "NORI" PATENT VERTICAL MULTITUBULAR BOILER.

THE accompanying illustration represents in section a new Patent Vertical Multitubular Boiler, manufactured by the Grantham Crank and Iron Company, Limited, Grantham. As will be seen, it is arranged to give a large amount of heating surface, while it is simple in construction, and the parts are readily accessible for examining and cleaning. The fire-box has a dome-shaped top, from which a short tube leads directly to a combustion and tube chamber, the products of combustion passing amongst the tubes and escaping at the opposite side through a passage to the smoke-box and chimney. The tube or combustion chamber is formed wholly inside the cylindrical shell, and there is a water space between its bottom and the top of the firebox. The tubes used are of the "Field" type, and are solid welded at one end. They are fixed vertically in the crown of the tube chamber, and hang down to within a short distance of the bottom. They are thus protected from direct contact with the fire, and are much less liable to burn out. The shell is of the usual type, with the top stayed to the crown of tube chamber with long screwed bolts, and there is door on one side of the shell, in a line with lower portion of tube chamber, for cleaning, &c. It will be noticed that the heating surface is all below the water level, which insures the best results in steaming. The illustration represents a boiler 9ft. high by 4ft. diameter; but when required for marine purposes they are made of large diameter, and not so high. Durability, economy of fuel, and moderate cost are some of the features claimed for this type of boiler.



SECTION

STENO-TELEGRAPHY.

A METHOD of transmitting telegrams by a combination of mechanical stenography and telegraphy has been recently described by M. G. A. Cassagnes to the Paris Academy of Sciences. At the transmitting station the apparatus consists of a keyboard perforator, an automatic transmitter, and a distributer; while at the receiving station there are a distributer, polarised relays equal in number to the keys of the perforator, and a printing apparatus. At the transmitting station, the keyboard of the perforator, manipulated by one stenographer only, perforates in a band of paper a series of apertures arranged in horizontal lines, each of which represents at least one syllable. The perforating is done at the rate of two hundred or more words per minute. Through the position assigned to it by the keyboard, each aperture corresponds to a definite stenographic sign, which is to be printed upon the stenographic band of paper at the other station. The perforated band is placed under the transmitter, where it remains immovable, as does also the band that is to receive the impression at the receiving station. If, through one of the apertures, the transmitter then automatically emits a current that passes into the line wire through the brush of the transmitting distributer, this current, on reaching the other end of the line, will be received by the brush of the receiver, which will keep up a continuous motion synchronous with that of the brush of the other station, and will actuate a polarised relay
that closes a local circuit designed to pri
sign corresponding to the current emitted
transmitting station. Since, in consequence
very revolution of the distributing brush
transmitting station, the same operation is re
for each of the apertures in succession (
form a small, perforated, horizontal line
since the paper at the two stations remains
immovable, a horizontal line is printed, a
line of apertures of the transmitting sta
thus converted into a line of signs, represen
least one syllable, at the other station. The
then move forward by the space of one in
at both stations, and everything is in readin
the printing of another line, and so on.
number of syllables that may be thus
during one revolution of the brushes de
then, solely upon the number of contac
which the distributer and receiver of the t
tions can be divided, and such number its
pends upon the possible duration of the em
—that is to say, upon the length and state
telegraph wire. Numerous experiments
upon the French lines have given the fol
speeds of transmission with a single line
1. As far as 210 miles, 400 words per minut
with two keyboards, 24,000 words per hour.
far as 390 miles, 280 words per minute; an
two keyboards, from 16,000 to 17,000 wo
hour. 3. As far as 540 miles, 200 words per m
and with a single keyboard, 12,000 words pe
The transmitting, moreover, may be done
entirely in one direction or the other, or
taneously, partly in one direction and pa
the other, according to requirements.
telegraphy, then, affords a means of grea
creasing the number of words transmitted
same conductor. It may consequently be em
to great advantage in telegraphy, since it p
the encumbering of the wires, by utilisin
of them more perfectly than has been done
past. Again, it permits of stenographing
course while it is being delivered, and of
mitting it at the same time to distant poin
this way, the first sentences of a discourse b
Paris at two o'clock might be put in ty
minutes afterward in a printing of
Marseilles; and as the keyboard and
transmission (without relays and through
wire) never cease to follow the orator, the

discourse might be distributed simultaneously in the two cities, which, as is well known, are 578 miles apart.—*Revue Internat. de l'Electricité.*

TRAIN SIGNALLING APPARATUS.

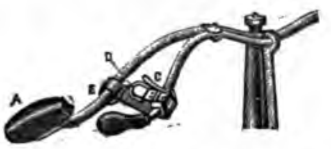
ALL the passenger trains on the Pennsylvania Railroad and on several other lines are now equipped with a train signalling apparatus in which a whistle is used in place of a gong. This arrangement has been perfected by the Westinghouse Air Brake Company, and can be easily applied to trains on which this air brake is used. To the main reservoir—which supplies the brakes with air—is fastened a reducing valve, and to this valve the main signalling pipe is connected. This pipe runs through the whole length of the train, and between the cars it consists of hose and couplings. At one end of each car the main signalling pipe extends upwards and connects to a small valve fastened to the car directly under the hood. From the end of the handle of this valve a cord is run along the inside of the car, in the position usually occupied by the bell cord; this cord is not connected between the cars. On the engine a signalling reservoir is placed, having to one of its ends a signalling valve attached. The main signalling pipe leads into this valve; and another pipe connects this valve, and a small whistle placed in any convenient position in the cab of the engine. This signalling valve has a diaphragm which divides it into two chambers, the lower chamber being in communication with the signalling reservoir, and the upper chamber with the main pipe. This diaphragm is so arranged that it allows air to pass freely from the main pipe to the signalling reservoir, so that an equal pressure is maintained in both. The air from the main reservoir is taken through the reducing valve, which is so constructed that, notwithstanding the great variation of the pressure in the main reservoir, the air is admitted into the main signalling pipe throughout the train, the signalling reservoir and its valve, and maintained in the same at a constant moderate pressure of about 15lb. per square inch. When it is desired to give a signal, the car-valve is opened by pulling the cord. By doing so, the pressure in the main pipe is reduced below that in the signalling reservoir. This inequality of pressure acts on the diaphragm in the signalling valve, which will then permit a portion of the air in the reservoir to escape to the whistle, and give a signal to the engineer. It is stated that signals can be given at the rate of four or five per second with great certainty. Also, if the train should break in two, the whistle will blow loudly for a considerable time. This apparatus has been used on the Pennsylvania Railroad for some time with great success. *American Machinist.*

DIET AND TRAINING.

THE victory of Cambridge this year in the boat race has given rise to many comments as to the mode of training best adapted to get crews into condition. It has been stated that Mr. Bristowe, the President of the Cambridge University Boat Club, allowed fish, entrées, puddings, and dessert for dinner through the whole course of training, and did not insist upon the monotonous and excessive flesh diet usually enforced. For some years past there has been a growing tendency to adopt a more rational plan of feeding, and to permit a greater range of carbohydrates and hydrocarbons in the diet. Indeed, the more varied the food the better the health of the individual, and as training was defined by Prof. Parkes as a method of obtaining the highest degrees of vitality, a scientific mixture of the various principles of diet is called for. With hard muscular work at a quick pace more animal food is necessary than for ordinary work; but this should never be given in excess, and beyond what the digestive secretions are able to dispose of: one pound and a half is certainly as much as is required. In giving carbohydrates, care should be taken that they are well cooked, and are of a digestible character. Rice, sago, and tapioca puddings are excellent; but potatoes should not be indulged in in any quantity, as they are apt to cause flatulence—that bugbear of the trainer known as "inwardful." The hydrocarbons should be supplied by a liberal allowance of butter; the men should be encouraged to eat the natural fat on the chops and steaks, and not cut it off, as they have been directed to do; whilst meat with plenty of fat on it is usually more tender than lean. Fresh fruits should also form part of the daily dietary, since these supply the alkaline salts so useful in keeping the blood in a healthy state. The chief article to be avoided in training is sugar, especially sugar with pastry; it tends to cause acidity and promotes "biliousness." The question among trainers is the amount of fluid permitted. Under the old system great cruelty was often practised by keeping men, especially during hot weather, on a strict allowance; this was a mistake. On the other hand, men should not be allowed too much freedom in this respect for fear of diluting the digestive fluids; it is well, therefore, to keep this within physiological limits. A man of 12st., under ordinary circumstances, eliminates about three pints and a half from the body daily by the skin, lungs, and kidneys; with strong and quick work, he probably gets rid of one pint and a half more. Five pints of fluid would therefore be sufficient for most men. As training advanced and the elimination became less, the quantity might gradually be reduced. At the beginning of training slight excess of physiological requirements might be permitted, as it would help tissue metabolism and carry off the waste products formed in consequence of increased muscular activity.—*Lancet.*

STRIFFLER'S PATENT BRAKE-HOLDER.

THE brakeholder shown in the annexed engraving has been patented by Mr. F. L. Striffler, Middleton, Lancashire, to relieve the rider from the necessity of holding on the brake during the descent of hills. It is applicable to all "bicycle-steered" lever brake cycles, and serves as a lock when the machine is not in use. In the engraving A is the handle, with the brake lever handle close to it; but preferably the latter should be bent out more than usual. C is a little lever to release the brake; D a ring, on pulling which the brake is put on, and held on by the action of the clutch box. E is the part where surplus strap is cut off, and the buckle should be close to handle. If the brake lever is round, a flat should be filed where the screw touches, to prevent the clutch box turning. The engraving shows the parts in position for the finger to drop into ring D, and pull on the strap, when the brake will be held on until released by lifting the lever C. The brake can, it will be seen, be applied in the ordinary way while the holder is in position.



EDISON'S EXPERIMENTS IN SEA TELEPHONY.

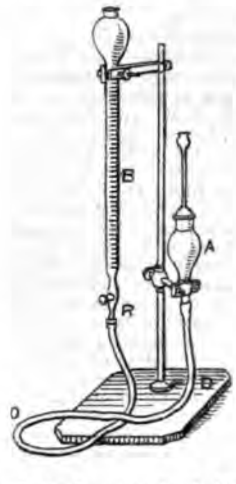
A REPORT from Fort Myers, Florida, where Mr. Edison is sojourning, says that he is working on his sea telephone. The inventor says that already he can transmit sound between two vessels from three to four miles distant, the one from the other, and he seems confident, now the principle is established, that he will be able to increase the distance between his stations as the apparatus becomes more perfect. The Florida waters are peculiarly favourable for experiments of this nature, because of the absence of steamers upon them or other disturbing sounds on the adjacent shores, resembling, in their quiet repose, the waters of the open sea, where the invention he is striving to perfect will find its most important application. Up to the present time, Mr. Edison has not succeeded in transmitting articulate speech through his sea telephone, nor is this essential to the success of the system. By means of submarine explosions, he is enabled to form a series of short and long sounds in sequence, and by these, as in the Morse system of telegraphy, words and sentences can readily be transmitted. In the original experiments in this direction, made by Prof. Trowbridge, and from which these have sprung, two vessels, each furnished with an electric generator and a steam-engine, were anchored a mile or two apart in quiet waters; wires charged with the current were hung over their sides into the water, the upper ends being connected with the telephonic transmitter and receptor. It was sought to send articulate speech between them, and when the two were quite near together, this, it is said, was readily accomplished. Later, however, this seems to have been regarded as impracticable, and the system now experimented upon by Mr. Edison, of transmitting short and long sounds, was adopted, and, up to a certain point, gave no little promise. The distance which separates the purely scientific from the practical success is so wide, however, and the way is so beset with obstacles, that it is no easy matter to find, or if found to keep, the right road; and so it was that these first experiments, valuable as they were, soon ended, and it remains for the practical man, the experimenter rather than the student, to take up the problem and push it on to a solution. Edison is peculiarly fitted and equipped for this work. When in good health, he is a close and constant observer, tireless and original. If he succeeds in finding a practical and reliable means of transmitting any kind of intelligible signal through the water between two vessels several miles apart, a principal cause of disaster on the ocean will have been removed. Though many ingenious and admirable contrivances have been thought out of late years to lessen the dangers of ocean travel, nothing has been done to prevent collisions in thick or foggy weather, which may fairly be said to be the most menacing of all. It has before been explained in these columns that the present system of whistle and horn signalling is reliable only while favourable conditions prevail—to wit, in calm weather. At other times, when two vessels approach one another, only that which is to leeward is likely to hear the warning whistle or horn; and when the wind is abeam or quartering, the direction of the warning signal is so indefinite as to give little or no indication of the point whence danger is to be expected. Were the sea telephone perfected, however, collision in thick weather could readily be averted. Vessels would keep their telephone warning going as well as their whistles, and, while the latter only sounded a general alarm, the telephone would give the exact compass course of the direction whence each ship was advancing, and this, too, in time to prevent a meeting. — *Scientific American.*

APPARATUS FOR OBTAINING THE DENSITY OF SOLIDS.

THE specific weight of a body, which is usually confounded in physics with density, is the ratio of the weight of such body to the weight of an equal bulk of water, or, what amounts to the same thing, the specific weight of a body is the weight of the unit of volume of such body. The following classical formula,

$$D = \frac{P}{V},$$

which is well known, shows that, in order to obtain D, it is necessary to know P: that is to say, the weight of the body, and V, its volume. The methods ordinarily used for such determinations are those of the hydrostatic balance, the bottle, and aërometers of constant volume. All such methods take time, and require a certain amount of dexterity on the part of the operator. Messrs. Brasse and Vlasto have devised a very simple little apparatus for rapidly estimating the density of solid bodies. With this, it requires but a single weighing, which may be effected up to within a decigramme. A reading once made, the volume is known. The apparatus is constructed as follows: A burette, B, graduated to tenths of a cubic centimètre, and the upper extremity of which is ovoid, while the lower one is provided with a cock, R, is connected by a rubber tube, C, with a "balloon," A, having the shape of the bottles used for taking densities. The aperature is ground and fitted with a stopper surmounted by a capillary tube with a datum mark. The lower part of the terminates in a slender tube to which the rub is affixed. The burette and balloon are supp clamps that are movable around the rod. mode of using the apparatus is as follow first filled with water, whose temperature sh as near 15° C. as possible. Then the ba raised by causing its clamp to slide along t porting rod, and things are so arranged that the level of the water reaches the datum mar water shall enter from the other side at the ba burette. Then the division at which it sto



read. Let us suppose that we find it to be five cubic centimètres. We then weigh the body whose density we wish to take. For the sake of example, we shall take statuary marble. We put on a scale several fragments of this, that are small enough to enter the neck of the balloon, and we find it to weigh 25·4 grammes. We raise the balloon, and the water then lowers therein, and rises in the burette, filling a portion of the bulb as it does so. We then open the balloon, introduce the fragments of marble, insert the stopper, and lower the balloon again until the water returns to the datum mark of the capillary tube. The body has displaced a volume of liquid equal to its own, and the water has therefore risen in the burette, and has reached a second level. A new reading is now made, and we find 14·4 cubic centimètres. Upon obtaining the difference between the two figures read, we have the volume of the body, which in the example above selected, is $14{\cdot}4 - 4{\cdot}5 = 9{\cdot}4$ cubic centimètres.

Applying the formula, $D = P/V$, we have

$$D = \frac{25{\cdot}4}{9{\cdot}4} = 2{\cdot}702$$

By the bottle method, we find 2·709, say an error of $< 0{\cdot}01$. With bodies soluble in water, or upon which water exerts an action (such as cements, for example), some other liquid (kerosene, for example) is substituted. The apparatus is simple, and easily and quickly manipulated.—*Le Génie Civil.*

HOW TO EAT WISELY.

AS a universal rule in health, and with very rare exceptions in disease, that is best to be eaten which the appetite craves or the taste relishes. Persons rarely err in the quality of food eaten: Nature's instincts are the wisest regulators in this respect. The great sources of mischief from eating are three, quantity, frequency, rapidity, and from these come the horrible dyspepsias which make human life a burden, a torture, a living death. By eating fast, the stomach, like a bottle being filled through a funnel, is full and overflowing before we know it. But the most important reason is, the food is swallowed before time has been allowed to divide it in sufficiently small pieces with the teeth; for, like ice in a tumbler of water, the smaller the bits are, the sooner they are dissolved. It has been seen with the naked eye that if solid food is cut up in pieces small as half a pea, it digests almost as soon, without being chewed at all, as if it had been well masticated. The best plan, therefore, is for all persons to thus comminute their food; for, even if it is well chewed, the comminution is no injury, while it is of very great importance in case of hurry, forgetfulness, or bad teeth.

Cheerful conversation prevents rapid eating. It requires about five hours for a common meal to dissolve and pass out of the stomach, during which time this organ is incessantly at work, when it must have repose, as any other muscle or set of muscles, after such a length of effort. Hence persons should not eat within less than a five-hours' interval. The heart itself is at rest more than one-third of its time; the brain perishes without repose. Never force food on the stomach. All are tired when night comes. Every muscle of the body is weary and looks to the bed; but just as we lie down to rest every other part of the body, if we, by a hearty meal, give the stomach five hours' work, which in its weak state requires a much longer time to perform than at an earlier hour of the day, it is like imposing upon a servant a full day's labour at the close of a hard day's work; hence the unwisdom of eating heartily late in the day or evening, and no wonder it has cost many a man his life.

Always breakfast before work or exercise. No labourers nor active persons should eat an atom later than sundown, and then it should not be over half the midday meal. Persons of sedentary habits, or who are at all ailing, should take absolutely nothing for supper beyond a single piece of cold, stale bread and butter, or a ship biscuit, with a single cup of warm drink. Such a supper will always give better sleep and prepare for a heartier breakfast, with the advantage of having the exercise of the whole day to grind it up and extract its nutriment. Never eat without an inclination.—*Hall's Journal of Health.*

Emery Cloth Files.—An ingenious device for stretching emery cloth for use in workshops consists of a couple of strips of wood about 14in. long, hinged longitudinally, and of round, half-round, triangular, or any other shape in cross section. On the inside faces of the wood strips are pointed studs taking into holes in the opposite side. The strip of emery cloth is laid on to one set of the studs, and the file, as it is called, closed, which fixes the strip on one side. It is then similarly fixed on the other side, and thus constitutes what is called an emery file, which is a handy and convenient arrangement for workshop use.

SCIENTIFIC NEWS.

THE death is announced of Dr. Jean Jaques Kickx, Rector of and Professor of Botany in the University of Ghent, Director of the Botanic Garden and School of Horticulture in that city, and President of the Botanical Society of Belgium. The deceased professor, who was born in 1842, was the son of an eminent botanist, and was highly esteemed by all who knew him.

Prof. Simon Spitzer, who filled the chair of Analytical Mechanics at the Technical High School of Vienna, died recently at the age of 61 years. He was the author of several well-known mathematical works.

The *Journal* of the Liverpool Astronomical Society for April contains several interesting papers, abstracts of which have appeared in our reports of the meetings. Amongst the "notes" we find it stated that the Société d'Astronomie de France has just been established in Paris under the presidency of M. Camille Flammarion, with MM. Trouvelot, Paul Henry, and General Parmentier as vice-presidents. MM. Gerigny and Armand Gunziger are the secretaries, and the council is composed of well-known workers in astronomy, including our valued contributor, M. Gaudibert.

The French Association for the Advancement of Science, and some of the Paris medical societies, have jointly purchased an hôtel in Paris which they intend to convert into a house for scientific societies.

At a recent meeting of the Royal Society, Part I. of a paper on the "Embryology of Monotremata and Marsupialia," by W. H. Caldwell, M.A., was read in the form of an abstract prepared by Prof. Michael Foster, Sec.R.S., the author being absent in Australia. The paper is of considerable importance in Embryology, but must be read in at least the fairly full abstract prepared by Prof. Foster.

At a meeting of the Scottish Society of Arts last week Major Mackenzie's improved military sketching protractor was exhibited and recommended to the favourable consideration of the prize committee. The continuous process of manufacturing gas from mineral oil, devised by Mr. John M. Turnbull, was also reported upon, and the best thanks of the society awarded to the author of the paper—the system not having yet been tested in practice. The president, in the course of the evening, exhibited the new incandescent gas-light devised by Dr. Auer von Welsbach.

The annual meeting of the Institution of Naval Architects was held last week, the President, Lord Ravensworth, delivering the address, in the course of which he repeated the statement that Dr. Lardner had affirmed the impossibility of establishing steam communication between England and America. What Dr. Lardner said, speaking of the steam-engine as he knew it, was that voyages could not be made with regularity and certainty, and at the same time profitably, unless the steamers were subsidised—because the steam vessels had then so little advantage over sailing vessels that they would fail to attract a large number of passengers. Sir N. Barnaby read a paper on "The Merchant Service and the Royal Navy," in which he concludes that a secretary of State of the Navy is needed who would unite the interests of merchant shipping and the Navy, and thus form a truly national marine. Amongst other papers read was a notable one by Mr. Biles on the twin screw torpedo boats, *Wiborg* and *El Destructor*, built for the Russian and Spanish Governments respectively, both of which average 20 knots an hour; "Fifty Years of Yacht Building," by Mr. Dixon Kemp, and "Fuel Supply in Ships of War," by Sir N. Barnaby. The Institution has been invited by the Town Council of Sunderland to hold the autumn congress in that town.

The construction of the Birmingham Cable Tramway has been commenced, and it is hoped that the system will be in working order in four months.

The central station of the Birmingham Compressed-Air Power Company has been commenced, and it is expected that in the course of the next three months the preparations will have so far been completed that about 6,000 indicated horse-power will be available for customers. When the station is completed there will be fifteen engine-houses, built in rows, on strong concrete walls, in the spaces between which will be placed forty-five Lane's patent water-tube boilers. Each engine-house will be constructed to receive one triple expansion beam air-compressing engine of 1,000 indicated horse-power, driving six single-acting air-compressing cylinders, coupled to opposite ends of the beams, and capable, in the aggregate, of delivering 2,000 cubic feet of air per minute at 45lb. per square inch above atmospheric pressure. The free air will be drawn into the compressors from the top of each engine-house through casings, in which will be inserted filtering screens to clear the air of solid impurities. When the full 15,000 indicated horse-power is at work 6,000,000 gallons of water will be used daily for the feed for condensing and for cooling the air cylinders. This enormous quantity of water will be drawn from the canal at one end, and after use will be returned to the canal at a point some 400ft. lower down. In addition there will be at the central station stores, workshops, offices, and other buildings required for the work. The mains will vary in diameter from 7in. to 24in., and will extend about eighteen miles. They will be placed in concrete troughs, supplied with movable covers, as near as possible to the surface of the road; and means will be adopted by which, in the event of the bursting of a pipe, the general supply shall not be interrupted.

In the *Comptes Rendus* M. Guoy describes a cell suitable for use as a standard for E.M.F., which is as high as 1·39 volt, with a temperature correction of only about ·0001 per Centigrade degree. The cell is similar to the Latimer-Clark, except that peroxide of mercury is used instead of the sulphate.

The Berlin Geographical Society has received from Dr. Wagner a unique present in the shape of a complete set of all the books, pamphlets, essays, &c., published by Alexander von Humboldt. It would take about 30 years to make such a collection again, even if it were at all possible.

Prof. Moebius, of Kiel, has accepted the directorship of the Zoological Museum at Berlin.

The Van Depoele electric street railways seem to be taking the lead in America, as they are now in operation, with success, in the following places:—Minneapolis, Minnesota; Montgomery, Alabama; Detroit, Appleton, and Port Huron, Michigan; Scranton, Pa.; also in Toronto and Windsor, Canada. In a short time the company will have electric cars running in Lima, Ohio, and Binghamton, N.Y. More miles of electric railways on this system are now at work than all other systems put together.

At the January meeting of the Seismological Society of Japan two papers were read in Japanese. The first was by Mr. Kikuchi, on the geology of Corea. In it the writer described the geological map made by Prof. Gottsche, who visited that country after leaving Japan. The paper also gave a description of the geological formations and the minerals found in the different provinces of Corea, and showed that Corea differs from Japan in the fact that these formations in the former country are much older, and on that account more stable, than those in the latter. This, Mr. Kikuchi thought, might account for the comparative absence of seismological phenomena in Corea. The second paper, by Mr. S. Sekiya, was on recent destructive earthquakes. The writer described in succession the causes and effects of the earthquake which occurred in Japan on February 22, 1880; the earthquake in Ischia in 1883; the shock of October 15, 1884, in Japan; the earthquakes in Spain in 1884; those of the United States of last year; and the shock of January 15 in Japan. It was pointed out that the three earthquakes mentioned as occurring in Japan were very similar in their intensity, and that they extended over nearly the same area; but, with regard to their place of origin, the writer said the first two shocks originated in Tokio Bay, or in the ocean beyond the peninsula, while that of the present year originated in a spot to the south-west of the two previously mentioned.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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THE ASTRONOMICAL DIRECTORY OF M. LANCASTER—ENDOWMENT FOR OBSERVATION AT GREAT ALTITUDES—A GREAT TELESCOPE AND A SMALL SQUABBLE—A YEAR'S WORK AT THE U.S. NAVAL OBSERVATORY—IS MIND MATERIAL?—APERTURE AND MAGNIFYING POWER—KEPLER'S THIRD LAW—ASTRONOMY AND MATHEMATICS—SATURN—SURVEYOR'S CHAIN—DRIVING CLOCK FOR TELESCOPE.

[27045.]—I HAVE just seen the second edition of the "Liste Générale des Observatoires et des Astronomes, &c.," by M. Lancaster, of the Royal Observatory at Brussels, and find that its author has taken very great pains to make it both accurate and complete. It now forms a perfect directory of every astronomer of any note; of all existing observatories; of astronomical societies and publications, and of the chief constructors of astronomical instruments throughout the world. As a work of reference it is as valuable as it is cheap.

A circular has just been issued from the Harvard College Observatory which is worthy of a passing notice. It would seem that a gentleman named Boyden bequeathed a sum amounting to some £48,000 in trust for the purpose of astronomical research, "at such an elevation as to be free, so far as it is practicable, from the impediments to accurate observations which occur in the observatories now existing, owing to atmospheric influences." The trustees of the fund have transferred it to the governing body of Harvard College, and they now invite information as to suitable localities at sufficient altitudes for the erection of observatories for celestial observation. For obvious reasons fit places in the Southern hemisphere would be preferred, as the stars invisible in Europe have been so much less observed than the Northern stars. Moreover, it is, I imagine, supposed that all that can be done in the United States with a telescope at an exceptionally great altitude will be effected at the Lick Observatory on Mount Hamilton; but Prof. Pickering invites communications from anyone and everyone in any locality at a sufficient elevation above the surface of the earth.

By the way, speaking of the Lick Observatory reminds me that a curious literary warfare has been, and for aught I know still is, going on in America on the subject of the Mammoth telescope there. From what I can gather, Mr. Proctor has been writing to some paper or papers in the Northern States, alleging that, so far, all monster telescopes have been comparative failures, and warning the scientific public not to look for too much from the great Lick instrument. Professor Holden retorts, in effect, that Mr. Proctor knows nothing at all about it, gives some calculations to show that separating power is a function of aperture (a fact about as well known in England as the National Anthem), and, in short, asks the public to suspend its judgment until the results of the Mount Hamilton observations are before it. Now it seems to me that both disputants are right, and both are wrong, in this controversy. Merely as a matter of fact, very big telescopes have, from one cause or another, hitherto all been more or less failures; but that hence, they must always continue to fall short of their theoretical capabilities, does not appear to be quite a *sequitur*, and I think that there is justice in Professor Holden's appeal to wait and see what the giant refractor can accomplish. I however, say, nothing of the very questionable taste of his method of speaking of Mr. Proctor personally. Should Mr. P. choose to retort in the same strain, he will probably have something unpleasant to say (and probably not without reason) even of Mr. Holden himself. However, the squabble has not been confined to these two disputants, but has been taken up by at least one Californian newspaper, the San Francisco *Evening Bulletin*, in the impression of which for March 1 occurs an article headed "The Men Behind the Instrument," which for bad taste (and even untruthfulness) it would be hard to surpass. Mr. Proctor has dared to contradict Professor Holden, who is "an original investigator in the field of astronomy." Ergo, Proctor is *not* an original investigator; but is "following in old lines, foraging in other men's labours," and so on, and so forth. Now either the wiseacre who wrote this stuff knows to what extent we are indebted to Mr. Proctor for our present knowledge of the physical structure of the visible stellar universe—or he does not. If he does not, he is a mere blind leader of the blind, whose dicta are not worth the paper they are printed on. If he does, then he is simply a ——, well, the word I must use is not a Parliamentary one, so I will leave every one familiar with the facts of the case to supply it.

"The programme of work to be pursued at the Naval Observatory, Washington, during the year 1887," is an extensive one indeed. In addition to the meridianal observations, time service, &c., common to all observatories of the first class, double stars are to be observed with the great equatoreal; the fainter stars in the Pleiades measured; the conjunctions of Saturn's five inner satellites with the minor axis of the ring and the position angles and distances of Hyperion observed; while comets, certain stars for identification, asteroids, and lunar occultations form the objects for observation with the smaller equatoreal. Daily photographs of the Sun are also to be taken. Here we get an inkling of the source of those odds and ends of astronomical information which render the American *Nautical Almanac* of such value to the amateur.

Admitting, for the sake of argument, everyone of the allegations made by "F. W. H." in the latter half of letter 26984 (p. 80) to be a matter of undisputed fact, I wholly fail to see how his deductions from them are either warranted or warrantable. If we grant—what, in fact, is indubitable—that every act of thought is accompanied by a molecular change in the substance of the brain itself, we are yet a very long way from having to admit that such molecular motion *is* thought. No one in his senses, listening to a skilful performer on the pianoforte, playing one of Bach's sonatas, and noting how the keys and hammers are depressed and the dampers raised, would contend that such rising and depression were the *melody* produced. And in a similar way it seems the merest solecism to attempt to treat of mind or spirit in terms of motion. It would be as rational to speak of the linear co-ordinates of belief, or the specific gravity of love. If I understand your correspondent's meaning, he would seem to imagine that the brain secretes mind just as the parotid gland does saliva, the lachrymal gland tears, or the liver bile! Let anyone acquainted with the very rudiments of psychology attempt to formulate such a theory expressly, and see what the result will be. The mind (or, as "F. W. H." says, "the soul") "is developed in close resemblance to the development of material organisations." Just so. If by this he intends to convey that as the brain grows and increases in complexity, so does intelligence develop, he is uttering the merest truism. Reverting to the simile of a musician, let us suppose that a very skilful organist is provided only with an instrument consisting of a single octave of pipes. What can he possibly play upon it but the most simple tunes? Add now two separate stops, each of five octaves, and alter the keyboard, and the same musician will produce very much more elaborate music, and so on until the mechanical limits of the instrument are reached. But now let there be a rent in the bellows, or a crack in the wind-chest—and the organ is dumb. The talent and capability of the performer are still there, the external aspect of the instrument remains unaltered; but there is this hidden internal rift, and no music can be produced. Assuming that the particular instrument within our own view is silent, how can we even assert that the performer is not discoursing divine melody upon another and totally different one? At most, we can only say that we do not know. Does your correspondent see the application of this analogy? It is a matter of history that during parts of the years 1692 and 1693 the immortal Newton himself suffered under a temporary attack of insanity. His cerebral mechanism was out of joint. *The* Newton was there; but the instrument on which he had, so to speak, to perform, was for the time defective, and discord instead of harmony proceeded from it. Were the subject not too serious a one, one would be almost tempted to smile at the calm self-sufficiency with which "F. W. H." says that, under certain specified circumstances, his "soul, if it should still exist, would have something to do of which at present" he "can form no conception." A very much greater and more profound thinker than either "F. W. H." or myself, that able mathematician and logician, the late Augustus de Morgan, once said that "there may perhaps be a few millions of forces in Nature of which we have no conception"; but Messrs. Büchner, "F. W. H.," and company have progressed far beyond the weakness of making such an admission as this. They know *everything*; or, at all events, anything they do not know *ipso facto* ceases to exist. This may be the height of sublime philosophy; but to ordinary folk it looks suspiciously like a low and stupid form of Atheism.

The literature on the subject of "M.'s" query (62034) on p. 90 is very widely scattered indeed. A hunt through some of your back volumes would reward him; but I may summarise what is known with reference to the relation between power and aperture by saying that on a night when no power over 200 could be used on a 4in. telescope, a 6in. and 8in. would *not* bear powers of 300 and 400 respectively; indeed, I gravely doubt if much could be seen with the 8in. under such circumstances even with the same power as that employed with the 4in. On many a night when definition is execrable with large apertures, it is moderately good with small ones. I have advised "M." to consult back volumes of the ENGLISH MECHANIC for information as to the relation between aperture and power. In some recent ones he will further find the superstition of "100 to the inch" exploded by more than one thoroughly practical observer. Upon how many occasions has your correspondent employed a (measured) power of 400 on his 4in. Cooke?

In reply to query 62066 (p. 91): Yes.

It will be absolutely necessary for "T. S. S." (query 62067, p. 91) to master spherical trigonometry. As for his future course of reading, everything will depend upon whether he proposes to follow up spherical and practical or gravitational astronomy. In the first case a knowledge of the calculus will be an advantage to him; in the second, it will be indispensable; and, as a preliminary book, Abbatt's "Elements of Physical Astronomy," published by Longmans in 1871 (if still in print), very good indeed. If he will say specifically to which branch of science he proposes to devote himself, I may hope to help him by a more definite reply.

In connection with Mr. Watson's interesting letter (27011, on p. 97) I may perhaps be allowed to say that Proctor does not profess to figure Saturn, in his celebrated work, from his own observations. My impression is that the principal figure in the frontispiece is copied from the well-known engraving of Dr. De la Rue's drawing, made with his Newtonian reflector (now at Oxford). I may add that on the 29th ult. I saw the shadow of the planet on the rings, almost precisely as figured by Dr. Terby (letter 26975, p. 79), save that I failed to perceive the little notch represented by him as contiguous to the outer edge of ring A. I also saw Encke's division in the following ansa; but, with the utmost attention, could not detect it in the preceding one. I employed a refractor of 4½in. in aperture, and used powers of 260 and 400, detail being beautifully seen with the latter.

"Murano" (query 62089, p. 112) puts a question which, in the absence of further details, it is difficult to answer. It may, perhaps, help him through to say that the ordinary surveyor's chain is 66ft. long, and is divided into 100 links; hence each link is 7·92in. long. The little pieces of brass (of different shapes) are attached to every tenth link. Thus, at the 10th link would be one with one point; at the 20th link one with two points; three at the 30th, four at the 40th, at the 50th, the middle of the chain, a round mark. From this the notched pieces of brass proceed in reversed order.

If "St. Aubyn (query 62129, p. 113) can obtain access to a series of volumes of the R.A.S. *Monthly Notices*, he will find articles on Driving Clocks in Vols. XXIX. p. 268, and XXXIX. pp. 462 and 486.

A Fellow of the Royal Astronomical Society.

SATURN—NEW LABORATORY TROMP.

[27046.]—IN reply to Mr. Watson (letter 27011), the difference in the N. and S. poles was not intentional. I do pretend to be a good draughtsman, and Saturn is not an easy subject to draw. My sketch was not made at the telescope; but the salient features were marked down and elaborated the next morning. The continuance of Encke's division was, as I have already explained, an oversight. I am not an habitual observer of the planets. Our work consists of double-star measuring and spectroscopic observations. Conseque "celestial objects" are only brought forwa the delectation of visitors. When last I look Saturn I considered that the S. pole a covered ring A, and that the shadow was dist *broader* towards the S. I could not dete notch. On previous occasions (e.g., last when the shadow was the *other side* of the p the notch was very conspicuous, and, in fact, is the first time I have ever noticed its absenc

The vacuum pump (No. 1,148) is not new either in principle or design. The principle is that of the Giffard injector, and in the *Engineer* of June 9th, 1876, Mr. James Brownlee showed that a vacuum was formed at the point of junction of the two cones. I believe I was the first to construct an aspirator on this principle, and an illustrated account of my model may be found in the *Chemical News* for October 13th, 1876. It is capable of producing, with sufficient water-pressure, a vacuum which will lift a column of mercury equal in height to that of the barometer *minus* that allowed for pressure of aqueous vapour. I have used one of metal as a filter pump for some years.

A. Percy Smith.

SATURN'S SHADOW.—ENCKE'S DIVISION.

[27047.]—THE *Observatory*, March, 1884, has a drawing of Saturn, by Prof. Holden, of Washburn Observatory, where the notch is shown on ring B, not far from Cassini's division. Your readers can judge if such is an optical illusion, caused by the juxtaposition of curved lines; its appearance is that of the shadow of an opaque body being projected on a convex surface. In the same number Prof. Davidson (6·4in. equatorial) remarks, "The shadow of the planet on the ring was *so well defined* that the irregularity at the division of the ring was unmistakable." The notch is now blunted, ring A hardly overlapping B. Mr. Kempthorne, in his last letter, says he does see the notch; but, in letter 26976, "E. M.," p. 79, he stated, "if the notch exists it is not visible in my mirror, and the boundary is distinctly convex." On the very rare occasions I have been able to see Encke's division it has appeared an undefined shading rather than the narrow clean line shown by Mr. Percy Smith, and the white zone not actually in contact, but close to Cassini's division, and much fainter than ring B. Has not the crape ring, though, of course, quite evident, been of late abnormally dark, and the brightness of the two ansæ variable?

H. Watson.

ON THE PROPER MOTIONS OF $\beta, \gamma, \delta, \epsilon, \zeta$ URSÆ MAJORIS, AND ALCOR.

[27048.]—MR. PROCTOR appears to have first called popular attention to the existence of the remarkable community of motion among certain groups of stars, to which he gave the very appropriate name of "Star-drift," in an essay headed "Are there any Fixed Stars?" which appeared in the number of the *Popular Science Review* for October, 1869, and in his "Preliminary Paper on certain Drifting Motions of the Stars," communicated to the Royal Society on October 26th, 1869, and published in the *Proceedings* of that society for January 20th, 1870. He mentions that Mädler had found instances of drift in Taurus [no reference is given, but I presume that the allusion is to Mädler's paper, "Die Centralsonne," published in No. 566 of the *Astronomische Nachrichten* (1846)], but that "in reality the community of motion in Taurus is only a single instance, and not the most striking that might be pointed out, of a characteristic which may be recognised in many regions of the heavens." Mr. Proctor was evidently not acquainted with the very valuable XIVth. volume, published in the year 1856, of the Dorpat Observations (unfortunately, too little known in England), which contains Mädler's investigation of the proper motions of 3,222 of Bradley's stars reduced to 1850, and compared with all the best catalogues then existing, or he would have noticed that many other instances of the kind might be gathered from a perusal of Mädler's data, which are arranged in a very convenient fashion for the prosecution of researches of this character. The first distinct allusion to "star-drift," and one unnoticed by Mr. Proctor, seems to me to be found on page 311 of the "Fundamenta Astronomiæ," where its illustrious author expresses himself as follows: "Præcipue vero mihi notabile videtur, stellas etiam non admodum prope stantes, sed plures minutas inter se distantes, sæpe motum proprium communem habere." This was written in 1818. Bessel gives, as an instance, 36 Ophiuchi (A, B,) and 30 Scorpii, three stars which are, in the words of Baily, "evidently *journeying together* through space, and leaving the neighbouring stars behind." Mr. Proctor, however, was certainly the first to bring these common movements of the stars prominently before the general public; but the chief instance selected by him seems to me to be a singularly unhappy one. This is that of the community of motion of β, γ, δ, ϵ, ζ^1 ζ^2 Ursæ Majoris, and Alcor. "A singular instance of this star-drift," Mr. Proctor observes in his essay "Are there any Fixed Stars?" as reprinted in "The Universe of Stars" [2nd ed. 1878], "is found among the bright stars of Ursa Major, five of which are moving in the same direction and with the same velocity. Two other stars near ζ are also moving in the same manner." [Cf. Fig. 1, which is copied from the diagram on p. 141 of "The Universe of Stars."] "One cannot doubt that these stars are associated in some way, and so form a system, especially when it is noted that the stars are moving in a direction almost directly opposite to that due to the sun's motion in space." Mr. Proctor's charts of the relative proper motions of the stars are based entirely on the proper motions obtained by Mr. Main in Vol. XIX. of the *Memoirs* of the R.A.S. from a comparison of Bessel's Bradley and the Greenwich Catalogues for 1840 and 1845 (the "Greenwich Catalogue" and the "Twelve-Year Catalogue"); by Mr. Main, again, in Vol. XXVIII. of the *Memoirs* from a comparison with Bessel's Bradley of the stars in the "Six-Year Catalogue" for 1850 not included in the two preceding ones; and on those given by Mr. Stone in Vol. XXXIII. of the *Memoirs* from a comparison of Bessel's Bradley with the stars in the "Seven-Year Catalogue" for the epoch 1860, not included in the preceding Greenwich ones. In the cases of α, β, γ, δ, ϵ, ζ, ζ^2, and η Ursæ and Alcor, the proper motions given by Mr. Main in Vol. XIX. have been employed by Mr. Proctor. In his communication to the Royal Society, Mr. Proctor so far modified his statement as to the *exact* equality in the direction and rate of motion of β, γ, δ, ϵ, and ζ, as to say "the stars β, γ, δ, ϵ, and ζ are all drifting in the same direction, and almost exactly at the same rate, towards the 'apex of the solar motion'"; but in his lecture before the Royal Institution, in May, 1870, he again stated that "the stars β, γ, δ, ϵ, and ζ of the Great Bear, besides two companions of the last-named star, are travelling in one direction with equal velocity, and clearly form one system." ("Pleasant Ways in Science" [1879], page 143). Again, in an essay published in the *Student* for October, 1870, and reprinted in "The Universe of Stars," he writes: "Of the seven bright stars in the Great Bear, five are travelling in a common direction with uniform velocity. The other two are travelling in another direction, and also with a common velocity." These statements are repeated in "Other Worlds," in "Light Science for Leisure Hours" (2nd series), and in others of Mr. Proctor's works. I must confess that I am absolutely unable to understand how he has arrived at these conclusions from the proper motions assigned by Mr. Main (or, as a matter of fact, by anyone else) to the stars in question. In Fig. 2 I have given a diagram of the proper motions of these stars, according to Mr. Main's data; the proper motion of γ being the same in Mr. Proctor's diagram, and in the one traced from his (Fig. 2) on which I have inserted the actual values of the proper motions assigned to these stars by Mr. Main. In Mr. Proctor's two charts of proper motions these are indicated by arrows attached to the stars, whose directions and lengths show the directions and magnitudes of the several proper motions in 36,000 years. This plan is an excellent one for indicating the relative directions and magnitudes of the various proper motions for a short period of time; but it takes no account whatever of the secular variations of those proper motions. We may consider the proper motion of a star, when not too near the Pole, as constant (except, of course, in such cases as Sirius, Procyon, and the like) in direction and magnitude for one or two hundred years; but the proper motions of any star at the present moment are certainly not the same in direction and magnitude as they were 5,000 years B.C. To assume that they are is much the same thing as if one were to sit down and compute the place of a star for B.C. 5000 from the data given in some modern catalogue, using the precessions given therein, and taking no account of the secular variations of those precessions.

In Table I. I give the annual proper motions for the seven bright stars of the Great Bear, the companion of Mizar, and Alcor, from the determinations of Main (in Volume XIX. of the *Memoirs* of the R.A.S.); of Mädler (in "Dorpat Beobachtungen," Vol. XIV.); and of Auwers (in "Publication der Astronomischen Gesellschaft," XIV., where Auwers's own re-reduction of Bradley's observations is employed). In Table II. I give the secular proper motions (1750-1850) expressed in Mädler's most convenient method in arc of great circle (r), and in angular direction (ϕ) (counted as in double star observations from North (0°) round by east, south, west to 360°), according to the formula $r \sin. \phi = \Delta \alpha \cos. \delta$, $r \cos. \phi = \Delta \delta$. In my own reductions of Main and Auwers I have only given ϕ to the nearest half-degree; but I have retained Mädler's own values, which are expressed to the nearest tenth of a degree, merely correcting a clerical error in ϕ of α Ursae. The spectroscopic evidence for the association of the stars in question I hope to examine in a future communication.

It is perhaps hardly necessary for me to say that I wish in no sense to call in question the *reality* of the phenomenon so ably advocated by Mr. Proctor. I simply take exception to the *particular instance* on which he has laid so much stress, and which happens to be the one alluded to in most text-books of astronomy. Auwers's proper motions would seem to indicate that γ and δ *may* form one system, while ζ, its *comes*, and Alcor have long been suspected of forming another. In Figure 2 the arrows denote the relative values and directions of the proper motions reckoned from the centres of the discs representing the various stars, according to Mr. Main's data.

FIG. 1.

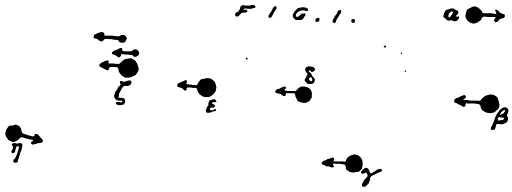


FIG. 2.

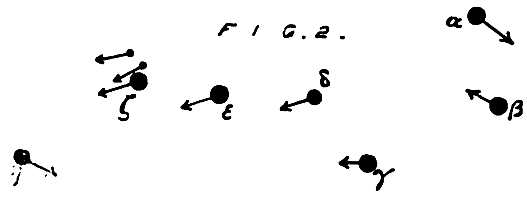


TABLE I.

Annual Proper Motions of $\alpha, \beta, \gamma, \delta, \epsilon, \zeta, \zeta^2, \eta$, Ursæ Majoris, and Alcor.

	Main. α.	Main. δ.	Mädler. α.	Mädler. δ.	Auwers. α.	Auwers. δ.
	sec.				sec.	
α.	−0·017	−0″·09	−0″·242	−0″·072	−0·0180	−0″·071
β.	+0·010	+0·03	+0·155	0·000	+0·0086	+0·041
γ.	+0·011	0·00	+0·190	+0·005	+0·0098	+0·008
δ.	+0·015	−0·04	+0·280	−0·025	+0·0135	+0·002
ϵ.	+0·013	−0·05	+0·244	−0·044	+0·0121	−0·030
ζ.	+0·017	−0·04	+0·288	−0·056	+0·0134	−0·022
ζ^2.	+0·014	−0·05	"	"	"	"
Alcor.	+0·016	−0·03	+0·263	−0·047	+0·0135	−0·021
η.	−0·012	−0·03	−0·164	−0·013	−0·0115	−0·014

TABLE II.

Secular Proper Motions of $\alpha, \beta, \gamma, \delta, \epsilon, \zeta, \zeta^2, \eta$, Ursæ Majoris, and Alcor.

	Main.		Mädler.		Auwers.	
	r.	ϕ.	r.	ϕ.	r.	ϕ.
α.	14″·5	233°	13″·2	247°·0	14″·6	240°·5
β.	8·6	69·5	8·4	90·0	7·9	60
γ.	9·6	90	11·0	87·4	8·5	84·5
δ.	12·7	108	15·0	99·6	10·8	89
ϵ.	11·9	114·5	14·9	107·3	10·5	106·5
ζ.	15·0	105	17·1	109·1	11·6	101
ζ^2.	12·8	112	"	"	"	"
Alcor.	13·8	102	15·5	107·6	"	"
η.	11·9	256	10·7	263·6	10·8	262·5

ERRATUM.—In letter 27009, page 97, *for* "Mr. Elger" *read* "M. Gaudibert."

March 29. **H. Sadler.**

ASTRONOMICAL.

[27049.]—I THANK "F.R.A.S." and Mr. Sadler for their notice of my query *re* star *n.f.* Castor. Σ 1119 appears to answer the description; but the star I saw is not 1° 50′ N., since when the double is in centre of finder, Castor is just visible at top of field of same, and finder field is very slightly over 2°.

Σ 1830 is triple, having a faint *comes* at 16″ or 18″, about 70°.

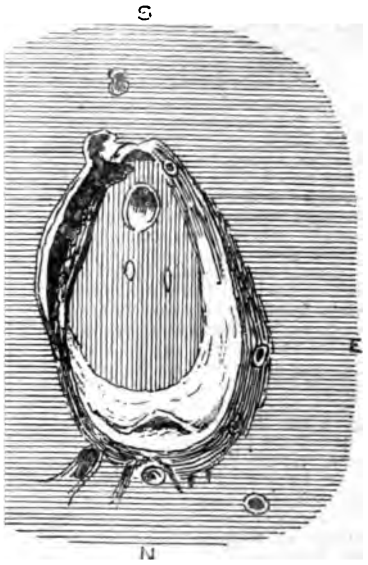
is given in Webb as De 70°4″ 1863—3rd 39 Dv's *min. vis.* 9$\frac{5}{16}$in. 299·4° 7·5″ 1875. On g this star the minute *comes* is easily 9in., and position est. 300°; but the brighter iow about twice the distance apart of the *es*, and I make the P.A. about 100°.

ld be glad to know present distance of is and ϕ Ursæ Majoris.

E. Holmes.

HERCULES.

]—In answer to Mr. Mee's request (letter 61), I forward herewith a sketch of the ng plain Hercules. The drawing was March 30, with a power of 200 on my



moon about 6 days 4 hours old. I could a crater in the position assigned to one ee, in letter and sketch 26938.

is a crater on the south-east wall, as in ı, and also a depression in the extreme l, which, under certain illumination, looks h like a crater, but, I believe, disappears igh sun. The dark spot on my sketch, outh of the large crater in Hercules, is :r-like depression. After very careful discovered three small craters on the errace or slope, one in the extreme north, on north-east. Two very minute dark een the northern crater and Hercules B ny craterlets; but of this I am not con- [presume the illumination was not high or the white spots to appear so decidedly :d by Mr. Mee; for, after a very attentive I could only catch a glimmer of two ɪnspicuous spots. There are many craters round about Hercules; but I have drawn in the south, and I could not tell whether ouble, or merely elongated. **Jason.**

THE L.A.S. REPORT.

]—The value of Mr. Tarrant's work is y recognised to be affected by the in- of a report, even supposing such to have but, if he will turn to p. 77, he will find ıas entirely altered the meaning by his of the word "probably" from his of the report (letter 27013). Now, the between "probably the shortest" and *y one* of the shortest" can hardly amount ous inaccuracy," because if the period is e shortest there cannot be any shorter; f "it is undoubtedly longer than that of ," there is no *probability* about it, and the in the vagueness of the original expres-

W. H. Davies

on. sec. Liverpool Astronomical Society). itreet, Liverpool.

urther explanations must be made pri-)ur space is really too precious to be thus. -Ed.]

ONY AGAINST THE ROCKS.

|—The notion of "F.R.A.S." that dif- ches of gravel (p. 78) "may well differ in ːty or a hundred thousand years," is quite someone like "Memnon." If he means ;ravel-beds in the same valley, they must contemporaneous. Why should one flood London gravel, but none at Reading, and ɛposit a bed at Reading only, or another or? Different dates for drifts in the ɪy are flatly impossible, and even in the same river-basin, however large, the idea is nearly as absurd. There remains only the question, as I said, p. 55, about those of distant great continental basins, as the Ganges, Nile, Po, and Mississippi. These you might explain by a sea falling on Asia at one time, another sea on Africa, at a time, say, half a century or a century different, and so on. But if the difference were 50,000 years, or even 1,000, the alluvial delta of one river would have a thousand more annual deposits above its last gravel-seam than the other. All the borings contradict this. They show, at every point of every delta, in each Continent, neither so little as 48 nor so much as 52 times the known centurial deposit of that place. Even in Lyell's "Principles," written to deny all catastrophes, these facts will be found. The highest gravel-seam in each delta, in whatever continent, testifies to one catastrophe about 50 centuries ago, and none whatever at 40, or 60, or 100 centuries. By nothing but stupendous miracles could this testimony of "F.R.A.S." against the rocks be made tenable for a moment. Besides each continental deluge being a miracle, each has to miraculously misdate itself! I really wonder he does not insist that all the gravelling is by human hands. He will find much to be said for this. Our ancestors were here for such countless ages, leaving no other traces of their work, that surely such priestly power as got the Pyramids built, might in all other lands, to establish the dogma of a deluge, employ the people some half-million year or so in carrying sea-beach or glacier-moraine to the various valley lodgments where, accumulated as gravel, it would suggest and seem to prove this dogma. As for some being "water-borne, and some ice-borne, and so on," what else but this can he mean by "so on"? Is some alcohol-borne, brandy-borne, or what? The general notion of "Burlington House" is that whatever gravels are not water-borne are ice-borne, and called "moraines." But there seems much ground for thinking nearly all those of temperate climates are of moraine material, afterwards water-borne.

In the same page (78) "F.R.A.S." flatly contradicts every account or engraving that was given during the late appearance in the Andromeda Nebula. They all estimate how many seconds from the "brightest part" it appeared. Even if appearing, as he now tells us, "in the midst of the brightest part," that would by no means have proved his point. It might be perspectively projected on the "midst of the brightest part," while really in the extreme faintest margin of the nebula, with one half not lighted by any of it. All we can tell of its position is purely negative, that it was in no part which is one-tenth as bright as the brightest —for aught we know in none, that is one-millionth, as bright; but at any rate in a position where one side could only have comparative night.

His question about the mass and dynamic effect of the diluvial addition is easily answered. The tons of water were only "innumerable" in the sense, as he must well know, that the acreage of land on the globe, or of water or ice, is innumerable. We know the acreage of all together; but, unless the Polar regions were explored, not that of water or of land; nor consequently whether the top 100 fathoms of present sea is equivalent, say, to a thirteenth of a mile of water, or a twelfth, or an eleventh on the whole globe. If we suppose a twelfth of a mile, the planet's mass would be augmented about one 80,000th; and if the added mass overtook her from behind (as I can by several reasons make nearly certain), it would so increase her velocity and enlarge her orbit, as to lengthen the year possibly three or even four minutes; more probably less than two. Now I should like to see the proof that the year of Noah's youth was not shorter than the present by a few minutes. Poor Whiston, who never imagined a comet to be less dense than a planet, got convinced from various old documents, chiefly the Bible, that the Antediluvian year had been shorter than ours by above five *days!*—and not only so, but the lunation so much longer than ours as to be just 30 days; his imagined ancient year being a mean between our present solar one and the Mohammedan twelvemonth, exceeding the latter and falling short of the former, each by over five days. I should like to see any astronomical reason against him. The sole ground on which I reject it, is because it would need several hundredfold greater addition to the earth's mass than I can gather the Deluge to have made.

It is deplorable that nobody induced our great astronomer to undertake what he promised in these words, at the end of his paper, "laid before the Royal Society on the 12th of December, 1694, by Dr. Edmund Halley, R.S.S."; but only published in 1724. "If this Speculation seem worthy to be cultivated, I shall not be wanting farther to insist on the Consequences thereof, and to show how it may render a probable Account of the strange Catastrophe we may be sure has at least once happened to the Earth." He evidently implies that the earth had been in her orbit long enough to meet with many such disasters; and, in fact, we can easily show, by the cometary statistics of the past half-century or less, that the mean frequency of encounters with comets' heads is now above four per million years. Whatever the number, however, Halley would soon have proved that, for one chance of our shooting one across its path, transversely or obliquely. There are very many, perhaps scores, of greater chances of being overtaken by one, having its perihelion on the earth's orbit, and going in our own direction, but with greater speed. Tempel's 33-year comet, that is believed to follow the orbit of the Leonid meteors, has an orbit of quite this character, but retrogade motion, which is very rare indeed in those of such low inclination. Among the 200 calculated orbits, at least three or four will be found with perihelia quite as near our own, equally low inclination, and their motion direct; and these may be called the pre-eminently dangerous bodies, there being far more chance of our being overtaken by either of these than of cross encounter among all the 200 that have more inclined orbits, even if all of those intersected our own. Now, my inference that the deluge-comet overtook the earth in her own direction agrees remarkably with this detail in the Hindoo account, which calls this catastrophe the "Fish-Avatar," or that advent of Vishnu (the Saviour god), in which He appeared as a fish. It agrees with Genesis in saying the final warning to the patriarch and his "seven companions" was just a week before the catastrophe; but says it was given by the deity in the form of a "little fish" no longer than his finger. This was to be watched daily or nightly, and its increase each day is described very slow at first, but in three days reaching double this length; then, in two more, equalling his arm, and with such prodigious growth in two more that at last its train, "shining as gold," extended a million leagues. Now, plainly, these are just the appearances a tailed comet would have during seven days of direct approach. If, exactly following the earth, it would throughout the time be in the Zodiac three signs east of the sun, or always on the meridian at sunset, and setting at midnight, like the moon at first quadrature. And, as Genesis tells us, this week began on the tenth day of a lunation, the moon was just gone far enough east to leave a fainter body at that longitude visible.

In the utter darkness of the storm the patriarch trusted Vishnu, or, as the Hindoos express it, attached his cable to the Fish's mighty horn, who guided the vessel; but was never more seen. Vishnu's next manifestation was as a boar, whose tusks grubbed under the vessel, and at length hoisted on high on a mountain, with which mountain other gods are represented as churning the sea, while new "streams of life" flowed down from its summit. All this plainly records the throes of the upheaval of Ararat, which Genesis too implies in viii. 3 and 5, where the old margin (authorised, not revised) twice gives as an alternative to "the waters decreased," or "returned continually," they were "going and returning"—ebbing and flowing "till the tenth month."

Whiston's notion of the lunation having formerly been just 30 days, hung mainly on the statement, Gen. vii. 11 and viii. 3, 4, that from the 17th of Noah's second month to the 17th of his seventh were 150 days. But an astronomer named Langius showed this to be possible, in certain years, with the present lunar elements. Its occurrence is so rare, however, that I think it more likely Noah mistook 148 days for 150, through the inability to count the first few in the darkness of the downpour (which the Hindoo account calls a "whole night of Brahma.") Part of the promise afterward (viii. 22) was that while the earth remaineth, "day and night shall not cease," implying that their regularity *had* been once interrupted. The order to leave the Ark being given in the same month of the calendar that they had entered, but just ten days more from the New Moon, seems to imply this was the excess then, as now, of the year over 12 lunations, and that the imprisonment was for exactly a year of the present length.

Nothing of Whiston's extravagances can be, I think, of any use. But one must not forget it was simply his wild book that drove Halley to publish (30 years after writing) his valuable paper. De Morgan said of Newton, that "after he made any discovery, somebody had to discover that he had made it"; and so it seems in this case with his nearest follower, Halley. Of course, if either he or Whiston could have guessed, what we now know, that a comet of a score or fifty times the earth's volume may be not a fifty-thousandth of her mass, they would have regarded the Deluge comet, as I do, as simply ending its separate existence. Instead of what Halley calls the "*cho* of a comet," it was the entire fall, collapse, condensation of one. This would not occur on meeting one (as the 33-year one of Tempel crossing one obliquely; but was quite possibl one overtaking us. If it were one of the nume class that Jupiter arrests, "like a huge policem and turns into orbits of 5 or 6 years periods might overtake us with no greater velocity th 22 or 20 miles per second, or but 4 or 2 miles partaken of. Seal or whale blubber was too valuable for burning in the lamps, oiling leather, and many other purposes, especially for trade. Neither does the general belief that they drink train-oil appear to be supported by reliable evidence, and some authors in various localities especially deny it. I trust that I have presented sufficient evidence to show that the popular picture of the dwarfish Eskimo, dozing in an underground den, keeping up his internal heat by enormous meals of raw blubber washed down with draughts of lamp-oil, is based on exaggeration, to say the least, rather than on actual facts." **E. A. N.**

HEAT, FORCE, &c.

[27059.]—IF "F. W. H." (letter 26984) would refer to a good textbook of physics, I think he will find that heat is attributed to molecular vibration, and it is a simple deduction that whatever increases the rapidity of vibration will increase heat, and *vice versâ*. Heat and cold are relative terms, and I hope that "F. W. H." will now see that it is a mistake to interpret Tyndall's phrase in a literal sense, and say that "cold is an opposite mode of motion and a concentrating force." I do not think that heat can properly be called a force at all, but a form of energy. What the relation of force to matter is I do not pretend to know anything about; but it is a fair inference, from the present state of knowledge, that if all the matter in the universe were in one mass, and, so far as visible motion is concerned, at rest, it would be practically dead. Our friend with his speculative difficulties reminds me of the mathematicians who busy themselves to find out how far our present conceptions and experiences would hold good in a world where space was of four or no dimensions, instead of doing what they can to develop the mathematics of actual relations. When "F. W. H." has mastered the mysteries of his present existence—knows, for example, how molecular nervous movement becomes sight and hearing, in short, how he obtains knowledge through the medium of his senses, what is inexplicable to him now might be so no longer. Mind cannot be shown to be a mode of motion, but it may be a form of energy, and energy, we have every reason to believe, is indestructible. **I. A.**

THAT PRESSURES ARE DYNAMIC EFFECTS.

[27060.]—LEAVING out an elastic stress, it has seemed to me that all pressures are really dynamic effects. Elasticity of bodies seems to me a necessary condition of the constitution of matter as we know it. I shall be glad, and exceedingly obliged, if you will allow me to bring under the notice of your specially qualified readers—first, a *theoretical* proof that pressures are dynamic, and, secondly, a *practical method* to determine the minimum dynamic equivalent of this pressure.

We have the well-known pressures of the wind and of steam, both measured in pounds of pressure. The pressure of both is a dynamic effect. We could here put such a question as this: What is the amount of the impact at any instant, the rapid succession of which amount of impact produces a certain pressure? If a small steamer is pulling, say, an empty ship on comparatively smooth water against a heavy gale of wind, is there any rate of motion so slow that the "instant" the tow line is cast loose the ship is stopped in its course and begins to give way to the wind?

A theoretical proof: Let a good steel spring, several inches in length, and perhaps as flexible as a good carving-knife, be securely fixed to a heavy mass of iron, so as to project horizontally, say, 5 or 6in. beyond the edge. To the outer end of this spring suspend, say, a weight of 20lb., or sufficient to bend the end of the spring down 1in. or less. Now let a catch hold the end of the spring down, and remove the weight. The spring is now bent to the extent to which a 20lb. weight would bend it. If now a 1lb. weight, or less, be placed on the end of the spring, it will not, of course, bend the spring in the least. It would take more than 20 of such 1lb. weights to bend it any further. If, however, the 1lb. weight be allowed to fall from above a certain height, it will certainly bend the spring further. The momentum acquired by the 1lb. weight in falling from that "certain height" is what I should term the mininum dynamic equivalent of a pressure of 20lb.

If a heavy case is being lifted out, or into, a large steamer by means of a steam-winch, it will sometimes be hoisted slowly and sometimes rapidly. Now theoretically and actually, the faster the package is hoisted the easier does the winch work, so to speak. Theoretically, if, when the case is being hoisted rapidly, it were "instantaneously" disengaged, it would rise a short height before falling. Now the question—Would the package rise in this example, no matter how slowly it was being raised? This question has been answered above, and the answer is, That there is some uniform slow rate of upward motion during which, if the package be "instantaneously" disengaged, it will at that "instant" not rise further, but begin to fall. Now, I think this rate can be determined practically. The momentum of the package at this rate of motion is what I call the dynamic equivalent of the pressure of the weight of the package.

I should be very glad to know of some effective, and if possible some simple, mechanical method of carrying out this experiment. I think it may not be unlikely that some who have mechanical appliances at their command would make this experiment themselves; but if not, I would bear the cost, if not too great, when I know the mechanical means that would be adopted. **T. Wakelin.**

ON PRIMARY BATTERIES AND ON CHARGING ACCUMULATORS FROM THEM.

[27061.]—I WAS pleased to see the practical and interesting letter from "Electrician" (No. 27018, page 98), on this vexed question. The opinions expressed in "Ours" as to the practicability of using primaries are many, and widely diverging: therfore, to the believers in primary batteries his support is gratifying, since on the whole he recommends their use under certain conditions for practical lighting, a point which nearly all the electricians I have met hitherto have "pooh-poohed." The battery he gives cost of is certainly very efficient, and I for one should be very glad of a few details as to its elements, solution, and general construction, if he would give them; and while on that subject let me point out that the working cost should be a fraction over a penny per lamp per hour, upon the figures he gives, and not 11d. as printed.

Why is it that the supply of electric light is not dealt with in a similar manner to gas or any other manufactured article? It is true there are difficulties in lighting from centres; but it seems to me they are not insurmountable or more difficult than the supply of gas from centres was in the first instance. With a primary battery each house could be entirely independent, and by the use of accumulators no very elaborate system of regulating is necessary; but so long as the consumer is saddled with the bother of recharging every day or so, as well as the first cost and cost of maintenance, they are not likely to be much used.

I am quite of "Electrician's" opinion—a primary, no matter how used, either direct or in charging accumulators, must, in order to come into use commercially, have great lasting power, no local action, and be cheap in running. The first cost, and high E.M.F., I, for one, do not consider very important, since, if dealt with commercially, the first cost should be borne by the suppliers, and the E.M.F. could be raised by using sufficient cells. What is wanted seems to me to be a firm or company to undertake the maintenance, and to supply the current at a fixed price, relieving the consumer of all bother of manipulating and charging on the one hand, or keeping an engine going on the other; and when this is done, electric lighting in private houses will be generally adopted by a certain class, and not before. Of course the price will be an object, and as "Electrician" has given us the cost of the best battery he has met with, I will show what can be done with a battery upon the plan referred to. It is proposed by the company formed to work this battery, to supply sufficient accumulators and the necessary primary cells for any number of lights at a small fixed rental per annum, and to maintain the same at a fixed sum per annum per light; this sum for the present will be on the basis of 8s. per 10c.p. lamp for 365 hours, or one hour per day per annum; three days throughout the year would be 24s., and so on. Four cells of this battery of a certain size will give out a constant 2·48 volts, and 75 ampères for 120 hours without any attention whatever; in 20 hours they would put 1,500 ampères into 10 accumulators, or, say, to leave plenty of margin, an available 120 ampères at an E.M.F. of 20 volts for the remaining four hours of the 24.

Now, since zinc is consumed in nearly all primaries, also in this one, it becomes necessary, in order to use the system profitably, to recover it, and also to regenerate the depolariser and solution, or else no such result as this could be proved. It is in the simplicity and practicability of the method of doing this that the secret lies. I have, I think, investigated every system of primary battery lighting that has been brought out in the past few years, and this is the first which has made a move in the right direction. It has always seemed to me that, given a primary and dynamo both producing a similar current and E.M.F. at a cost which shows the dynamo to be slightly cheaper, relieves the consumer of all bother of manipulating the primary; but tell him he must provide some means of keeping the dynamo at work, and in 99 cases out of a 100 he will choose the primary simply because there is no responsibility on his part attached to it. Of course a good deal must depend upon the primary: it must give off no fumes, have a long life, and details must be arranged so that recharging does not worry him too much. But let consumer be relieved of all manipulation, and let him know exactly what he has to pay per annum for the light, and electric lighting in private houses will come to the fore.

In my opinion, it is the prime cost of an installation which frightens so many. Take the installation of 24 16c.p. lamps quoted by "Electrician." The first cost is £200—quite enough to scare the ordinary householder without going into the cost of maintenance at all (which, by the way, "Electrician" has considerably under-estimated). On the other hand, relieve him of that first cost entirely, and supply him with the light at a given sum per annum, and after comparing it with his gas-bills, he will consider its many advantages, and probably adopt it.

I shall look with much interest for the opinions of those who are up in this subject, and hope that the matter will be well ventilated. **Kalon.**

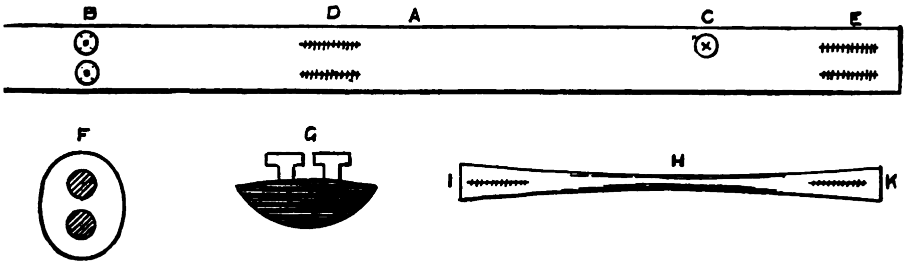
MEDICAL ELECTRICITY.

[27062.]—I HAVE read with pleasure letter 27023, and I must say that this is a subject which stands in great need of discussion, and it is to be hoped that some light may be thrown where at present all is dark. Mr. S. speaks of medical men applying the wrong current, &c., but gives no hint whatever as to which current is the right one; or, to be more correct (as we do not know there is any current whatever), which electrode should be applied, and when. I cannot agree with what he says about the difference between currents from large cells and currents from small ones; he says the former "produce sores under the poles"; but I may add so do cells of high resistance—e.g., I had occasion to use a constant current for diabetes. The cells which I employed had a resistance of 20w. to 30w. each, or, say, not less than twice as much as the small cells, 4in. by 1in., he speaks of, yet the application of current for a few hours each day for about five days produced sores under the + electrode, so that the application had to be discontinued; the only difference between large and small cells of the same E.M.F. can only be a matter of internal resistance, and the resistance of the human body, hand to hand or hand to foot, being always over 1,000w., the internal resistance of the battery can only affect the current in a very small degree. Before any useful discussion can take place it would be well to have some idea of the action of a current passing through the body. Does Mr. Smith consider it to be electrolytical, mechanical, or some action which we might call electrical, due to the current as such?

My own opinion is that the current from an induction coil acts mechanically, or much in the same way as rubbing would do; as, however, it does this internally it may be more beneficial. The increase of current due to reversal of a continuous current is, no doubt, owing to polarisation, and I have no doubt whatever but a galvanometer will show it. I have not time to test now, but will do so and report. Galvanometers for constant current should be graduated into miliampères, and such an instrument will show that a current passes in one direction, even when an induced alternating current is used. I have seen Mr. Sprague use such a galvo. for showing the current passing through a vacuum tube. Careful measurements of the resistance (such as Dr. W. H. Stone has made) of the human body, both in disease and health, will yet throw light upon many obscure matters. **Ohm.**

MY RUPTURE TRUSS.

[27063.]—FOR the benefit of many sufferers from this distressing and too often dangerous injury, I wish to make known a cheap and easily-made form within the reach of any person of common ingenuity. I invented it on my travels, when very far away from surgeons and shops. I have since improved on the original form, and gave it to a rubber goods manufacturer, with permission to copy the one I supplied for his own use, and to sell as many as he chose to make; but I have never seen it since that day. My pattern has stood the test of 20 years' wear by men who have to walk, ride, and do hard manual labour for hours in succession. It has the following advantages—(1) A set of three enables the owner to have them constantly washed with belts and parts. (2) Any desired alteration in the fit can be done with a penknife and needle. (3) If two pads be made, one can be washed and dried at pleasure without any interference with daily wear. (4) Bathing and swimming by the ruptured entail great risks of strangulation, unless a support be worn. Here is the very thing, only the pad being made lighter; a darning needle the only tool requisite. (5) Portability; a spine belt and cross strap rolled tight will go into a small pocket, or could be carried in the crown of a hat. (6) Cheapness of material. I have made the whole turn-out except the little metal appendages from cast-off apparel for working men, as patterns, but even wearable for a time; the belt and cross strap from discarded



races; their lining and buttons from old trousers nd coats—even a temporary pad, too, of same tuff filled with soft rags. Now for the description. The belt should be of surgical tape 1½in. broad, long enough to be a few inches over the girth of a man's body, just over the hips. An exact fit is the hief point of attention—the little finger should find t difficult to find room between band and flesh. line this belt with stout brown-holland. The utton holes and buttons should be worked with waxed thread of flax only. The cross strap in ength will depend on the shape and bodily outline f the wearer. This important measure is easily ttained by a piece of string with a loop at the end, y which it can be attached to the belt when tried n the body, the opposite end of this string being hen brought round the hip and over the pad to ts place, and marked with a lead pencil. Two or hree of these straps should be made, one for each elt, in fact, for washing days. A little "tinkering" is required to construct the pads, which will ast for years if put together in the following manner:—Having got some cracked rubber lawn-tennis balls (always thrown away), with a sharp knife divide the plaything so as to give you a nice round cup, rather over the hemisphere in shape; then cut out a circular piece of strong linen of a size that when you have run double flax thread round the edge of it and drawn it, the cloth will pucker up like a lady's reticule (a paper pattern will guide you well enough); clean sheep's wool chopped fine with scissors must now be thrust into this contracted bag. With a thick penholder, stuff regularly till it seems unable to hold more. Compress this cushion between weights; go to work again, taking care that the wool is well distributed, and so on. Then draw the threads in till the centre is nearly shut and the knots to secure it. Now pinch and knead this soft ball, and force it into the rubber cup under weights. After that you will generally find that there is still a little loose space in the cloth cover. Through the small hole at the gathering of the thread push in slowly and continuously pinches of wool. Again put between smooth weights with a board over, on which you can stand. This simple press will perfect the cushion, and it ought to be down ¼in. below the edge of rubber cup, for a reason which will be understood. Having procured two thick and solid brass studs (much better than any other), bronze or solder them into the light obovoid plate of 1-16th sheet copper at the same distance as the two buttonholes in belt. Under the copper I put a thin oval to match, of stiff pasteboard; stretch any strong supple leather, brown or fancy, with slits to pass over the stud heads (damping this leather previously makes a better fit), cut out all round within ¼in. of oval, and then sew it neatly over linen cushion; then try the fit in the rubber cup. If correct, you will put the pad between boards in a large vice and give it a squeeze, protecting the stud heads with a slip of deal plank. Leave your work for a few hours under compression. On removal you will havé some rubber cement ready. Take out the parts from cup, smear bottom of same and interior with the adhesive, introduce the linen ball with some force to make it stick, then apply it thickly to the top of ball and inside rim of the elastic cup. Treat the bottom surface of stud plate in same way, and then employ a clamp or vice the same as before, and leave the work to dry for 24 hours. The simplest form of pad for aquatic sports or very poor persons is merely the same sort of cushion made of fine canvas stuffed with soft horsehair. Two strong metal collar buttons are let into a piece of light leather; this is afterwards sewn on to the cloth, and can be attached to the band instantly. The hip strap is best made of the tape used to carry the leather button holders of braces, about ½in. broad; a piece of the best plaited sash cord is used as a core, the edges of said tape united over it by sewing, except at each end, which is lined with brown-holland, and button holes made as in sketch. Nicety of fit in this strap, when on the body, is of the first importance. It may be covered with list or wash-leather.

A, the tape band; B C, metal buttons as used for trousers; D E, button holes; F, front view of pad; G, side view of ditto; H, hip strap; I, one end is fastened to the single button at C when in wear; the other end, K, is brought round the neck of the lower stud, then secured by the buttonhole to upper stud, both of which metal fixtures should have necks nearly ⅛in. long from base and ¼in. thick. Several house surgeons have seen and approved of this simple truss.

Should any shrinkage occur in washing, alteration of buttons at B is the sole work. A lady nurse with an hospital diploma is the latest applicant for a pattern. Cheapness and readiness of construction, in her opinion, make it valuable.

Eos.

AQUEOUS VAPOUR.

[27064.] — "KENSINGTONIAN," and also "J. Q. D.," in a former letter ask why aqueous vapour mixed with air cannot be decomposed by heated metallic iron with production of hydrogen in the same manner that steam is? The explanation is very simple: Metallic iron, when heated, has a strong affinity for oxygen; when in contact with an atmosphere of steam or H_2O, this affinity is powerful enough to decompose the latter and to liberate the hydrogen. When the H_2O, however, is mixed with a large proportion of *free oxygen*, as is the case of ordinary atmospheric air, this free oxygen entirely supplies the requirements of the heated iron, and thus most completely protects the molecules of H_2O from decomposition.

The hot iron unites far more readily with the free oxygen than with oxygen already combined with hydrogen; and since, in the case discussed, the former is enormously in excess of the latter, we can confidently regard the decomposition of H_2O under such circumstances as impossible.

F. S. C.

[27065.] — "KENSINGTONIAN" cannot have read my letter carefully. I expressly stated that when steam issued into the air it suffered condensation. I cannot see that I suggested the possibility of the co-existence of steam and aqueous vapour. I think it time that this very unprofitable discussion was dropped. If "Kensingtonian" has read the previous correspondence, he will know that I have merely been trying to set right "J. Q. D.," who asserted that a hot stove decomposed aqueous vapour into oxygen and hydrogen. "Kensingtonian" himself appears also to misunderstand the question. When steam is decomposed by iron, it is always in a confined space from which air is more or less excluded, and the steam and metal are brought into intimate contact at a considerable elevation of temperature. Under these circumstances, the iron becomes superficially oxidised and the hydrogen escapes. In a room warmed by a stove the aqueous vapour cannot play the part of steam. In the first place, the quantity is small; it is in constant circulation, and does not come into contact with the iron under pressure. Of course, iron will rust in a damp atmosphere if the iron is cold, because it then becomes moist.

A. P. S.

STRUCTURE OF ARACHNOIDISCUS E.

[27066.]—GRANTING Mr. Morland's reasons as correct (letter 27027) for not being able to see the fine markings well from the Gothic window side, that should still allow the angular perforations to be seen as well, or better, from that side; but as a matter of fact that also is ill defined.

With regard to the objection to the inner film, it should be remembered that the ribs go through the whole thickness of the diatom and wall, therefore form a support at regular intervals. I must admit that the fracture on one of my specimens did not go beyond the Gothic window, and feel this is a weak point in the evidence which wants clearing up. The easiest way to do this would be to study some smashed specimens mounted in cassia oil, with different sides up.

My argument is that a structureless membrane will explain certain appearances in different diatoms that can be explained in no other way. Take Triceratium fanus for instance. The hexagons there are large, and not likely to interfere with the definition from whichever side viewed, and yet the fine markings can be seen very easily from one side but are very ill-defined from the other.

In answer to "R. O. H." (letter 27026), I should say this diatom could be separated into at least four different plates—first, the structureless membrane, as figured in the photograph, then a plate of coarse areolations, oval in shape, with the largest diameter in a line with the circumference of the diatom, then a plate of fine areolations, also oval, but with the largest diameter radiating from the centre to the circumference, and on the outside of all a thin membrane with the fine markings. I have examined almost every species of Arachnoidiscus and find the apparent structure precisely the same except the fine markings, which differ very much in size, being finest of all in A. Japonicus. In assuming that the plates could be split up, I have left out of consideration the main ribs, as it is possible that may be one solid structure, and the areolations a sort of girder-work between.

T. F. S.

RAISING WATER.

[27067.]—MY attention having been drawn to a letter appearing in ENGLISH MECHANIC *re* raising water, &c., and signed by some malicious person in my name, no doubt calculated to damage my reputation, I hasten to assure you that it is a base forgery, and absolutely deny being the author of such letter. Trusting in justice to an old supporter of your paper you will print this.

W. H. Wildig.

Grosvenor-street, Chester, April 1.

[Just as we expected. There is a Bedlamite at large somewhere in the neighbourhood who, for the past ten years, has amused himself by sending us communications on all possible subjects under all manner of signatures. Sometimes he writes to some of our correspondents, who are, of course, astonished, and sometimes he uses the signatures of well-known contributors, who get replies to letters they are supposed to have written, which puzzle them still more. There is no doubt that the communication referred to is one of this individuals freak's, which somehow escaped our notice. —ED.]

MANDRELS.

[27068.]—I NOTICE that the worthy doctor is again to the fore with his Treble X Mandrel. I have never ventured to criticise this, as the Amateur Mechanical Society, after due examination of its merits, did, I believe, accept it as the standard. But does not the suggestion of various lubricants from oleo-margarine to watch oil rather imply a doubt as to its running properties? Does the inventor seriously intend that we shall consider what the work in hand is, and then lubricate out of the special bottle, pro re natâ? This would imply taking out the mandrel, wiping, and replacing it. That won't do any how. I believe the doctor is right as to the principle of chuck fitting, and that the form is good; but I do not think it is at all likely to be adopted generally by the trade. The money question will, in reality, decide the matter; and this mandrel will only pay in very high-class lathes at very high-class prices. Is the interchangeable mandrel a necessity? Turners do not lend each other costly chucks; and the facilities of carriage are now so great, that if we need an additional one it is a very easy and, to my own mind, a far more satisfactory plan, to send up the headstock to have it fitted. I have never wondered at the Doctor's hobby, because he upholds a very sound theory.

No doubt a chuck ought to run true upon two or more mandrels, and would do so if such mandrels had absolutely no defect; but if it will not pay to carry such theory into practice, I am morally sure it will never be done; such mandrels will be "made to order." But the subject is one of interest, and the doctor has initiated a new question, upon which I hope someone who knows will write. What length should a collar be for a mandrel of given length and size? Beginning with a knife-edge, or collar so narrow as to endanger the formation of a groove in the mandrel, when do we arrive at such width of bearing surface as will give sufficient support and no more? The front collar having the greater burden, how small may the other be? And, again, how does it affect the question of the bearing surface of the front collar when the other end of the mandrel is supported by a back centre? I cannot but think these items of more real importance than the question of interchangeable mandrels and chucks.

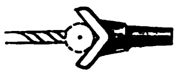
O. J. L.

LATHE MATTERS, VERY VARIOUS.

[27069.]—REGARDING Mr. Armstrong's chuck-fitting, on page 83, it strikes me there would be a difficulty in adjusting shoulder and cone to on another, so that both should fit up equally. I wa interested in the sketch he gives of the arrangement he has fitted for ornamental work. If has a photo. of it, and will send one to me 4, Clarence-road, Tunbridge Wells, I will sen him one of mine in return, which is somewh similar. The most complete thing of that kind know of is the arrangement contrived and made by Mr. Massa, of Brooklyn.

As to the self-centring punch of "Eos," also on page 83, I suppose he would still have to set the work to be marked between the points by the eye. Would not the contrivance shown at Fig. 1 suit him better? It is a simple forging, which goes in the place of the dead-centre, having been turned inside the jaws when running in the mandrel, and then filed flat to the turned part, so as just to remove the mark of the turning tool. It is, therefore, true with the centre, and, when used for drilling, the drill goes straight through the middle with no trouble.

FIG. 1.



I see "A Country Parson" is anxious (query 61839) to make twist drills, and seems to think it "a simple thing." I fear he would require a cutter for every size of drill he makes, costing about 8s. each. Surely he might almost as well try to make steel pens. Churchill's book (by Brown and Sharp), on "Universal Milling Machines," describes the process: it costs 6s. 6d. On page 464 of Vol. XLIII. is an apparatus for making T drills on the lathe; but I do not think it would succeed. You require a circular cutter, not a round-ended one. Then you have to relieve the sides of the drills, and then to harden and temper, which is all rather difficult for anyone who is not constantly doing it. On page 362 of Vol. XLII. is shown a bracket for setting upper part of slide-rest upright. I have this, and find it very useful. For a twist drill you would require to turn the bottom of the bracket round to the proper angle for the inclination of the twist, and then have on the proper change wheels to give the spiral; the cutter must be carried in a strong-geared driller, which will drive it at about two revolutions to each tread. Then, having adjusted the cut to proper depth, you would turn the lead screw by hand, and drive the cutter by the foot.

This week's issue contains so many interesting things, one hardly knows where to begin. I was very glad to see Dr. Edmunds back again amongst us. May I ask him and "Eos" for what purposes they propose to have a screwed nose on the back-centre? and how Dr. Edmunds would use the one on the back-gear spindle? For medallion turning, perhaps? I only wish Mr. G. Birch would respond to Dr. Edmunds' appeal, and that he would send photographs and descriptions of the many new and scarcely-known apparatus which he makes from the designs of Mr. Jesse Lowe; but if he is too busy to do this, if he will place the information at my disposal, I will make myself the exponent of his work to the readers of the "E.M." in return for the information I should receive. I am afraid to go forward with our lathe design until I am acquainted with the requirements of the medallion turner, so as to make provision for it in what we have called the "E.M." lathe. I am sure many will be pleased with the description of Mr. Madan's screwing apparatus, so clearly described, because it looks like the sort of thing an amateur could make for himself.

"J. M. G.'s" observations appear to me very sensible, though founded, I think, on a misapprehension. My letter above his explains partly, and I hope Col. J. Campbell, or some other mathematical reader, will confer a public benefit by investigating the problem suggested at the end of my letter. The word in the last lines (p. 106) printed "equally" should read *equably*, and again "equably to and fro," not "equally to and from," as unfortunately printed.

F. A. M.

LATHE MATTERS.

[27070.]—IN the "E. M." for 25th March there is a sketch showing Mr. Armstrong's plan of fixing chucks to the nose of a mandrel. The plan appears to me to have a fatal defect in it. This defect is the impossibility of having more than one chuck at a time which will fit the nose. It would be impossible, without grinding the piece of the chuck A into its place against the face of B and the female cone of the nose, to insure perfect contact between the surfaces of A and B, and those of the male and female cones. These surfaces would consequently be altered at each time of fitting a chuck, and the last chuck made would, therefore, be the only one which would fit.

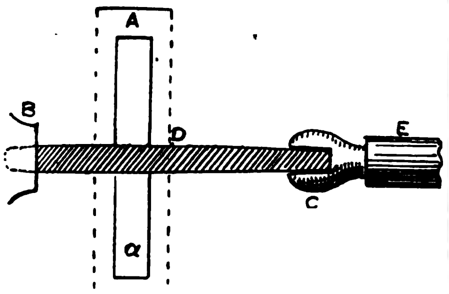
I have seen the number of the A.M.S. *Journal* referred to by "E. B. F." The report on the screw-threads is not of much value, unfortunately, as the questions are not given, but only the answers. A large number are in favour of a standard pattern and aliquot rates of screw-thread.

I have just seen Dr. Edmunds's letter in the last number of the "E. M.," and hope next week to send a sketch and calculations of the proportions necessary for a traversing mandrel, and also to discuss the primary questions of the form and size of the mandrel-nose and of the screw-thread.

A. Gray.

CUTTING GROOVES.

[27071.]—FOR the benefit of those who may wish to make hollow drills without the previous labour of constructing a cutter wheel, I was induced to try an experiment which has proved successful. Having forged and finished the flat portion and shank to desired gauge and length, get a new rat-tail file, the larger part of which is equal to the required segment. With this make a furrow, or groove, about half diameter of said tool, across a slip of hard wood, 3in. long, 1in. broad, and 1in. thick; break off about 2in. of the point end of this file; put the tang of it into your drill chuck, and screw up very tight; put the female centre on end of your back spindle, which screw up till end of file rests securely in the same (having first put on a bit of hollow lead to prevent abrasion). Fix the T rest bar across the shears; place the wood slip thereon, the file resting in the furrow; secure your drill by the shank in any kind of tight clamp or hand-vice; apply the broad end of drill, (previously a little hollowed by hand-filing), to the revolving rat-tail, with a *firm, pushing motion* along the thicker portion, till you get near the chuck; (this process to be constantly followed, using plenty of soft soap as lubricant). I succeeded on a rather *hard* bit of steel, the first trial, having none properly annealed at hand. Harrison's book informs me he made minute wheels for grooving the points of sewing machine needles—an operation which was previously performed by hand-labour. I subjoin sketch of above adjustment.



A, *a*, bar of T rest with slip of grooved wood thereon. B. Drill chuck with file held tight. C. Female-centre on spindle. E. The end of tool running in lead plug (tin would be better). The intended hollow drill must be well secured at a slope sufficient to keep the fingers of the operator clear of the file. This simple mode of grooving metal will do for small chucks, and other appliances I think.

Eos.

NIBLETT'S SCREWING APPARATUS.

[27072.]—THE letter of my excellent friend, "F. A. M." well answers "J. M. G.'s" answer, as is not unusual, by another question. The theoretical defect has been in fact obliterated by Mr. Niblett. At "F. A. M.'s" request I cut a series of pitches with a single-point tool, and with the expected result that the threads slightly approached each other at each end of the traverse, previous to running into a single line. But I had used the first screwing apparatus made by Mr. Niblett, in which he had, as I found subsequently, noticed this defect, and by opening out the curved ridge at those two points he has equalised the traverse for all pitches.

The patient perseverance of the inventor won my admiration from the first. He has not had the advantage of a mathematical training or scientific education, but is a practical mechanic, and had to work out under all conceivable difficulties this unique invention. The readers of the "E. M." will therefore also remember that he is hoping to obtain his hardly-won reward by the sale of this clever and effective apparatus.

I was wondering why the invention had met with that aggravating reception—*speaking silence*—which is worse than the most hearty abuse; because the mere ingenuity of the device is calculated to command the attention of all who are interested in novel mechanical appliances, and apart from being in design a very beautiful theory, it is in the result a capital workshop appliance, and *by no means a makeshift screwing apparatus*.

It is hardly worth while to say that I have no interest beyond what all our readers ought to feel in an invention of this kind. I never saw the inventor in my life; but if ever I meet him he will have as hearty a handshake as I know how to bestow. Many an invention of far less value has received a Society of Arts medal, and I shall certainly hesitate about reporting other clever novelties if this is consigned to a cold oblivion.

O. J. L.

COLOUR-BLINDNESS AND IGNORANCE OF COLOUR NAMES.

[27073.]—MAY I, as one whose work deals much with colour and colours, add to Mr. Stretton's remarks on the subject a further criticism of the skeins of wool—namely, that if those used by Captain Galton at the Health Exhibition are a fair specimen of them, they are wretched samples of colour, and that a man might well fail to recognise any analogy between the colour of grass which he calls green, and the muddy brown which did duty for one of the four tints of green one was asked to select. There are few subjects where more divergence of opinion is to be expected than in naming colours. Homer gives the same colour-name to the sea as to wine, and on this ground it has been learnedly argued that the Homeric Greeks were colour-blind; yet I doubt not if his cup had been surreptitiously filled with sea-water he would have observed the difference without taste or smell of it. I do not deny the reality of dichroic vision, colour-blindness: I only impeach the accuracy of the test.

W. A. S. B.

RAILWAY-SIGNAL LIGHTS.

[27074.]—I HAVE read with much interest letters 27005—27007, from your correspondents Mr. Stretton and "Rover." It is quite clear that before long the question of railway-signal lights will have to be settled on a common-sense footing. It is a characteristic of railway companies at the present day to spend their money in beating about the bush, and in perhaps adopting an inferior article in preference to a good one at the same price. Common sense tells us that red and green are the colours for signals, and that white, although it is very distinguishable from a distance, is unsafe. I understand that the companies have formed a committee on signalling, and I should much like to hear how they are getting on. If there is no result from their deliberations, then it might be advisable for some powerful and authoritative body to seriously draw the attention of several lines to their very defective system of signalling.

I beg to differ from "Rover" (27006), about the S.E. backlights. I have tried them and found them quite distinct from the green "clear" signals even in very foggy weather. It is not a mauve colour, but a very deep blue, and I think it answers admirably.

The Midland Company are altering their signals at Appleby and at Carlisle to red and white, as "Rover" remarks; but he is wrong in saying they are retrograding. This is done on account of the N.E. company's signals all being red and white, and at these points the Midland and N.E. companies' system forms a junction. Although Midland signalling is very bad, still it is as well to do it justice.

As regards the recent accident at Carlisle, I may say I perfectly agree with "Rover" (27007), as I know the station well.

I hear that several N.E. drivers have been retired on account of colour-blindness (?). To what test were they subjected? There is such a thing as being able to distinguish between colours, and not to know their names. This is properly colour-ignorance, and should not disqualify a driver from following his calling.

The Midland Company are building "single" engines at Derby, with several unique features. Particulars will be found in the *Railway News* of the 19th March. One will be sent to the Saltaire Exhibition.

P.

BRAKES.

[27075.]—I SEE in your issue of April 1st a letter (27015) from Mr. Stretton in reference to Mr. Marshall's paper on brakes, which, in common fairness to the latter gentleman, ought not to pass unnoticed.

Mr. Marshall treated the subject by dealing with the vacuum and pressure brakes as at present in use; Mr. Stretton, on the other hand, carries us back seven years, by referring to some trials which took place in 1880. This surely cannot be considered to be throwing "further light upon the subject."

Again, the automatic vacuum brake quoted by the writer of the letter was the Sanders, and not the brake now known as the "Vacuum Automatic." I have a copy of the official report before me, and I take the following from it:

"These experiments do not afford sufficient data for full and fair comparison of the stopping powers of the several brakes employed." "For these and other reasons these trials cannot be taken as fairly competitive."

Now I consider the above facts show that the figures given are misleading, and the report ought not to be used for comparison, even in the case of the brakes tried, to say nothing of one which was not.

One thing the report does show, that the L. and Y. R. has thoroughly tested the capabilities of the Westinghouse brake. After much experience with

liance, they have abandoned it, and adopted
ce so admirably described by Mr. Marshall
omatic vacuum).
ɪgarding the position of the stored com-
air, and the fact that the air for supplying
uum brake must enter by the application
on the engine and in the vans, I fail to see
atement such as this proves anything; for
akes must be controlled throughout the
om the engine; it matters not where its
ı stored, and the simplest manner in which
be done will be the best—in support of
might recall the words of the ever famous
Watt, of steam-engine fame—"Of all
out proverbially in mechanism, the supreme
ce is simplicity." **Geo. Kiernan.**
uke-street, Brooks's Bar, Manchester.

THE BRAKE QUESTION.

5.]—In the correspondence which has
d in your columns no reference has yet been
the constant trouble we have on the Man-
Sheffield, and Lincolnshire with the new
tri-coupling. It comes disconnected, and
brake fails—and so numerous have the
become that this notice has just been
d:—

"[COPY.]

ester, Sheffield, and Lincolnshire Railway.
ocomotive and Carriage Department.
"Office of Superintendent,
"March 22, 1887.

"Notice to Drivers.

ong as it is found necessary to use a tri-
; to form a brake connection between the
r tender and the front vehicle of the train,
e your duty to see it is effectually secured
g or otherwise, so as to prevent the possi-
the coupling working loose and becoming
cted.
are given to understand that for the future
cept no excuse whatever for such failures.
"(Signed) Thomas Parker."

ould, on our line, much like to know what
etton and your railway correspondents
tying a brake together with string!
M. S. & L.

ODIC FORCE.

7.]—It is strange to see this conceit, which
to the dark ages when table turning
d, resuscitated. Experimenters should
nind that it is impossible to hold the hand
ly still, and therefore a movement in the
ed object is a natural consequence. When
was first introduced, the power was claimed
telling the correct time by striking the
the inside of a glass tumbler. I never
is to succeed, unless the operator *knew the*
o metal was then required to be placed
ath.
planchette, which writes on paper, is
by similar means. It is a miniature table
legs, one being a pencil; two persons
rest their hands on the top, and after
for some time the table begins to move.
ad plenty of fun out of this apparatus, and
ake it write anything I chose by slight
of two fingers, while my *collaborateur* was
unconscious of any directing force, and
the writing to spiritual agency.
Sm.

ECTRICAL THERAPEUTICS.

3.]—I have both performed and witnessed
nderful cures by galvanism during the last
s. In my long experience there are few
in which properly applied forms of
ty are objectionable. The late Dr. Gold-
d was a leader in this branch of curative
it, and was well succeeded by Harry Lobb
haus, the great American star in this
of practice. A specialist was Dr. Garratt,
whose books are considered standard
ies on the subject. One of these, "Guide
ng Medical Batteries," is an exhaustive
full of illustrations, besides anatomical
lucidating the local administration of the
, published by Lindsay and Blakiston,
lphia. I think that every zealous practi-
hould possess this book. I have had the
-electric, electro-magnetic, and all kinds
ermacher's inventions. The chains of
forms and combinations are best suited to
use and self-treatment. I will state as
as possible the disorders where I have
hem valuable and the bodily ailments on
ey worked magical effects:—Torpid liver,
tion, piles, dyspepsia, general debility,
from fevers or exhaustion from overwork,
art, affections of the bladder and urinary
facial neuralgia, toothache, muscular
ism, rheumatic swellings and enlarge-
paralysis, writer's cramp, loss of
and many more. All the normal functions are vitalised, I may say, by the permeating stimulus. I have noticed as a proof of this statement that the effects of all medicines are assisted and hastened in their operation when the patient is wearing a Pulvermacher's chain over the region of the liver. I have been a sufferer for many years from the combined martyrdom of broken bones and the sequelæ of jungle fevers, so that I often wear a Pulvermacher with broad links in the lumbar region in bed, removing it when I rise. From a week to ten days of this application always restores my vital energy and removes all pains. When I moved this galvanic appliance during the day time I noticed that my watch occasionally stopped, and sundry tools — files especially—became magnetic. Facts substantiated by the watchmaker's memo I alluded to in last week's "E. M." A very clever surgeon I knew in India cured two or three horses of that sudden and previously incurable paralysis of the loins known as a "stroke of the wind." They were thrown, the hair shaved off the lower part of the spine, and a strong intermittent current sent through the seat of the disease. I have been informed that intestinal parasites of all kinds can be dislodged by a properly conducted current. Golding Bird, at a lecture illustrating the power of a current to restore suspended functions, exhibited artificial peristaltic action in a dead ox. **Eos.**

MEDICAL ELECTRICITY.

[27079.]—I was very pleased to see Mr. G. Smith's letter on this subject, as there is scarcely any branch of therapeutics concerning which there is such appalling ignorance, or in which quackery is so rife, as in the application of electricity to the human body. I trust that those of "our" readers who contemplate using this valuable agent will profit by his lucid remarks.

In alluding to the augmentation of current-strength observed when a current is reversed, after passing a short time through the body, Mr. Smith has touched on a much-vexed point, of which so far no satisfactory explanation has been given. Such an increase might be due (1) to a diminution of the external resistance from soaking of the epidermis and hyperæmia of subjacent structures, or (2) to an increase of E.M.F. in external circuit due to polarisation of the body and electrodes. The first theory is disposed of by the fact that the increased current-strength is only temporary, and soon falls to its former level; while it has been objected to the second that no polarisation current in the body and electrodes can be detected by the galvanometer. Experiments have been made on this subject by Waller and others, with what result is not yet evident; but there is strong evidence that it is due to some form of polarisation. **Reymond.**

MEMORANDUM ON WATCHES.

[27080.]—The movement of the aneroid during the storm, described by "Eos," is surely due to changes of pressure. It is not necessary to imagine the action of any electric force. A well-made aneroid is so sensitive, that it will record a change of pressure due to a difference of 5ft. in altitude. **Sm.**

PUTTY AND STOPPING.

[27081.]—Everyone knows what putty is like, when by that term is meant the stuff (in more senses than one) used to hold glass in frames, &c.; but there are other putties or stoppings used in the higher trades, and a few notes on them may be useful to some of your readers. Common putty is made of whiting and linseed oil, which make a very good article of the kind; better than when the whiting is mixed with marble-dust and fish or cottonseed oil. Such putty as either of the above is not fit for use in good work. We must go to the carriage-painters for the best kind of putties or stoppings. Hard stopper is made by mixing dry white-lead and brown japan to the desired consistency. Ordinary putty is made by taking equal parts of good whiting and dry white-lead, and mixing to a putty consistency with equal parts of carriage rubbing varnish and brown japan.

The best putty made for use upon any part of a carriage or waggon is, however, made as follows:—Take, say, ½lb. of dry white-lead, ¾lb. of whiting, and a ¼lb. white-lead ground in oil, and mix to a proper consistency with equal parts of rubbing varnish and brown japan. The oily lead giving greater elasticity, will make the putty more durable under ordinary circumstances; but in all cases good judgment should be used in the addition of any oily ingredient to putty on waggon or carriage work, to avoid too much in the mixture. "Glazing" or "plastering" putty is made by mixing whiting and brown japan to a stiff putty consistency, then adding white-lead ground in oil until soft enough to spread freely under the knife. Putty for glass frames is best made by mixing whiting two parts, ground lead one part, with brown japan to a thin consistency; then intimately mix with it the short fibres of plush or velvet (which may be unravelled from scrap pieces very easily). If not thick enough to spread with the putty knife, add a little dry white-lead. Putty may be made of any of the earthy pigments in the place of the whiting or lead, and in many cases it is found advisable to use it in puttying over screws and nails on mahogany and other hard woods. Yellow ochre, umber, Indian red, &c., may thus be used to advantage. Putty must, however, be made of material which will not be acted upon by the sun's rays or by cold so as to swell or contract, and the less the painter has to do with the oil and whiting putty of the glazier the better, for the latter wants something that will hold the glass in place without becoming so hard that it cannot easily be removed. **L. A.**

SCALES IN DRAWING OFFICES.

[27082.]—What scales are generally used in drawing offices in your country? Here there has been some discussion on the matter, a Mr. Meyer having stated in some articles on drawing, contributed to the *American Machinist*, that "Ivory or paper scales should not be used in a drawing office." Now paper scales are very generally used, and accordingly a critic replied that "no others should be used where drawings are made for machine shop use, for all purposes, and on all occasions. No other scale is so cheap, so convenient for use, so durable, or so easy on the eyes. It is perfectly true that of a score of paper scales 18in. long, no two will agree exactly in total length of graduation. It is also perfectly true that this is a matter of no consequence whatever in the production of accurate drawings. It is also perfectly true that a draughtsman who depends upon a scale in putting the sizes on a drawing will take more time, and is in far greater danger of error than the artful craftsman who ascertains the dimensions of his work by addition, subtraction, multiplication, and division. Even in full-size drawings the scale should never be depended on for measuring up the sizes; keep a scale in your hand while putting the sizes on the drawing; but use it only as a check on your figures, and to help you out on the even inches after you have settled the fractions by calculation. The one essential of a scale for draughtsman's use is uniformity of graduation. One inch should be about as long as another inch; it makes no difference whether the inches are absolute inches or something quite different; but it does make a difference in small-scale drawings if, having set off a line of measurements from the edge of the scale, the scale is moved along on the line and a discrepancy appears in the previous points, which discrepancy is due to a want of uniformity in the graduations of the scale. No one can be found to deny that the paper scale is the most convenient to use on the board, nor that the paper scale is by far the cheapest and cleanest for the paper. Properly treated the paper scale is also the most durable and the least affected of all scales by changes of the atmosphere. The correct scale for ordinary machine work is the paper scale, printed on Bristol board, 18in. long; scale, 3in. to the foot. In selecting several scales, pick out those which most nearly coincide in total length of graduation. As soon as the scales reach the drawing-room, give each one two heavy coats on each side of the best white shellac varnish, made with alcohol (not methyl), and if possible let the scales have twelve hours to dry before using. Paper scales so treated are about the colour of ivory, are perfectly clean and agreeable to use, afford a hard and reliable centre for sharp-pointed dividers, and can be wiped clean with a damp cloth at any time. When the scale is worn by the points of the dividers, varnish it over again. The varnish will fill the holes perfectly, and I have used such a scale a year and a half constantly before it was worn out. No finer graduation than 16ths is needed for the drawing-board; 32nds are easily read from the 16ths graduation, and 64ths are matters of conjecture only on a paper drawing which is not figured. It is needless to state that all drawings should have every dimension, radius, and centre clearly defined by figures, broken lines, and witness marks. Nothing should be left to subsequent shop measurement." We should like to hear the opinions on your side.

Newark, N.J. **Three Compasses.**

Emigration.—A number of circulars giving information about the Colonies have just been issued by the Government Emigrants' Information Office, 31, Broadway, Westminster, S.W. These circulars can be had gratis on application, by writing or personally, to the chief clerk at the above address, and further information will be found in the Handbooks for the respective Colonies, which are published at 1d. each. The office is under the supervision of the Colonial Office; but while the committee of management spare no pains to make the information as accurate as possible, they cannot hold themselves responsible for the absolute correctness of every detail.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61255.]—**Embrocation.**—For the benefit of A. F. Shakespear and others, I will give my experience in subduing a constitutionally deranged liver, rendered still more unruly by a long residence in an unhealthy climate (not California) and improper diet. Before rising in the morning, I turn over on my back, clasp my hands under my head (the exercise has more effect thus), stretch out my legs heel to heel, draw up the right leg from the hip, still keeping it straight and alongside the other, and at the same time, by a movement of the abdominal muscles and muscles of the loins, throw the ribs over to the left. Reverse the movement, and draw up the left leg, &c. Repeat these movements rapidly and as vigorously as the soreness of the stomach and liver will permit until you feel the muscles are tired; rest a minute or so, and repeat again two or three times. In the evening, when retiring, repeat these movements if the stomach is nearly empty, but not immediately after a meal. In a week or so you will be able to stand 10 minutes' steady banging of your ribs on your liver and stomach; and if, as is generally the case, constipation accompanies the symptoms, you will find it gradually disappearing. In my own case, living as I do in a warm climate, I find that I must give up the use of meat almost entirely, also sugar, and live largely upon fresh fruit, milk, eggs (sparingly), brown bread, and other vegetable foods. A daily sponge bath, as much open-air exercise as I can get, and open windows at night I rely upon to cure all my ailments. If this benefits Mr. Shakespear, I shall be glad if he will let us (the readers of the "E.M.") hear from him.—BACKWOODSMAN, Los Angeles, California, U.S.

[61452.] — **Electrical Apparatus — i.e., Charging Accumulators from Primary Batteries.**—I do not at all wonder at Mr. Conry's reply on this matter, if his experience has been with such cells as those he describes in answer (61768), as this battery would need recharging after doing, say, 160 watt hours' work, and this, too, at a prohibitive cost of, say, 2¾d. per lamp hour of 20 candles. My work, with the cells I employ, shows I can get 1,800 to 2,000 watt hours from one charge, and can light a 20c.p. lamp for 1¼d. (or less) per hour. In criticising my reply, it would have saved Mr. Conry some trouble if he had only read it correctly before rushing into print. The statement that it is cheaper to run lamps off accumulators charged by batteries, rather than running direct from the primaries, is certainly wrong, but was never made by me. What I did say was that the loss by so doing was 15 per cent. (this should have been 25, as my letter [27018] will show); but that certain advantages counterbalanced this loss. This is very different to what Mr. Conry would have me to say. I am not an advocate for lighting by primary batteries as at present constructed; but my experience has been with them that users complain, not of the expense, but of the trouble of attending on them. Now, the fewer cells the less the trouble. With such cells as he describes this week, the trouble would be even worse than their high working cost. He says, again, that the cost of accumulators and charging batteries to do certain work would be higher than batteries alone to do the same work. He is surely out of his depth here. Take those cells he describes at 16s. each, for example. To produce 25 ampères at 28 volts, assuming those cells to give 1·5 volts per cell at the discharge of 8·3 ampères, we should require 57 cells, 3 in parallel and 19 in series; this would cost £45 12s. Now, 14 accumulators would cost £25 14s., and the charging battery and switch £13, or £38 14s. in all, to give above discharge. I have here purposely taken a cheaper primary than I ought to have done, as the one I spoke of costs about 70 per cent. more, and is about 700 per cent. better suited to the purpose. With this battery, as the first cost is higher, although it is infinitely superior to the one described, the difference in cost would be still more marked. I am very glad Mr. Conry gives a decided answer to "Iota's" rash statement (61716) by giving two instances of the use, for a lengthened period, of primary batteries running lamps direct. As to the "more perfect apparatus for the transformation of electrical energy, &c.," I ought to know something of this, being about the first in the field to patent such. Although the primary batteries I have worked with behave differently to the "ordinary primary battery sets," yet they are far from "enormous." Mr. Conry will see that he and I are not so widely different in opinion on these matters after all, but that the mistake was in his not pausing to consider the exact meaning of what I said.—ELECTRICIAN.

[61612.]—**Food for Animals.**—The following mixture is largely used as a substitute for milk for calves in the United States and Canada:—10lb. pea (beans will answer as well) flour, 3lb. linseed-oil cake, 10lb. bran, and 3lb. oatmeal; grind them all together into a fine flour, and stir into boiling water, adding the meal by handfuls to prevent lumps; 1lb. of this mixture to every gallon of water, with the addition of one teaspoonful of salt and one tablespoonful of brown sugar per gallon. In weaning calves, only give one part of this gruel to three parts of milk, gradually increasing the quantity until the milk is completely withheld in about a week. It is said to contain all the elements of milk. Young pigs thrive on it very well, particularly if they have the run of a clover pasture. I have raised a litter of young pigs, seven in number, which ranged from 70lb. to 84lb. live weight when exactly twelve weeks old. They had as much as they would drink twice a day, and a free run in a clover field, with plenty of *clean* water. They were from common stock, known here as "gutter snipes" or "rail-splitters," from the length of their noses and their slabsided build, which enables them to slip through a rail-fence without trouble. Skimmed milk, with the addition of some green food, ought to make his (Thomas') pigs thrive, even if confined to a pen; but they thrive better and at a less cost if running in a small paddock—at least, we find it so in the States. Corn alone is too heating for young animals; the green feed corrects the feverish tendency and increases the appetite.—BACKSWOODSMAN, Los Angeles, Cal., U.S.

[61647.]—**American Organ.**—Without entering into any needless discussion with my would-be critic (p. 85), I trust that it will suffice for me to explain that the dimensions previously given (viz., 2ft. 4in.) for centre-board was merely a special size to suit a special circumstance, and was not intended by me to convey the idea that 2ft. 4in. was the standard width for all centre-boards. "J. S.'s" organ is represented to be a nondescript instrument, and my previous reply is acknowledged to suit this special case (see p. 20). There is no standard size, strictly speaking, for American organ bellows boards, the best rule being to make the bellows as large as possible, both in length and width, as each case will allow. It is not for me to say to what extent this golden rule is carried out; but it also holds good with regard to harmoniums and pipe organs. "A. C. W." has given no description of the instrument he is making; otherwise I should have answered his query, and given advice to suit his requirements. "A. C. W." can make his centre-board even wider than 21in., without being puzzled to know how to get it into the case. My would-be critic's advice to "A. C. W." about making scale drawings is certainly good in its way; but before anyone can make an American organ successfully, he must thoroughly understand what he has to do, and also how to do it. "J. S.'s" organ, I am inclined to think, will not turn out a success if he carries out all his ideas expressed in query 61885. He had better take the advice previously given him. I see that my would-be critic (p. 85) also accuses me of a sublime method of getting out of difficulties (?). Would he make us believe that the celeste effect cannot be produced without having one of the sets of reeds out of tune with the other? If so, he is entirely at variance with an existing fact, and he has something yet to learn about American organs. If the celeste can be produced by such means in American organs, why can it not be produced in the harmonium by similar means? I much regret that time has not permitted me to fulfil some of the promises I have made; but I shall certainly do so at the first opportunity.—G. FRYER.

[61765.]—**Staining or Dyeing India Matting.**—Possibly the aniline dyes might answer the purpose; but it would no doubt be better to use the regular dyes for vegetable fibres—such as the indigo vat; that, however, requires special plant and some skill.—E. G. M.

[61777.]—**Ferro-Chrome.**—I have found the following method for estimating Cr in ferro-chrome very much quicker and easier than the methods given by "W. H. S. S." and Mr. Hardy in your last number, and quite as accurate; in fact, these methods seem to me to be intolerably troublesome and tedious, when many samples have to be tested, as in the laboratory of a works where chrome alloys are being made. The method I am about to describe is specially adapted for chrome pig, which may contain any percentage of Cr up to say 40 per cent., but will answer equally well for chrome steel. I have taken it from a method for the valuation of chrome iron ores, described in Crooke's "Select Method in Chemical Analysis," page 132, altering it to adapt it for chrome alloys. The sample must be as finely divided as possible especially if high in Cr, and a quantity taken which will contain not more than ·15 or ·20grm. Cr, then dissolved in HCl. This, however, is often very difficult to do, and unless certain precautions are taken, practically impossible. Care must be taken to completely exclude all oxidising agents, and even the air from the flask or beaker in which it is being dissolved, and if this be done, alloys containing as much as 30 per cent., or even 40 pe cent., may be dissolved. This fact I learnt onl after much trouble had been taken in tryin various solvents. When dissolved, it is dilute without filtering or oxidising the Fe in solution, an precipitated with AmHO, well boiled, filtered, an washed with hot water. All the Cr is obtained i the precipitate, and also a little of the Fe, bu hardly a trace of the Mn. The filtrate will b turbid, but that does not matter. The precipitat with the filter paper is placed in a platinu crucible, and there dried and ignited, the transferred to an agate or smooth porcelain morta and triturated with 4 or 5grm. of a mixture o 3 parts soda lime and 1 part $KClO_3$, the mixtu is added in small portions at a time, and wel triturated after each addition. The whole is transferred back to the crucible, and the mortar cleane out with a little more of the mixture. The crucibl is then ignited at a bright red heat for an hou and a half or more. The mass will not fuse, bu when cold a few taps will cause it to leave th crucible almost clean. The mass is then triturate in a clean mortar, and transferred to a 4oz. or 6o beaker, 20cc. or 25cc. water added, and boiled. I thought necessary, a drop or two of alcohol o hydrogen peroxide may be added to decompos any permanganate, and boiled well afterward The crucible may be cleaned with a little ho water, and then a few drops HCl. After coolin 18cc. or 20cc. HCl are added, and it is then warmed if necessary, until all dissolves except a little silica then poured into a large porcelain dish, into whic a quantity of a solution of $FeSO_4$ in dilute H_2SO_4 accurately measured by a pipette, is added. Par of the $FeSO_4$ is oxidised to $Fe_2(SO_4)_3$ by mean of the chromic acid, and the remainder of th $FeSO_4$ is estimated by titration with standar bichromate solution. Another titration is als made of exactly the same volume of the $FeSO$ solution direct, and the difference between the tw readings is a measure of the amount of Cr in th portion of the sample taken for analysis. If th bichromate solution be of such strength that 100c = 1grm. Fe, then 100cc. = ·32grm. Cr. A convenient strength for the $FeSO_4$ solution is 50grm of the crystals to 1 litre of the dilute acid (1 in 4) and a 50cc. 1,000grm. or 100cc. pipette may be used —FER.

[61780.]—**Mainspring Gauge.**—Is "Tinker' sure the gauges he has are mainspring gauges? I so, a little more description is necessary befor anyone can tell him how to use them.—D. G.

[61782.]—**Sugar.**—To answer Mr. J. Gree fully would occupy too much space with matte of little interest to the majority of readers; bu so far as concerns estimating the sweetness o different sugars, he will probably find all that h wants in a letter by Mr. Allen, p. 232, last volum I would recommend him to read the notes on suga in "Commercial Organic Analysis," Vol. I., by A H. Allen (London, J. and A. Churchill). I do no think there is a "little book" on sugar; bu Weatherly's "Art of Boiling Sugar, Crystallisin &c.," Baird, might be useful to the querist.—NUX DOR.

[61783.]—**Flywheel for Gas-Engine.**—Flywheels for gas-engines follow the ordinary rules that is, those for engines with high expansion an irregular load. The diameter of the wheel shoul be from three to four times length of stroke, an the weight of rim will be found in cwts. b $\frac{P S}{45 D}$, where P equal average pressure on piston i pounds, and S stroke in feet. I think you will fin that makers of gas-engines increase the weigh thus found by one-half. I do not think eithe Clerk or Macgregor gives a rule, and I suspect th most suitable weight and size have been found b practice.—T. J. M.

[61797.]—**Locomotive Boilers.**—If this que tion is put the reverse way the answer is clea One locomotive has 72sq.ft. of heating surface t each square foot of grate; the other has onl 52sq.ft. to each square foot of grate: hence th former is the more powerful engine, so far a boiler is concerned.—T. J. M.

[61799.]—**Boiler Front.**—I suspect the queri will have to scrape the old stuff off as best he ca The best thing to paint with is coal-tar as fresh can be got, applying whilst boiler is hot. A co of Brunswick black is a refinement. Clean with little tallow, but always rub it off thoroughly. T. J. M.

[61839.] — **Twist-Drill Apparatus.** — If " Country Parson" has, or can procure No. 527 this paper, he need not get the book referred for that number contains an extract on " Drills twist and flat"—giving all the useful informati from Harrison's book.—LATHEMAN.

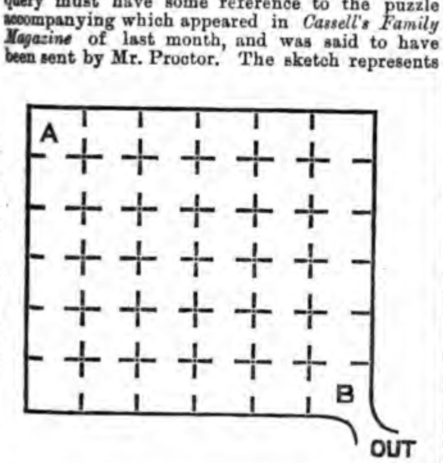
[61839.]—**Twist Drill Apparatus.**—Thou Harrison gives plenty of lathe appliances in useful book, there is no mention of any machine for making these drills; filing from the solid, a forging the flat bar into a twist are the only methods suggested. His dictum ends thus: "Unless to fill up spare time it will be hardly worth while for any machinist or other mechanic to manufacture them for himself." I have an idea that the plans for cutting spirals in cylinders of wood, described and illustrated in the "Lathe and its Uses," may be made available for the same purpose on steel rods; but the tempering of twist drills below ¼in. will be found a risky and uncertain operation—they are exceedingly fragile articles.—EOS.

[61869.]—**Fleas.**—So far, none of your contributors have mentioned the old-fashioned remedy—sprigs of pennyroyal. The essence or "water" would, perhaps, be better. The odour is, however, very powerful, and to some objectionable. The botanical name is *Mentha Pulegium*.—NUN. DOR.

[61903.]—**Harmonium.**—The valve and other parts are right enough, and it therefore depends on what "Queen" means by saying that the reeds "do not seem free when in position with the pan closed." If he means that they do not make so much noise as he expected, his surmise is most likely correct, that it will be "better with more wood about." If he means that the reeds no not speak promptly, that is to be remedied by setting them higher or lower, for there is not much doubt the pan is all right.—ORGANON.

[61951.]—**Legal.—Dentists Act.**—"Os" considers I am wrong in my reply to "Dens of Peckham," and that he "ought to know that the Dentists Act will trouble him." Well, I should not care to say what "Dens of Peckham" ought to know; but it's several years now since the Act was passed, and during all these years many regular dentists (not registered) have gone into business for themselves, and there has been no prosecution, so that I still think and say that "Dens of Peckham" should exercise all his rights as a regular dentist under protection of the common law, and calmly wait till he is troubled. "Os" also says "Dens of Peckham" "cannot possibly be a regular dentist, however many apprenticeships he may serve . . . and that he cannot call himself a regular (or any other) dentist till he has been registered." Now, "Os" is not the first, and I don't suppose he will be the last, to talk in that style; but if a man who has served a regular apprenticeship as a dentist under a stamped indenture is not a dentist, and cannot call himself such (they do it all the same), will "Os" clearly and distinctly say *what he is, and what he should call himself?* As to the statement, "He might just as well blame the railway company if he missed his train by ten seconds," it has no bearing on the question in any way whatever. If he missed his train, he could get the next; but registration means the spending of at least £200, and I am sorry to have to say it, but it's a fact, that many of the regular dentists when they are out of their time have hardly two hundred shillings, and a very great many more hardly as many pence; consequently you might just as well ask them to walk to the moon as to register.—DENS.

[61980.]—**Two Puzzles.**—I fancy this second query must have some reference to the puzzle accompanying which appeared in *Cassell's Family Magazine* of last month, and was said to have been sent by Mr. Proctor. The sketch represents the ground plan of a prison containing 36 cells—a prisoner is placed in A, and informed that, if he can make his way to B through the open doorways he shall be free. He may pass through the cells in any order he chooses, but he must go through them all, and not enter one more than once. He must also end his walk at B. I cannot solve it myself.—B. H.



[61968.]—**Woodward's Spongy Lead Accumulator.**—Mr. Austin here confuses two somewhat similar names. The patent he refers to was in '82. The particulars given by Messrs. Shippey Brothers are most interesting; but would they kindly explain what the "polarised litharge" is? Camille Faure, in one of his earlier patents, uses this word "polarise" in a somewhat similar sense, if my memory serves me right. This battery, however, I understand he abandoned, owing to defects. Would it be asking too much of Messrs. Shippey Brothers to describe this process, as I am anxious to obtain full particulars, and so, doubtless, are many others? This battery, which would be unsuited for amateurs to dabble in, seems to open up a new line outside of the present "group" of secondary battery patents. The use of sodic carbonate is as new as it is good. Would Messrs. Shippey Brothers oblige with description of their "lithanode" plate? I may add that I am ordering samples of this plate for testing purposes, and will one day give results, with the Editor's permission. —ELECTRICIAN.

[62004.]—**Comets' Orbits.**—Watson's "Theoretical Astronomy," and Oppolzer's great work on the "Orbits of Comets and Planets" give tables of motions of comets for all orbits—viz., in the parabola, the ellipse, and the hyperbola.—TRIA.

[62012.]—**Horizontal Sundial.**—"Aqua" can construct the dial he requires without much trigonometrical calculation, by the aid of what are called dialling scales. As it is not likely, however, that he possesses these ready made, they may be constructed as follows. Draw a circle to any convenient radius, and divide it accurately into four quadrants. Lay off the angle A B C (Fig. 1) equal to the latitude of the place. From the point D in the circle draw D E parallel to C O; B E will then be the sine of the latitude. From the point N draw N E, prolonging it until it cuts the circle in M. Join M O. Leaving this for the moment, bisect the lower quadrants by drawing lines B P and B R, prolonging them until they meet a tangent touching the circle at IX. Divide the circle between the points P and R into six equal parts, each of which will subtend 15°. Draw lines from the centre of the circle through the points in the circumference so found, extending them until they meet the tangent in the points VI., VII., VIII., IX., X., XI., XII. Intermediate divisions may be made to give the half-hours and quarters, remembering that the circle is to be so divided, not the tangent. The base of the dial being then prepared, draw two parallel lines S T, S' T' (Fig. 2) at a distance apart equal to the thickness of the style that is to be used. This is necessary because the morning hours are marked by the shadow of one edge, and the afternoon hours by the shadow of the other. These lines form the noon line, and at solar noon the dial should be shadowless. Draw a line at right angles to the above lines, VI., VI., right across the dial. These will be VI. o'clock lines, morning and afternoon. From T and T' set off a distance of T Y and T' Y', both equal to M O (Fig. 1), and also from the points Y Y', so found, set off distances Y Z, Y' Z' equal to VI. XII. on the hour line (Fig. 1) letting them intersect the style lines S T S' T' where they will join Y Z, Y' Z', and mark off on these lines the positions of the hours as found on Fig. 1. If now lines be drawn from the points T T' through the points marked on the lines Y Z, Y' Z' they will be in the correct position for marking the hours. It must be noted that all the lines for the morning hours radiate to T, and all those for the afternoon to T'. These lines can be extended to any distance that is convenient, and the dial may be of any shape desired. It is as well to make the distance T XII. somewhat greater than T VI., otherwise the hours near noon are crowded together unduly. The early morning and late evening hours can be formed by taking angles for three hours equal to the same hours on the other side of the VI. line. The style to cast the shadow must then be made of an angle exactly equal to the latitude—i.e., the angle A B C of the diagram. It must be so fixed to the dial that the edges casting the shadow intersect the plane of the dial in the points T T'. It must also be exactly vertical in the east and west plane, and exactly in the plane of the meridian. The base of the dial must be level in all directions. With regard to materials, the style in any case had better be of brass; but the base of the dial may be made of anything that will stand the weather, and that can be marked out clearly with the necessary lines. —W. J. R.

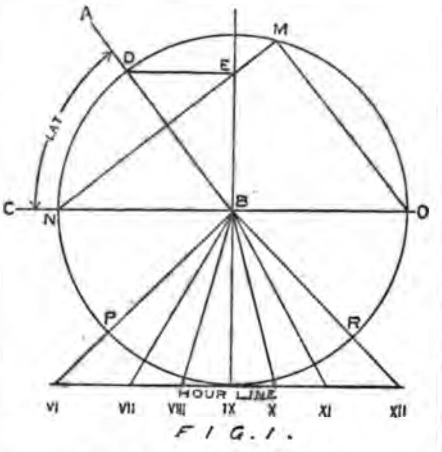
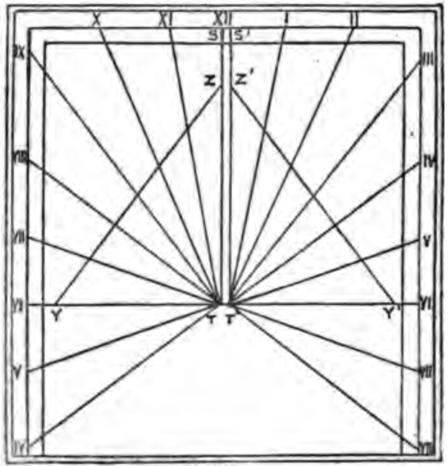


FIG. 1.

FIG. 2.



[62029.]—**Resistance of Armature.**—Yes, it is measured between the brushes. If a Gramme type of armature, the resistance is one-fourth of the whole quantity of wire; but in a Siemens H armature with a two-segment commutator, it is the resistance of the whole amount of wire.—W. A. W.

[62031.]—**Marbled Paper.**—The edges of books are done thus:—On to the surface of some clean water is allowed to flow some thin oil paint by scraping the brush against a knife. Several pools of different colours having been placed side by side, the workman takes a stick and stirs the colours together so as to make streaks interlacing with each other. The edge of the book is then carefully brought down on to the surface of the paint, removed, and allowed to dry. Another, but inferior, method is sprinkling—*i.e.*, by jerking the paint out of a nearly dry brush on to the surface of the paper to be coloured. I believe large sheets are marbled in the same way as books.—SM.

[62031.] — **Marbled Paper.** — In reply to "O. B. O.," I send description (the best I know) of the process and materials used in marbling paper. This is abstracted from Prof. Delamotte's admirable paper on "The Art of Bookbinding," in "Cassell's Technical Educator," Vol. IV.: A strong ley is made of linseed and fleeseed (gum tragacanth is the best). This should be of the consistency of cream, or thereabouts, and is spread over the surface of a wide but shallow trough. Colours are then prepared by being ground very fine with a small portion of ox-gall. These are thrown, one after another, on to the surface of the ley, a little more ox-gall being added to each as it comes later in order. Those colours are left till the last which appear most in spots on the top of the streaks of other colours. The ox-gall prevents the colours from mixing with one another, or the somewhat oily mixture below, consequently each takes its own place in spots or streaks, as it may be thrown on the surface. We now have on the trough a surface of many colours, in those peculiar shapes we call marbling. All that remains is to dip the edges of book upon this coloured surface; the embossed surface takes up the colour to which it is applied, and only requires drying and burnishing. Considerable variety is caused in the character of the marbling by inserting a comb, and with it a slight amount of streaky, small, curve-like waves are produced; or, by putting a stick in various places, and in each obtaining a little vortex around it, or by similar means; by tilting the trough a slight wave is produced, which will cause lines of greater or less intensity of colour. In this remarkable and amusing process there is plenty of room for ingenuity and taste, and an experienced workman may obtain considerable credit for his combinations of colour and form; whilst to the spectator beholding the process for the first time, it is certainly a source of much amusement. When all the books have been marbled that are ready at the time, the remainder of the colour can be used up in staining paper for the insides of the covers, or for similar purposes.—CŒPIO.

[62034.]—**For Aperture and Magnifying Power of Telescope.**—Browning, in his "Plea for Reflectors," says implicitly that the larger the aperture the lower the power that ought to be employed; but that, with the lower power more will be seen, on account of the increase in definition due to the larger aperture.—TRIA.

[62039.]—**Electrical.**—Mr. John Grey need not be alarmed about the fate of this querist, who wishes to galvanise his medulla oblongata, since only an infinitesimal portion of the current will traverse that structure if the electrodes are disposed as he indicates. The dry epidermis being practically an insulator, it is necessary to well soak the skin in warm salt and water over *both* electrodes, which should be placed, one at the top of the head, the other in the small of the back over the spine. The electrodes should be of sheet lead, about 5in. by 4in., covered with wash-leather, and well soaked in salt solution. Not more than about — Leclanché's should be used. On the whole, I think querist had better let such matters alone, or consult a qualified person.—REYMOND.

[62049.]—**Antidote for White-Lead Dust.**—All the correspondents who answered this query last week advocated the habitual use of sulphuric acid. This is no doubt very effectual in precipitating the lead as an insoluble sulphate; but its use is open to the very grave objection that it produces constipation, and the precipitated lead still remaining in the bowels does as much harm as before. Sulphate of magnesium—"Epsom salts"—has the double advantage of precipitating the lead as sulphate, and afterwards removing it from the body, and is in every way to be preferred to sulphuric acid.—REYMOND.

[62050.]—**Circular Arcs.**—"Levalton" is not likely to find any tables of lengths of circular arcs which go lower than ·1; but may compute any values he requires from the following formulæ:

h = height of arc.
$2b$ = chord, half-chord = b
x = half angle at centre.

$$\tan.\ \frac{x}{2} = \frac{h}{b}\ ;\ \frac{x''}{2} = \frac{x}{2} \text{ reduced to seconds.}$$

$$\text{Tabr. no. } t = \frac{x''}{2}\ .\ 2 \sin.\ 1''\ \csc x.$$

$$\text{Let } h = \cdot01,\ 2b = 1 \text{ then } \frac{h}{b} = \frac{\cdot01}{\cdot5} = \cdot02$$

$$\text{Log. } \cdot02 = \bar{2}\cdot3010300 = \tan 1^\circ\ 8'\ 44\cdot254'' = 4124\cdot254''.$$

$$\frac{x''}{2} = 4124\cdot254'' \text{ log. } 3\cdot6153454$$

$$\begin{array}{ll} 2 \sin.\ 1'' & \bar{6}\cdot9866049 \\ x\ 2^\circ\ 17'\ 28\cdot508'' \csc & 1\cdot3981655 \\ \hline t = 1\cdot0002666 & 0\cdot0001158 \end{array}$$

—A. D. L.

[62051.]—**Bending Brass Tubing.**—First fill your tube with lead or solder, bend, and melt out the contents. The filling prevents the tube from flattening.—SM.

[62051.]—**Bending Brass Tube.**—See that it is softened, and load with resin; you can put some paper up the tube, so that you will only have to load were you want to bend. Pour the resin in boiling hot, then get a table or bench that you consider square, and drive two or more staples in one side; then slide your tube in 6in. to corner of bench, then bend the other 6in. to the bench at right angles.—BAGOT.

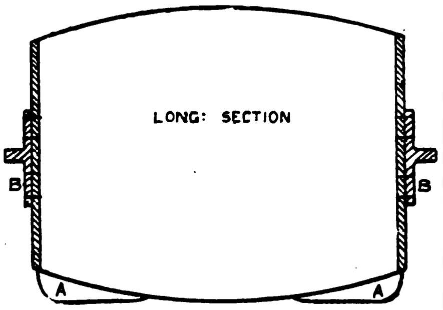
[62066.]—**Kepler's Third Law.**—Yes. $\frac{p}{P} = \frac{d^{\frac{3}{2}}}{D^{\frac{3}{2}}}$ is the same as $\sqrt{\frac{p^2}{P^2}} = \sqrt{\frac{d^3}{D^3}}$. See chapter on Indices in any Algebra. As "T. S. S." may know; this relation is only approximately true.—TRIA.

[62067.]—**Astronomy and Mathematics.**—"T. S. S." would require to have a fair knowledge of the first six books of Euclid. To read over Hamblin Smith's would be enough of algebra and plane and spherical trigonometry, to be followed by such a work on the differential and integral calculus as Hall's; he will then be prepared for Somerville's "Mechanism of the Heavens," or Pratt's "Mechanical Philosophy" (both unfortunately out of print, and their place unsupplied by any more recent English work). I am sorry to say all the best works on higher astronomy are in French. The article on "Gravitation" in the "Encycl. Britannica" is excellent as far as it goes. —TRIA.

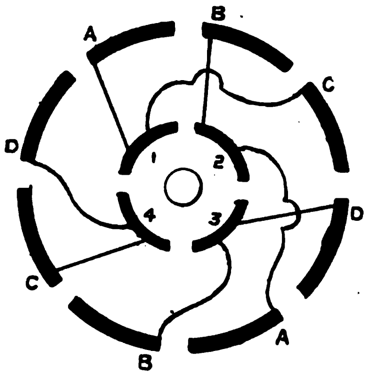
[62076.]—**Salt of Mercury Solution for Cell.**—There is not much doubt that Mr. Schanschieff's solution is the best. It was described on p. 78 last volume, and being patented is, of course, no longer a secret, so the question of "fairness" does not come in, as any one can see the specification at the Patent Office. As a matter of fact, on the small scale it will be cheaper and every way better to procure the solution from the patentee; but if wanted on the large scale, the usual plan would no doubt be followed—i.e., pay so much for a license to use, according to quantity or time.—NUN. DOR.

[62076.]—**Salt of Mercury Solution for Cell.**—Mercury sulphate is not used in the form of a clear solution, but as a paste packed round the carbon. It only requires moistening with water when it gets dry. Zinc sulphate is used with the zinc in the outer cell. This cell (Marie-Davy), although powerful, is not constant. It does well for intermittent work; but I prefer a Leclanché.—SM.

[62071.]—**Boat Carriage.**—I should think a barrel with good strong heads and with irons, B B, securely fastened to each end to act as an axle to rest carriage on, would answer very well; cleats *a a* might be nailed round the barrel at each end if required, to give lateral stability.—E. C. M.



[62084.]—**Siemens Armature.**—I should advise you to couple the coils to the commutator, as sketch herewith. The commutator to be in four sections, and the four coils of armature will form one continuous circuit. You will find this so if you follow them out. The resistance of 1½lb. of No. 20 wire is about 3·35 ohms, so the resistance between the brushes will be ·84 ohm, i.e., one-fourth. There will be only two brushes, and you may find their best position with relation to the commutator by experiment. I suppose the armature-core is a solid casting, which is a disadvantage; but the machine should light four 10-candle lamps in parallel.—W. A. W.



[62089.]—**Surveyor's Chain.**—The length of the chain is 66ft., and as there are 792in. in 66ft., $\frac{792}{100}$ will give the length of one link = 7·92in. (there being 100 links in a chain). At every tenth link from each end is attached a piece of brass with notches; that at the tenth link has one notch; that at the twentieth, two notches; that at the thirtieth, three notches; that at the fortieth, four notches; the middle of the chain, or the fiftieth link, being marked with a round piece of brass. I should say that a link consists of the straight metal part, together with half the rings connecting it with the adjoining links.—VIR SAPIENTIÆ.

[62089.]—**Surveyor's Chain.**—The total length of the chain should be 66ft., made up of 100 links of 7·92in. each. At every 10 links there is a brass label. Thus at 10 links from each end there is a label with one point denoting 10 or 90 depending on from which end the chain is being read; at 20 links from each end there is a label with two points denoting 20 or 80; at 30 links there is a label denoting 30 or 70; at 40 there is a label denoting 40 or 60; and at 50, the centre of the chain, there is generally a small brass disc denoting 50 links when read from either end.—ELAG.

[62092.]—**Microscope Stages.**—The mechanical stages allow of a rotary motion independently of the rackwork and screw for vertical and h motion.—HENDON.

[62096.]—**The Crumlin Viaduct.** three and a half years were occupied in this grand bridge. The first ironwork wa in December, 1853, and in May, 1857, the was tested. The height varies much, bu about the extreme height of the roadway. account of the work, by H. N. Maynard, lished by Messrs. Virtue in 1862.—I Godalming.

[62096.]—**The Crumlin Viaduct.**— structure, which spans the valley of the E was erected thirty years ago, Murray's book to South Wales" (p. 101), speaks as "The bridge itself, designed by T. W. Esq., is one of the most splendid en works in Great Britain, and consists of t ings, each of 150ft. span, and 210ft. high, being a series of cast-iron pillars, fastened by diagonal braces. The length of iro 1.500ft., or, including masonry, 1,658ft. T rials consumed were 2,479tons 19cwt. 31,294 cubic ft. of wood, and 51,361 cu masonry. It took 8½ years to build, opened for traffic in 1857. The cost of t was £62,000, or £41 7s. per foot. By a tra each end, leading to a wooden subway, th can walk along the whole length, and thu clear idea of the immense number and siz and pillars required for its construction. The cost of this structure was as modera design was magnificent; and the engine Messrs. Liddell and Gordon."—ARTHU Llanelly.

[62101.]—**Injectors.**—You should trouble with the "non-forcer," and it sh several feet; but this will depend on siz model. I cannot say the same as rega "forcer." A year or two back, when I th making one, I gave up the idea, as I co that, owing to the very small orifices requ the partial condensation of the steam i pipe, it would in all probability not work probably the cause in your case. If in th bourhood, I would examine.—T. C., Brist

[62104.]—**Frying Potatoes Brow** your potatoes raw into boiling fat.—HEN

[62104.]—**Frying Potatoes Brown** are not really fried, but boiled in fat. It i done in a stewpan or saucepan. The fat quite boiling before the potatoes are pu tell when the fat boils, observe the pecu vapour rising from the surface. When the are quite brown, take up with a slice, and plate with some kitchen paper under them the fat.—PRACTICAL.

[62104.]—**Frying Potatoes Brow** "Phonoscope's" wife proceed as follow her potatoes, then slice them, so that t will be about ⅜in. in thickness; wash a dry with a clean cloth (this is imperati lay on oven plate, your oven being as hot quired to bake bread. In a few minutes t become nicely browned; then turn over an other side. Serve immediately they are done the inside will be "meally" and very ap Another way is: Cut your slices about ⅛i and lay in frying pan with lard or drippin with a plate, and put on clear, sharp fir turning over until all are browned alike. should stick to bottom of pan, add a lit lard; serve hot with salt and pepper, dre These are favourite dishes at our hous relish at any time.—KATE SUTCLIFFE, S

[62106.]—**Watson's Problem.**—How man have an infinitely high conical cap? conical, it must come to finis at some HENDON.

[62107.]—**Engine Power.**—Your engi special dynamo, would, at 30lb. pressure, r lamps of 10c.p.; at 40lb., 5 of 15c.p.; at 5 15c.p.; at 80lb., 12 of 20c.p.—ELECTRICIA

[62107.]—**Engine Power.**—If run at volutions, or, say, 230ft. per minute, you indicate $\frac{1}{40}$ H.P. for each pound pressure in cylinder, but engine would run more fav if steam is cut off before end of stroke, exhaust opened before end of stroke. I th horse-power will light five 20c.p. lamps T. C., Bristol.

[62108.]—**Pollak's Battery.**—This is a lent cell, but does not suit for drivin power. It is patented, and in any c arrangement would not act well, if at all recommend something far better, and far too, if you write to me.—ELECTRICIAN.

[62109.]—**Submarine Light for C Fish.**—This has been successfully done. saying how to do it I should have t further particulars. If "Submarine" will speed of his engine, and size—i.e., diam breadth of face—of his flywheel, I can d him. He will find my address in proper column.—ELECTRICIAN.

[62112.]—**Weight of Tubes.**—Cubic inches of metal in tube = $\frac{5}{8} \times 3\frac{1}{7} \times \frac{1}{8} \times 27 = 6·6$. For W.I. multiply by 0·28 for weight in pounds, and by 0·26, 0·29, 0·31 for cast-iron, steel, and gunmetal respectively.—T. C., Bristol.

[62112.]—**Weight of Tubes.**—29½oz. The specific gravity of steel is 7,810, iron 7,746, and of a metal composed of equal parts of copper and tin (which I suppose is what you mean by latter part of third query), 7,979. Disc would weigh 21¾oz. ESSEX.

[62112.]—**Weight of Tubes.**—Solid contents of cylinder ¾in. dia. × 27in.
= ·4417 × 27 = 11·9259 c. in.
Solid contents of core ½in. dia. × 27in. = ·1963 × 27 = 5·3001 c. in.

Weight of tube = ·26 × 6·6258 = 1·72lb.

Spec. gravity of steel	8·
Spec. gravity of cast-iron	7·25
Spec. gravity of wrought-iron	7·8
Gunmetal (equal weight of copper and zinc)	7·78

Weight of iron disc 5in. dia. × ¼in. = 19·63in × ·25in. = 4·9075 × ·26 = 1·28lb.—ELAG.

[62114.]—**Reducing Current in Dynamo.**—Place a shunt across the field-magnets of your dynamo—i.e., a coil of wire which will divert more or less current, and so reduce the strength of magnetic field. By making the shunt longer or shorter, you can regulate the current as required.—OHM.

[62114.]—**Dynamo and Continuous Current.**—The Siemens H armature does not give a continuous current. There is an interruption each time the spring "brush" passes over the slit in the commutator. "F. G." can easily render the current takeable by shunting off a given amount of current, by placing a thick copper wire between the terminals. By altering the conductivity of this shunt he can regulate the shock to a nicety.—S. BOTTONE.

[62115.]—**Electrical Output of Batteries.**—TO S. BOTTONE AND OTHERS.—Premising that it is impossible to give even an approximate value to the output of batteries in ampères, as very slight variations in temperature, size, texture of negative plate, strength of solution, &c., will make great differences in current, I subjoin the following results as obtained by myself with elements nearly the size stated by "Own":—Bichromate, single cell 1·9 volts, 24 ampères, falling to 20 at the end of one hour; chromic acid, single cell 2 volts, 28 ampères; chromic acid double cell, 2 volts, 5 ampères; nitrate of soda, double cell 1·5 volt, 3 ampères; Schanschieff's, 1·52 volts, 6 ampères. The following table gives the result of some experiments made with batteries of the same size, exposing about 16 square inches of negative surface. I have noted the volts, also the ampères, when they were at all constant:—

Name of battery.	Volts.	Ampères.	How set out.
Smee	1·47	1·	Zinc, platinised silver, dilute acid.
Walker's	0·66	·5	Graphite zinc, acid.
Maiche	1·25	—	Salt and water.
Warren de la Rue	1·03	2	Zinc, silver, chloride of silver.
Skrivanow	1·45	2·	
Marié - Davy	1·52	6·*	Zinc, carbon, sulphate of mercury.
Leclanché	1·48	*·5	
Lalande-Chaperon	0·9	2·	Zinc in caustic potash, copper.
Trouvé's	1·9	24·	1 zinc, 2 carbons, bichromate.
Chromic acid	2·0	28·	1 zinc, 2 carbons, chromic acid.
Bunsen	1 8	22·	
Schanschieff	1·52	6.	

* Fall very quickly.

—S. BOTTONE.

[62116.]—**Safe Working Current of Wires.**—At 1,000 ampères per square inch (which is a very safe working factor), the number of ampères each wire will carry, taking them in the order stated in the query, is—1·0, 1·82, 3·4, 5·6, 9·4, 14·2, 18·2. At 1,500 per square inch (which I consider a safe working density), the wires carry half as much again.—PRACTICAL.

[62116.]—**Safe-working Current of Wires.** A perfectly safe-working current for wires is the Board of Trade rule—viz., 1,000 ampères per square inch sectional area; at this rate No. 20 B.W.G. would carry 1 ampère safely; No. 18, 2; No. 16, 3; No. 14, 5; No. 12, 9; No. 10, 13; No. 8, 21; but it is safe to work at twice this rate without any appreciable heating of the wires. You will find the working current is calculated at this rate (2,000 ampères per square inch) by most wire makers. See also Crompton's book of "Useful Formulæ."—W. E. H.

[62116.]—**Safe-Working Current of Wires.**—

GAUGE. B.W.G.	SAFE-WORKING CURRENT. Ampères.
8	40
10	26
12	17
14	10
16	6
18	3
20	1

The above is taken from Messrs. Crompton's "Price List Pocket Book."—H. COOK.

[62118.]—**Ammeter.**—TO MR. BOTTONE.—The instrument described by you must have been tampered with. I can well understand its high resistance if it is as you have stated.—S. BOTTONE.

[62119.]—**Ammeter Calibration.**—TO MR. BOTTONE.—The figures given at p. 48 are wrong. The ampère deposits 18·35 grains of copper per hour; by some mistake the number 17·35 was inserted instead. I do not quote or use Rayleigh's values, but those given by the Paris conference, which fixed the ampère hour at 1·19 gramme of copper deposit.—S. BOTTONE.

[62120.]—**Wheel Gearing.**—Almost any book on machine design will give the method of setting these out. You must draw centre line of shafts of present wheel and proposed wheel until they meet, and then all lines, top, bottom, and sides of teeth of wheel must be drawn to the point of intersection so found. Fifty-four teeth is about as many as you will get in of ¾in. pitch; or a diameter of $12\frac{9}{10}$in. on pitch line.—T. C., Bristol.

[62130.]—**Compound Engine.**—The low-pressure cylinder must be the same size as is required to do all the work, supposing that all the expansion took place in it. Expansion = $\frac{1}{12}$ absolute pressure; or, to allow for losses, say, 8 times—this would give average pressure of 40lb. ∴ area of cylinder required = $\frac{12 \times 33000 \times 10}{40 \times 3·5 \times 2 \times 450} = \frac{110}{7}$, or, say, 16sq.in., or a diameter of 4½in. The size of h.p. cylinder is usually half diameter of l.p., and cut-off to get the above expansion would therefore be at half-stroke.—T. C., Bristol.

[62131.]—**Hard Water.**—In my answer to this query, I gave full particulars as to the amount of saturated lime to be added per degree of hardness. I think "Rosicrucian" might at least read the answers he has received before asking further information.—ELAG.

[62133.]—**Screw-Cutting Apparatus.**—I have no doubt that this suggested arrangement would answer. It is a capital idea. The only thing *per contra* is that in its present form it will do what a traversing mandrel will not—viz., cut screws on work supported by the back centre. I think your idea would work.—O. J. L.

[62134.]—**Steel Screws.**—Mild steel will harden; or, at least, case-harden, if you use prussiate of potash.—T. C., Bristol.

[62134.]—**Screws.**—If small, use best Swedish iron wire, and when finished case-harden all over.—OHM.

[62134.]—**Steel Screws.**—Silver steel in wire and rods, though 3s. a pound, is the most reliable in my experience. Wrap in leather at cherry red, drop into warm saline solution, so as to harden throughout; dry and clean them well, then with a fine pair of pincers let them down to temper from their heads only, matching colours; drop them off into warm fat or oil. But so much depends on their gauge; large sizes, from ¼in. upwards, are best tempered on red-hot iron, or heated sand, or lead bath, and much also depends on weight and length of screw. The flame of a candle serves for the smallest. To finish and polish the head and blank part of any screw, I make a hole in the end of a round bit of deal, work the screw into this as far as the threads, put in a chuck, and revolve on emery paper. After this you can see your colour in tempering.—EOS.

[62139.] — **Dynamo Commutator.** — Your "brushes" are probably stout strips of copper. Try bundles of No. 20 wire, soldered together into a flat form at top, instead of these. Apply unsoldered end to commutator. I should have to see the dynamo to advise you further.—ELECTRICIAN.

[62139.] — **Dynamo Commutator.** — The brushes must be of a very extraordinary nature if it is necessary to put such heavy pressure on the commutator, as to "loosen it from the spindle." Use thin springy sheet copper as tips to the ends of your brass brushes, and let them press only very lightly and evenly on the commutator. You will get more current and less wear. Mercury is out of the question, both for mechanical and chemical reasons.—S. BOTTONE.

[62141.]—**Softening Hard Steel.**—Whether cutters or any tool I wish to file, I heat them in a "muffle" made of old tin cut up into a rough box. Fill this with charcoal dust or burnt leather shut up well; bring to a cherry-red in a slow coke fire without flame: have a metal pot ready full of charcoal dust and coal dust mixed together; at the above colour put the whole muffle deep into the dust, cover well up, and leave till quite cold. I soften old files and all my new steel in this way when making cutters.—EOS.

[62142.]—**Dynamo, 5 Volt.**—Put on about 4lb. No. 10 d.c.c. I cannot tell you what speed to drive at unless I know how you intend to wind your field-magnets; but, at a guess, if shunt wound, I should say 1,400 revolutions per minute.—S. BOTTONE.

[62144.]—**Clasp Nut.**—The screw action should be all right; at least, I find it so. Another I have has the cam action as follows:—The nut is split, and has a pin in each half, which project through slots in the apron and engage in grooves in the face of the disc which rocks on the apron. The grooves in disc are semicircles, being struck from centres ¼in. or less each side of centre of disc.—T. C., Bristol.

[62146.]—**Lifting Crab.**—If the handles were fixed direct on to the drum, the men would lift $\frac{15}{6} \times 30 = 75$lb., but they lift 2,240lb., $\therefore \frac{2,240}{75} = 30·1$ = purchase of gearing.—ELAG.

[62146.]—**Lifting Crab.**—Power due to barrel and handle = 15 ÷ 6 ∴ total force exerted by men = 30 × 15 ÷ 6 = 75lb., consequently power of gearing must equal 2240 ÷ 75 = 30 times nearly, neglecting friction.—T. C., Bristol.

[62146.]—**Lifting Crab.**—The gain due to the handle would be $\frac{15}{12} = 1·25$; therefore, if 30lb. was to act on the handle with only this mechanical advantage, it would, neglecting friction, be capable of raising 1·25 + 30 = 3·750lb. But as it raises 2.240lb., the problem becomes a simple proportion. Calling x the value of the gearing, the calculation becomes—

$$x + 1·25 : 1·25 :: 2240 : 3·750$$
$$x + 1·25 \times 3·750 = 1·25 \times 2240$$
$$x + 1·25 = \frac{1·25 \times 2240}{3·750}$$
$$x + 1·25 = 149·330$$
$$\therefore x = 149·330 - 1·25 = 148·080$$

—VIR SAPIENTIÆ.

[62147.]—**H.P. of Locos.**—Forty miles an hour = 3520ft. per minute ∴ 3520 × 15 ÷ 33000 = 1·6 H.P. for every ton of weight. Extra power required for gradient of 1 in 100 = 2240 ÷ (100 × 15) × 1·6 = 2·4.—T. C., Bristol.

[62147.]—**H.P. of Locomotives.**—"Student" does not give weight of his locomotive; but the actual h.p. exerted would be = $\frac{S \times 5280 \times W \times 15}{60 \times 33000}$ where S = speed in miles per hour, W = weight in tons of locomotive. To find influence of gradient, multiply 2,240 by sine of angle of inclination, which will give resistance in lb. per ton due to inclination, and this must be added to the resistance on the level for total resistance. In your example, 2,240 × $\frac{1}{100}$ = 22·4lb., and 22·4 + 15 = 37·4 must be substituted in the above formula to find the horse-power exerted on a gradient of 1 in 100.—ELAG.

[62149.] — **Platinum in Filings.** — Remove brass by dissolving in sulphuric acid. Remove solder by boiling with hydrochloric acid; the residue left is platinum.—ELECTRICIAN.

[62149.]—**Platinum in Filings.**—Treat the filings with dilute nitric acid, boiling them if necessary in a glass or earthenware flask. This will dissolve the baser metals, but leave the platinum intact.—S. BOTTONE.

[62151.]—**Projectiles.**—

Let H = Maximum height of shot
R = Theoretical range
A = Angle of projection with horizon.

Given $H = \frac{1}{n}$ of range

substituting for H and R

$$\frac{1}{n} = \frac{1 \tan. A}{4}$$
$$\therefore \tan. A = \frac{4}{n}.$$

—ELAG.

[62151.]—**Mechanics.**—Suppose the body projected in vacuo, in a direction making an angle a

with the horizontal plane; v its initial velocity; R its horizontal range; H its greatest height during its flight, and g the accumulated force of gravity. Then, we know from dynamics that—

$$R = \frac{v^2 \sin.2\,\alpha}{g}, \text{ and } H = \frac{v^2 \sin.^2\,\alpha}{2g}$$

Hence, since $H = \frac{R}{n}$, we obtain from these formulæ—

$$\alpha = \tan.^{-1} \frac{4}{n}$$

If, however, it be required to take into account the resistance of the atmosphere, the value of α will involve v, and the problem becomes one of great difficulty. For a low velocity the above result is nearly true.—J. R. C., Charing.

[62151.]—**Mechanics.**—Let V be the velocity of projection and t the whole time of flight, and let α be the required angle of projection. Then time of flight to point of greatest elevation $= \frac{t}{2}$, and if x = greatest height reached we have—

$$x = V\frac{t}{2} \sin.\,\alpha - \tfrac{1}{2}\,g\left(\frac{t}{2}\right)^2$$

$$\text{or—}\quad x = \frac{V\,t \sin.\,\alpha}{2} - \frac{g\,t^2}{8}.\quad (1)$$

Differentiating this with respect to t, and equating to zero, we have—

$$\frac{dx}{dt} = \frac{V \sin.\,\alpha}{2} - \frac{g\,t}{4} = 0$$

whence $t = \frac{2\,V \sin.\,\alpha}{9}$, and from (1), $x = \frac{V^2 \sin.^2\,\alpha}{2\,g}$

Hence, range on horizontal plane $= V\,t \cos.\,\alpha$

$$= \frac{2\,V^2 \sin.\,\alpha \cos.\,\alpha}{g}$$

$$= \frac{V^2}{g} \sin.\,2\,\alpha$$

And from the question we have—

$$\frac{V^2}{g} \sin.\,2\,\alpha = n.\ \frac{V^2 \sin.^2\,\alpha}{2\,g}$$

$$\text{or—}\quad 2 \sin.\,\alpha \cos.\,\alpha = \frac{n \sin.^2\,\alpha}{2}$$

$$\text{Or—}\quad 4 \cos.\,\alpha = n \sin.\,\alpha$$

$$\text{whence—}\quad \tan.\,\alpha = \frac{4}{n}$$

$$\text{or—}\quad \alpha = \tan.^{-1}\left(\frac{4}{n}\right)$$

—J. E. Gore.

[62154.]—**Rhubarb.**—"Materia Medica" describes malic acid and oxalic acid as abundant in the young stalks. Twenty per cent. of the latter acrid salt has been detected in the roots of some species. On the table lands of the North Himalayas the plant flourishes in a wild state, affording a pleasant addition to the meagre fare of the traveller. A giant sort, grown now in England for its leaves, used in packing produce, is absolutely poisonous as food. *Vide* Dr. Lindley's "Theory and Practice of Horticulture" (pages 100—101) on the abstraction of light and heat in influencing the secretions of plants:—"Example.—*Œnanthe Crocata*, poisonous in our Midland counties, is innoxious in the lower temperature and cloudier sky of Edinburgh." All plants grown in darkness part with their peculiar flavour. Thus I blanch chicory, endive, dandelion, &c., to remove the bitter principle and obtain the mild, nutty sweetness in its place. Field mushrooms have more flavour than those grown in cellars. Asparagus, beans, and peas, when forced, are all insipid and devoid of natural savour through being cheated of a summer's sun. Again, take the case of seakale growing on its native sands, or in the well-manured soil of a kitchen garden. It has the strong sulphurous sap of all the *Brassicæ*. Force the same specimens—they become soft, succulent, and transformed.—Eos.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

61509. Syrup for Cordials, p. 486.
61524. Universal Cutter Frame, 486.
61540. Portable Engine.—To Mr. Bottone, 487.

61764. Hydraulic Bending, p. 574.
61772. Lantern Transparencies, 574.
61773. Compressed Oxygen, 574.
61776. Water Question, 574.
61779. Micro. Mounting, 574.
61785. Corn store, 574.
61806. G.E.R. Locos., 575.
61807. Organ Question, 575.
61809. Cyclometer, 575.

QUERIES.

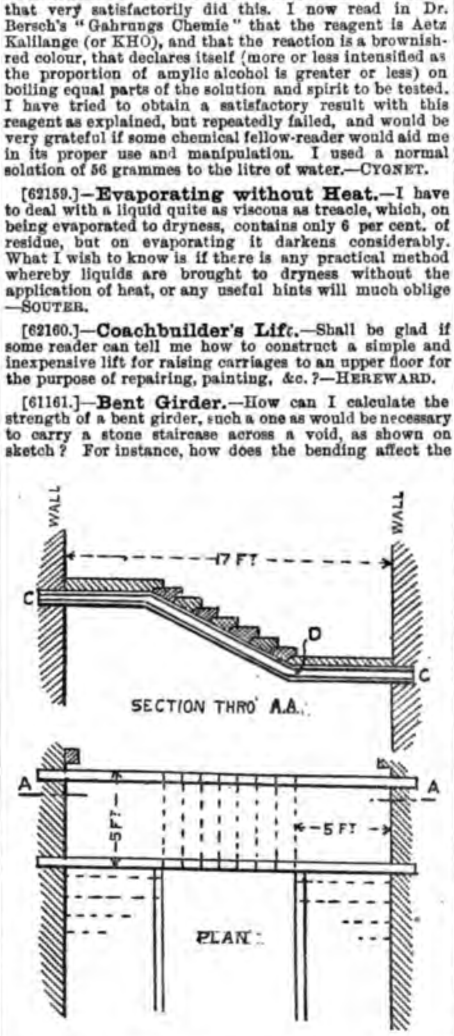
[62157.]—**Petroleum for Steam Boilers.**—Will some experienced fellow-reader advise me on the comparative value of petroleum as fuel against coal, and the best means of using it for raising steam? In the district to which I refer, coal costs 33s. per ton, and the petroleum (not purified) can be obtained at 9d. per gallon, or perhaps less. Any information will much oblige—Cygnet.

[62158.]—**Amylic Alcohol.**—Some time last year I troubled you with an inquiry asking for the reagent and its means of application for discovering the presence of this "impurity" in distilled spirits, and explaining that an instrument had been for some time in use in France that very satisfactorily did this. I now read in Dr. Bersch's "Gahrungs Chemie" that the reagent is Aetz Kalilange (or KHO), and that the reaction is a brownish-red colour, that declares itself (more or less intensified as the proportion of amylic alcohol is greater or less) on boiling equal parts of the solution and spirit to be tested. I have tried to obtain a satisfactory result with this reagent as explained, but repeatedly failed, and would be very grateful if some chemical fellow-reader would aid me in its proper use and manipulation. I used a normal solution of 56 grammes to the litre of water.—Cygnet.

[62159.]—**Evaporating without Heat.**—I have to deal with a liquid quite as viscous as treacle, which, on being evaporated to dryness, contains only 6 per cent. of residue, but on evaporating it darkens considerably. What I wish to know is if there is any practical method whereby liquids are brought to dryness without the application of heat, or any useful hints will much oblige—Souter.

[62160.]—**Coachbuilder's Lift.**—Shall be glad if some reader can tell me how to construct a simple and inexpensive lift for raising carriages to an upper floor for the purpose of repairing, painting, &c.?—Hereward.

[61161.]—**Bent Girder.**—How can I calculate the strength of a bent girder, such a one as would be necessary to carry a stone staircase across a void, as shown on sketch? For instance, how does the bending affect the strength? Could an ordinary rolled iron joist be used? It would be desirable to keep an even section throughout for the sake of the appearance underneath. C C is elevation of girder; A A is plan of girder. It would seem that the weak point would be at D. Is this so?—Mason.



[62162.]—**Boiler.**—To "T. C., Bristol."—I have a boiler, vertical, 30in. by 8in., with four tubes, 1in. diam., and ¼ plate. Is this boiler large enough for a 1-horse engine, cylinder 4in. by 3in. I have one boiler 18in. by 18in., no tubes, ¼in. plate, which would be the best? If the latter would be best, please state the safe working pressure of same and size of tube.—Click.

[62163.]—**Engine Governors.**—Will some reader kindly furnish me with a reliable and easy formula for finding the strength of coil spring and weight of cast-iron balls for fast-speed governors? What should be the strength of coil spring and weight of balls for a governor making 300 revs. per min., length of arms being 3¼in. from point of suspension? Ordinary throttle-valve, 3H.P. nominal engine.—H. G. B.

[62164.]—**Dead Beat Galvanometer.**—Can some reader kindly inform me of the relative proportions and arrangements of needle, coils, and magnet (if necessary) requisite to make a dead beat galvanometer? I perfectly understand making an ordinary instrument, but have tried to make a dead beat one without success.—Shunt.

[62165.]—**Time Keeping in a Factory.**—Will some correspondent kindly state the usual method of booking the time of the workmen in a large factory? I wish to know how the book is ruled so as to distinguish the men who lose half an hour, who lose a quarter (two hours and a half), and for full time and overtime, &c. I wish to know how the time-book is usually arranged in large factories.—Manufacturing Electrician.

[62166.]—**Leclanche Type of Cells.**—Will Mr. Bottone, H. Austin, "Electrician," or other kind correspondent please state: (1) The correct quantity (by measure) of crushed carbon and manganese respectively, to be used in recharging porous cells containing carbon plate, so as to obtain the best results? (2) Dispensing with outer glass jar, and using carbon cylinder (insulated on the outside) with porous cell, containing zinc rod or plate placed within the same; should the space between carbon cylinder and porous cell be filled with all manganese (in consideration of the large surface of carbon), or manganese and carbon? What is the rule for the quantity of depolarising material for respective size cells, also surface of zinc in above type of cell.—Carbon and Manganese.

[62167.]—**Chamber Organ.**—Having in view the construction of a chamber organ with two manuals and two octaves of pedals, I wish to know what is the space into which such an instrument could be put. What would be the amount per speaking stop. I cannot afford more than 6ft. in width.—Pan.

[62168.]—**Model Locomotive Engine.**—Will any kind reader of "Ours" inform, me what size slide-valve cylinders I shall require, size of boiler 8½in. by 3in., driving wheel 5in. diam., total weight, without water, 7lb. What pressure steam required.—R. Stroud.

[62169.]—**Photographic Developer.**—Having tried Beach's developer without much success, I now wish to try carbonate of soda, and shall be glad if any reader of "Ours" will tell me of a reliable formula containing this. I should prefer one that does not contain much sulphate of soda, as it acts with me as a restrainer.—F. E. J.

[62170.]—**Solar Eclipse.**—Will "F.R.A.S." be kind enough to give us details regarding the total eclipse of the sun due on the 19th August, telling us whereabouts in Europe the totality will be visible?—J. L. O.

[62171.]—**Turning Chilled Iron Rolls.**—Would some correspondent help me out of my difficulty—that is, to get tools sufficiently hard for the turning of chilled cast-iron rolls, fire and water of itself being of no use with the best cast steel, 1½ square? Rolls, 4in. long, 18in. dia. Have used chemicals, but can only harden, say, skin deep. Am also troubled with the steel flying when the tool is dipped.—Countryman.

[62172.]—**Globular Lightning.**—To "Sigma."—What is the most generally-accepted explanation of this phenomenon? In books I have hitherto seen it is said to be inexplicable. May it not be a brush discharge from a prominent point on a mass of perhaps almost invisible vapour, and that the moving of the "ball" is due to repulsion from the main body of the mass to which it belongs, and that the final "explosion" takes place when the point gets within sparking distance of earth or oppositely charged cloud?—Tau.

[62173.]—**Developing Dry Plates.**—I am only a very raw beginner, but have learnt the wet process, and am now ambitious to succeed at the dry. In developing, I find after about half a minute that the images gradually appear first in the high lights and then the shadows. Now, what I want to know is this (after a little time the picture gradually assumes the appearance of a beautiful steel engraving on a white ground—in fact, like a fine picture on opal; soon after it begins to gradually darken all over, and will go so dark that nothing is seen), when am I to stop the development? At what colour? Whilst it is like a picture on opal, or later? I have tried both, with the result of a miserable thin negative, even after mercurial intensification. Will some of "ours" give a helping hand? I have learnt all I know from books; but they don't go into minute details such as would suit a raw beginner. The formula used is the sulphate of soda and pyro. recommended by J. Werge (J. Hughes), page 92.—A. Stacey.

[62174.]—**Sparrows.**—Can any reader inform me what to do to get rid of sparrows? I have a thatched house, pleasantly situated facing the south, and anyone who did not know what it was would think the roof was full of rats' holes; but the sparrows have got scores of holes in it where they build their nests. They make a hole anywhere they choose by pulling out the reeds, one at a time, and in this way have formed a little colony, and in a few years they destroy a new coat of thatch. Is there anything I could distribute over the roof that they would dislike? I do not want to poison them, but should like to be able to keep them away.—G. W.

[62175.]—**Repairs.**—My lease of house and premises having expired four years ago, I have occupied the same since as a yearly tenant, paying the same rent, but with no agreement. Am I liable, by law or equity, for repairs or renewals in accordance with the terms of old lease? I might say that a new lease was agreed to two years since, but was prevented being carried out by one of the churchwardens, it being church property.—Haste.

[62176.]—**Measurement of Surface.**—Can any reader tell me of any known or possible or probable means by which the actual amount of surface contained by a solid article can be accurately or approximately measured? Take, for instance, two pieces of glass of the same cubic capacity and weight, but one piece with polished surfaces, the other with one or more of its faces ground so that it is no longer transparent. Can the surface area of these two pieces of glass be compared with another by any physical or other means by the science of the present day? There are only two methods I can conceive of; one is by some method of determining their absorbtive or emissive powers for heat or light, the other the determination of the occluded gases on their respective surface. But I do not see how to put the methods into practice, and no doubt someone will be able to suggest some much simpler and more practicable plan.—P.

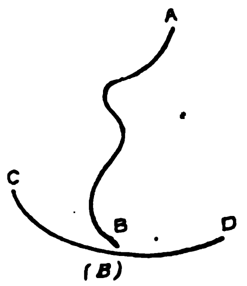
[62177.]—**Etching Ivory.**—I have some specimens of ivory that are beautifully etched, bitten in pretty deep, not merely surface marks. Will some reader who knows give information through our columns as to what is the agent used?—Campobello, U.S.A.

[62178.]—**Fires in Ships at Sea.**—Has carbonic acid gas ever been tried? It seems to me that in the case of fire in the hold this gas would displace the air and extinguish the fire where it is found impossible to get at it, so as to use water, which also damages the cargo? It might not be found practicable to use it on land, but I think at sea it would answer better and quicker, and do less damage than water. What is the opinion of your practical "English Mechanics"?—Backwoodsman.

[62179.]—**Lathe Centre.**—The other day I turned up the shifting centre of my lathe true, and after having got it tempered, I put it into the running spindle to see if it still remained true, but I found it ran at least 1 16th off the truth. Could any reader tell me the cause of the

, or suggest how I should temper a centre in 'P. TURNER.

Telephone.—Two telephone circuits, from ; to D. Both circuits are led in at B. What



dimple form of switch to be fixed at B for him ɔ that A could speak with C, or vice versâ ?—

Lunar Clefts, &c.—To "F.R.A.S."—Is nown observation of the effect of the impact bodies on the surface of the moon ? Doubtless ! such bodies as those which have fallen on our be terrific on the lunar surface, unprotected, a dense atmosphere. Are any of the very lefts, &c., authoritatively accounted for in And would not this lunar bombardment ex- of the slight changes of configuration I have not, in any work I have read, seen any en of this matter.—TAU.

Electric Clock for Factory.—Will correspondent kindly describe a method, clock may be made to make and break an ircuit to ring a gong in a factory ? It is a of the clock mechanism for making and e circuit I wish to know—not the electrical idea. I wish the gong to sound at five six in the morning, for one minute, then at arter of a minute ; then at half-past eight for a minute (for breakfast time) ; then at five nine for a quarter of a minute ; then at nine ne length of time, then at one, then at five two, then at two, then at five o'clock. I wish o do this automatically, and shall be very now how it can be done.—MANUFACTURING N.

Wood Pendulum.—Some time ago it was ur columns, whether any of your readers had saturated with paraffin wax as a material for but there was no response. I have since and although I should like to have better I have for testing, there is reason to believe nent a decided success. The fear was lest the of the wood might be so altered by the pores with solid paraffin, as to make it impossible to with a simple lead or zinc bob in the usual does not appear to be so, and if I am right, I suggest that, comparing cheapness with such pendulums would be very useful, and, re is no reason on the surface why they should e with steel and zinc compensation. It is clear ust be rendered unchangeable, and absolutely to damp, conditions which cannot be obtained arnish I am acquainted with. I have given s in the hope some others of your readers may the like experiment, and will give the result.— lington Quay.

Steam.—The travel of a slide-valve is 4½in., lap, 1in.; the inside lap, ½in., and the angle of the eccentric, 30°, neglecting the obliquity of ic rod or bar. Will anyone give me a rule how positions of the crank at admission, cut-off, compression of horizontal engine with loco- e-valve and single eccentric; cuts steam off at I want to cut off steam at three quarters of Would you tell me what alterations to make king parts to effect this ?—NOVICE.

Steam.—In an engine the back pressure is are inch on the piston, and actual pressure of eam-chest is 30lb. per square inch ; clearance piston and inside of the cylinder cover is ⅛in. ust the piston be from the end of the stroke at compression in order to compress the vapour der to the pressure of the steam in the steam a compound tandem engine the steam cut off the stroke in high-pressure cylinder, the dia. 20in. The areas of the two cylinders are as the initial pressure of the steam is 85lb. per above the atmosphere—viz., 15lb., what would sure of steam on large cylinder after leaving and would any of it act as back pressure ? If ch per square inch ? What would be average small cylinder ?—NOVICE.

Siphon.—I have a rain-water cistern, from sh to convey water to a small fountain 20ft. ; but the cistern is not high enough to give a as it is only 7ft. from the ground. To get a ssure, I have carried a pipe from cistern up 7ft., siphon, and then down to the fountain, having 6in. below bottom of cistern, making it the of the siphon. On the highest point of the he down pipe to fountain I have a plug. I p-tap and charge the down pipe to tap with lug tight and open stop tap, but I find it will What I want to know is whether I am working t principle of siphoning or not, as I want it to ut sucking. I may mention that the pipe from hon is ¾in., and the down pipe ⅝in. Would ny difference ?—PIPE TONGS.

Silica in Fluor Spar.—I shall be greatly someone would give a method of estimating a sample of impure fluor spar.—FER.

Aluminium Steel.—Will any reader ain how to determine the aluminium in alu- l ?—F. B. M.

[62189.]—**Settlement.**—A man settles property on wife, himself being one of two trustees. Can the settlement be annulled at the request of the wife ?—H.

[62190.]—**Register Paper Roll.**—Would some reader kindly inform me the best means of construction and fitting ribbon-paper roll, probably 12yds. in length, with reciprocating movement through ⅛in. space each time ? Have you any means of taking up again, mechanically, after passing over writing pad ?—MODEL-FITTER.

[62191.]—**Dies for Screw-Threading.**—I wish to make dies for screw-threading, from ¼in. up to 1in. ; how am I to proceed ? What are the important points to be attended to, so that I may have them cut well. I mean to make solid dies for all sizes, for which solid ones will do, as I think a screw can be threaded in shorter time by solid dies than by adjustable ones. What is the greatest size for which solid dies are made ? In my limited experience I have not seen them over ½in. Why are they not made for larger sizes ? I have services of blacksmith and use of screw-cutting lathe at command.—VERDANT.

[62192.]—**Telescope.**—Will any kind reader tell me what is the magnifying power of the best made binocular marine glasses ? I mean those constructed with 12 or 18 glasses. Are they equal in power to a 1½in. telescope, magnifying sixteen times ?—TOURIST.

[62193.]—**Parabolic Reflectors.**—Will some correspondent of "Ours" give particulars of the manufacture of parabolic reflectors used for search lights ?—Z.

[62194.]—**Lunar Sketching.**—At the last meeting of the Liverpool Astronomical Society some particulars were given of an improved method of making lunar sketches ; but there is no account of it in the *Journal.* Very likely other correspondents, besides myself, would like fuller details than appeared in the ENGLISH MECHANIC report.—ARTHUR MEE, Llanelly.

[62195.]—**Colliers' Grease.**—Can any of your readers give me a receipt for the manufacture of a good and cheap grease for colliery purposes ?—ROBERT MURRAY.

[62196.]—**Post Office Batteries.**—Could anyone give a drawing or description of the form of Dainell or other batteries at present used in the English Post Office ? What batteries do the French and German offices use ?—LONDINIENSIS.

[62197.]—**Nitrate of Silver Stains.**—Is there any way of getting these off the hands, except absolutely scraping them off, skin and all ? Also how can one get the stains out of one's clothes ? I find $AgNO_3$ leaves red stains ; but ammonia only turns them to a brownish yellow.—LONDINIENSIS.

[62198.]—**Light.**—I heard a lecturer the other day say :—"It is not merely by prisms, but by plates of glass, that we can disperse light," and went on to say that by looking through a sheet of glass at white paper one edge of the latter looks red, the other violet. This seems just the reverse from what Ganot says. Will some reader kindly explain ?—ELEM.

[62199.]—**Separation of Cream from Milk.**—In the Inventions Exhibition there was a method of extracting cream from milk by machinery. I would be glad to know the plan of operations. Also whence a small plant can be obtained, and the probable cost of same, with data, showing advantages over the well-known methods of scalding and skimming.—GRASS.

[62200.]—**Vertical Boiler.**—I wish to make a vertical boiler for model horizontal engine, cylinder, 2in. bore, 4in. stroke. Will someone kindly inform me the dimensions, thickness of charcoal plate, size of rivet, pressure required ; if tubes are necessary, how many, what kind and size ; diameter of safety-valve ?—A. E.

The Stafford-Eaves Dynamo.—Messrs. Stafford and Eaves, of Coventry, have sent us a photograph and particulars of a new dynamo they have recently constructed with an improved form of field-magnet, providing a direct circuit of low resistance for the magnetic lines of force. The armature is of the improved Gramme type, and the field-magnets are forged from the best wrought iron, the whole machine being so arranged that it can be run continuously with its nominal load, while eddy currents are reduced to a minimum. The following are details of a machine recently built for plating purposes:—Weight of machine, 4cwt. 2qr.; size of armature, 8½in. by 5in.; depth of core, 1⅜in.; material of core, charcoal iron rings stamped from No. 20 gauge; current in shunt coil, 12 ampères; current in external circuit, 138 ampères; E.M.F. at terminals, 6 volts; resistance of machine after five hours' run, armature, ·007 ohm, field-magnets, ·5 ohm; speed of machine, 640 revolutions per minute; number of circuits between brushes, four.

Industrial Partnerships.—A competition for essays on the principle of admitting workmen to a direct participation in the profits of an industrial enterprise, started by the Strasburg University, has recently taken place. Dr. Frommers gained the prize, and, according to the *Eisen Zeitung*, his arguments deal with the fact that the arrangement in question has never been other than a novel form of paying wages, in which, as a rule, only the better classes of workmen have participated. Attention is called to the circumstance that this plan has only been successfully tried where the results of a commercial undertaking are more or less directly dependent upon the workpeople, while it has not been found to answer where skilful management and a favourable situation of the market are the principal conditions of success. Moreover, the arrangement has never served to keep workmen away from social movements organised for their social welfare.

ANSWERS TO CORRESPONDENTS.

◆

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Tuesday evening, April 5, and unacknowledged elsewhere :—

J. T. GENT AND CO.—G. Birch and Co.—W. Watson and Co.—H. Thorpe.—G. Pottier.—J. Rawlinson.—J. Gillott and Sons.—G. Bruton.—G. B. S.—Quarryman.—Fred. Carre.—B Sc., Plymouth.—A. F. Shakespeare.—Eos.—H. H. D. B.—J. H.—Dusty Miller.

J. C. (The reason your questions were not inserted is primarily that they were of no interest to any one but yourself, and secondarily because it is simply impossible to insert even a moiety of the queries which reach us every week. You can soften the varnish by soaking with caustic potash, or you can burn it off with a painter's blowpipe lamp; but if you are wise you will do as we told you, and rub it off with glass-paper. You say you have tried that without effect. Try again, and add a little more elbow grease.)—BUNTING. (Varnish paint. Mix the ground colours with best copal varnish. Pigments of all shades are to be obtained ground in oil. To make ordinary paint, you mix with boiled oil and turps; for your purpose thin with copal varnish.)—INVENTOR. (Of what interest to our readers is such a query ? Send a description to the Secretary of the Admiralty, Whitehall, or get your M.P. to introduce it to their notice.)—W. H. R. BEDLINGTON. (Thin your oak varnish with turpentine.)—YOUNG HOPEFUL. (You must give some idea of what is the matter with your clock before an answer can be of use.)—W. NAROM. (For information about die-cutting and engraving, see pp. 209, 230, 255, 273, 296, 321, 338, 358, 409, Vol. XXXVI., and consult the indices generally. 2. You can purchase all requisite materials. 3. They are struck in the usual presses with dies.)—VERY POOR AMATEUR. (You will find an illustration of a simple ammeter in No. 991, and of a voltmeter in No. 1042. You should, however, look through the back volumes for much information on such subjects. 2. See indices for the air-pump. Must the tank be that shape, when a cylinder would be so much more convenient and procurable ?)—W. EARL. (You can use it, of course; but it is rather small for firing shells. It is not clear what you want to make; but perhaps you will find sufficient information in back volumes, or in Kentish's "Pyrotechnist's Treasury," London, Chatto and Windus.)—CHANDOS. (From any bookseller. See the catalogues issued by publishers.)—T. SLATER. (The only way to become an electrical engineer is to obtain work in the shops, either as an apprentice or articled pupil, while continuing your studies in connection with the science classes.)—AMATEUR. (Such water is certainly not fit to drink until filtered, boiled, and filtered again. No necessity to take it to an analyst, as his verdict is a foregone conclusion. If there is no other source of supply than a well, sink one of the Abyssinian tube wells; but collect all the rain-water you can.)—G. W. (If it is to be washable, why not paint at once ? At any rate, mix plenty of size with the distemper colour, and then give two coats of oak or copal varnish.)—VECTIS. (For air-gun, see No. 1094, and p. 43, last volume. There are illustrations also on pp. 499, 596, Vol. XL.)—AB INITIO. (Yes, from any respectable firm; but you should have a proper agreement in order to avoid any dispute. Those who work out and embody an idea would naturally consider themselves joint inventors, and possibly, if your idea is feasible, you would find firms ready to work it out on those conditions.)—CONFIDENCE. (If the invention is already so far complete that it can be described in a provisional specification, you should at once obtain such security as is afforded by the Patent Office. The application costs only a shilling or so more than the sovereign for the stamp, and you have then ten months in which to try the machine, &c., and prepare the complete specification. See the previous answer.)—CONSTANT READER. (We really do not know that there is any special term. Would not chain wheel do ? See Hints No. 5.)—TIRO TIRONUM. (We do not think there are any; but try the Finsbury Technical College, as some branches would be taught in mechanical engineering.)—F. H. ("The Smithy and Forge," Crosby Lockwood and Co., Stationers' Hall-court, E.C., price 2s. 6d.)—SCHOOLMASTER. (You should state what sort of cement it is. If, as we suspect, Portland, you will find great difficulty in removing it, and will probably break the vessel. If that leads to its disuse as a filter, it will be a benefit. Never use any filter that you cannot clean out and aërate the filtering medium. The late Prof. Guthrie's "Penny Water Cleaner," which he described in No. 965, is as good as anything for filtering water. Take a large flower-pot, and enlarge the hole at the bottom. Break up some well-burnt stock bricks into pieces, and place one of the larger pieces so that a corner projects through the hole; then reduce the other portions to, say,

with the horizontal plan
R its horizontal range:
during its flight, and g t
gravity. Then, we know

$$R = \frac{v^2 \sin.2\alpha}{g},$$ a

Hence, since $H = \frac{R}{n}$, w
mulæ—

$$\alpha = \tan.^{-}$$

If, however, it be requi
the resistance of the at
will involve v, and the
great difficulty. For a
result is nearly true.—J.

[62151.]—**Mechanics.**
of projection and t the
let α be the required an
time of flight to poin
$= \frac{t}{2}$, and if x = grea
have—

$$x = V\frac{t}{2}\sin.\alpha -$$

or— $$x = \frac{V t \sin.\alpha}{2} -$$

Differentiating this with
to zero, we have—

$$\frac{dx}{dt} = \frac{V \sin.\alpha}{2}$$

whence $t = \frac{2 V \sin.\alpha}{g}$, ar

Hence, range on horizonta

And from the question we

$$\frac{V^2}{g}\sin.2\alpha = n$$

or— $$2 \sin.\alpha \cos.\alpha =$$

Or— $$4 \cos.\alpha =$$

whence— $$\tan.\alpha$$

or— $$\alpha = \tan.^{-}$$

—J. E. GORE.

[62154.]—**Rhubarb.**—
scribes malic acid and oxal
the young stalks. Twenty
acrid salt has been detect
species. On the table lan
layas the plant flourishes in
a pleasant addition to th
traveller. A giant sort, g
for its leaves, used in packin
poisonous as food. *Vide*
and Practice of Horticultur
the abstraction of light a
the secretions of plants:—
Crocata, poisonous in our
innoxious in the lower tem
sky of Edinburgh." All
ness part with their pecu
blanch chicory, endive, d
move the bitter principle
nutty sweetness in its plac
have more flavour than th
Asparagus, beans, and pea
insipid and devoid of natura
cheated of a summer's sun.
of seakale growing on its
well-manured soil of a kitch
strong sulphurous sap of all
the same specimens—they
and transformed.—EOS.

UNANSWERED

*The numbers and titles of que
swered for five weeks are inserted
unanswered are repeated four we
our readers will look over the list,
they can for the benefit of their fell*

61509. Syrup for Cordials, p. 486
61524. Universal Cutter Frame,
61540. Portable Engine.—To Mr

61764. Hydraulic Bending, p. 57
61772. Lantern Transparencies,
61773. Compressed Oxygen, 574.
61776. Water Question, 574.
61779. Micro. Mounting, 574.
61785. Corn store, 574.
61806. G.E.R. Locos., 575.
61807. Organ Question, 575.
61809. Cyclometer, 575.

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the size of marbles or Spanish nuts, and nearly fill the pot with them. Soak all over night in water, boiling water if you like, and then set aside to drain. Now arrange the pot so that the water you want to clean drops into the middle of the chips of brick, and will trickle from the piece which projects at the bottom. After a few hours working, the water will be wholesome, filtered and well aërated. It is advisable to make two, so that one can be allowed to dry while the other is at work. 2. The apparatus named is a little wheel with sharp points, which makes holes in the stencil.—STUDENT. (The query was answered on p. 58; but if you want anything more, read Kennedy's "Mechanics of Machinery," Macmillan; Rankine's "Applied Mechanics," Griffin; Reuleaux's "Kinematics of Machinery," Macmillan; and Willis's "Principles of Mechanism," Longmans.)—P. O. P. (Sulphur is said to be effective; but it is not easy to fill the chimney with the fumes. Anything that will stop up the flue or prevent the access of air will put out the fire, especially if a little sulphur is sprinkled on the live coals. In your case, the chimney had no doubt become coked, and none of the brooms generally employed would have removed the caked soot. Scraping is necessary.)—[illegible]. (The cost of the materials will obviously depend on the quantity, and to a certain extent on the locality. The work is of very special character, and success depends much on the skill with which the oven is constructed. You will find sketches in No. 930, and other back numbers.)—DUSTY MILLER. (The book you refer to deals with the constructive details. Perhaps Mr. Reynolds's "Stationary Engine Driving," Lockwood and Co., 4s. 6d., will suit you.)—CONSTANT READER. (Try making them warm—as hot as boiling water. If you add copper you will make a brass.)—E. POWELL. (No. 594 long out of print.)—C. H. T. RATTLESNAKE. (We do not see how anyone can explain the differences in your quarterly gas consumption without examining the fittings and taking observations of the working of the engine. Assuming the governor of the gas engine to be in proper order, the consumption of gas will vary with the amount of work done by the engine, and it is quite possible for such differences as you give to occur with a gas-engine of two horse-power. Test the engine by the brake method, and compare with the readings of the meter, having the latter tested.)—[illegible]. (Venice turpentine is the resinous exudation from the Abies Larix, or larch tree; but is rarely met with in commerce. The article sold as Venice, Venus, or Venetian turpentine is made by dissolving rosin in ordinary turps.)—CASH. (We do not know whether it is a patent or not; but imagine that it is.)—A FRESH STARTER. (You cannot make the lamps themselves without the aid of rather expensive plant, and as to batteries, you will find ample information in many back numbers. See the index recently issued.)—JOHN T. DEWAR, Antwerp. (If you use soft solder (tin and lead), chloride of zinc or rosin will answer as the flux, the chloride being made by putting scraps of zinc into hydrochloric acid until it will dissolve no more. If hard solder, cut up brass pins into little bits, and use borax as the flux. The latter requires a much higher heat than the soft solder.)—J. M. H. (Depends entirely on the focus of the lens or combination, and no one can say whether the existing bellows camera will do without examination. Directions for making bellows camera have been often given. See No. 894, for instance.)—CROYDON. (See Nos. 997, 998, and the indices generally.)—HENRY J. LYON. (See Hints to Correspondents, No. 5. You will find all the information required in back volumes—most likely in the last.)—VICTOR NIELSEN. (If it is worth your while, or that of the makers, to send cliches of the blocks of the eyepieces, we will insert the letter. It is not worth our while to engrave them.)—J. CHARLES KING. (No; if the information is not forthcoming in Replies, the querist must go without it.)—ANXIOUS ENQUIRER. (They can oblige you to pay.)—F. GASS. (MSS. returned. We shrink with terror from a discussion on the features and measures of the Great Pyramid. We remember——but no matter. All these profitless discussions begin in the same way. Some modest and apparently inoffensive query or letter brings out some able but slightly erratic correspondent with a new theory about the Deluge, and then a stray allusion or two is eagerly seized on by fervid champions of all kinds of theories about all conceivable subjects. All readers will oblige us this week by *not* answering any statements about the catastrophe of fifty centuries ago.)

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CHESS.

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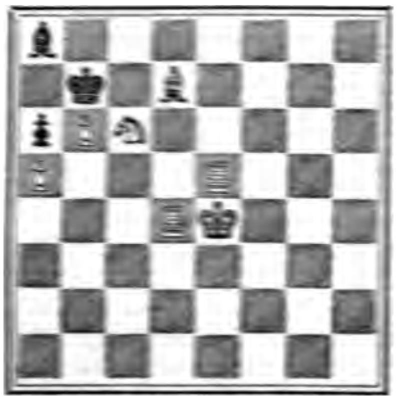

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White to play and mate in three moves.

SOLUTION TO [illegible]

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NOTICES TO CORRESPONDENTS.

CORRECT solutions to [illegible]

W. [illegible]

BLACK PAWN.—The [illegible] shall be inserted.

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Holloway's Ointment.—[illegible]

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Niblett's [illegible] wanted. [illegible]

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[illegible] **Compound Influence** MACHINE [illegible]

Wanted, [illegible] Machinery and Fittings [illegible]

Slide-Valve Cylinder, [illegible] stroke, [illegible] Exchange [illegible]

"**Spon's Dictionary of Engineering**," eight [illegible]

[illegible] **Auto**-[illegible]

"**Cassell's Popular Educator**," and [illegible]

[illegible] **Lathe** [illegible] Electric [illegible]

lish Mechanic
F SCIENCE AND ART.
APRIL 15, 1887.

M AND ITS USES.*

threatened "deluge" of
and the many attempts
ing made to utilise it as
for steam boilers, especi-
tile marine, the "practical
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in, geology, geographical
ry, chemistry, mining,
and transportation of
an appendix on the oil
eology of natural gas in
New York by C. A. Ash-
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and was consequently in
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has found a permanent
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a petroleum fountain near
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the petroleum used in the
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; but in 1852 the busi-
n Mr. Kier conceived the
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on worm surrounded by
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uminating oil of a light
he cannot be regarded as
at oil industry of Penn-
btedly was one of the
hich paved the way for far more extensive refining facilities. A few years afterwards the Pennsylvania Rock Oil Co. was formed; but obtained so little oil that they could not pay expenses. They sent samples of the crude oil to Prof. B. Silliman, jun., who made an exhaustive analysis, and reported that the company had in their possession a raw material from which, by simple and not expensive processes, they might manufacture very valuable products. In the summer of 1856 a Mr. Bissel happened to look in the window of a drug store in Broadway, and saw a remarkable showbill lying beside a bottle of Kier's petroleum. An examination of this show bill, which was intended to give an idea of how the "natural remedy" was obtained 400ft. beneath the earth's surface, did actually give Mr. Bissel an idea that the company's lands must be developed by artesian wells. In August, 1859, the first drill was started at Titusville; and on Saturday afternoon, August 28th, in that year, as the well-sinkers were about to quit for the day, the drill dropped into a crevice. The tools were withdrawn, and all retired until the Monday morning; but "Uncle Billy Smith" went to the boring on Sunday afternoon, and peering down saw that a fluid had risen to within 8ft. or 10ft. of the surface. He let down a piece of plugged tube, and withdrew it full of petroleum. The news soon spread, and when it was found that on fixing a pump the oil could be obtained at the rate of 25 barrels per day the "oil fever" soon set in. That was the commencement of the petroleum era in America. Since then enormous quantities of petroleum have been obtained in various parts of North America; but the wells or springs of that country are scarcely to be compared with those of Baku. The largest yield ever obtained from a well in the United States was at Thorn Creek, Butler co., Pa., where a well drilled in 1884 is said to have flowed for a few hours at the rate of nine or ten thousand barrels per day. At Balakhani, in the Baku district, a well yielded 36,570 barrels per day, which was considered something incredible: but last autumn another boring nearer the Bay of Baku delivered a fountain of oil at the extraordinary rate of 11,000 tons per day, or about three times as much as all the wells in America put together. So abundant is the oil in the district that the price at the well is about 3d. or 4d. a ton. On distillation the Baku naphtha does not yield much more than a third of the amount of the burning oil obtained from American petroleum, but the quantity of lubricating oil of different qualities is very large, about 43 per cent. Vaseline and benzine are obtained in proportions of 1 per cent. each, and there is 14 per cent. of liquid fuel or residuum. Where the oil itself is so low in price, the residuum of the stills cannot be a very expensive commodity, and as a matter of fact it is often sold in Baku for as little as 4d. per ton. As coal in the Black Sea can rarely be had for less than £2 per ton, it will readily be understood that there is every inducement to use the liquid fuel in Southern Russia for locomotive purposes as well as in the steam vessels plying on the Caspian Sea and the great rivers. The liquid generally used consists of the residuum of the crude oil after the burning oil has been removed by distillation, and it is obtained as a rule in the proportion of about 60 per cent.—containing, therefore, much hydrocarbon that might be separated in the form of lubricating oils. The theoretical evaporative power of the average petroleum refuse is about 16lb. of water per pound of the liquid fuel, while that of anthracite is little more than 12lb., at pressures of 120lb. per square inch. In practice, locomotives show a mean evaporation of 8lb. of water per pound of anthracite, while with the petroleum refuse an evaporation of over 12lb. is obtained in ordinary work. With the improvement adopted in the construction of furnaces to adapt them for burning the liquid fuel, the combustion is complete, and there is an entire absence of smoke. Although the price of the liquid fuel is increased enormously at even short distances from Baku, it is at 21s. per ton much cheaper than coal when tested by the cost per engine mile—about half, according to several experiments; but improved furnaces are being introduced, and the petroleum refuse is being largely utilised wherever it can be obtained. Steamers which can go to Baku for their fuel, use nothing but the refuse, and a recent trial of an improved furnace, devised by Lieut. Pashinin, showed that 15·6lb. of water were evaporated per pound of fuel. That was in the case of some steamers built for service on the Oxus, and it is believed that further experiments will lead to even better results—for Pashinin's furnace is being fitted to a large number of torpedo boats belonging to the Black Sea fleet, and though the supply of liquid fuel is now abundant, greater economy will be exercised than is the case at Baku, for the simple reason that the fuel-carrying capacity of torpedo boats is limited. A very great advantage in this connection is the absence of smoke. During the trial above mentioned a sheet of white paper was held at a height of 14in. above the funnel, and at the end of the test not a trace of soot could be detected. Petroleum and petroleum refuse have hitherto in this country been too costly compared with coal to lead to any extensive use of the liquid fuel in marine furnaces; but in the Caspian and on the Volga hundreds of steamers have had no other fuel for many years, and it is more than probable that before long petroleum will provide the majority of steam-vessels in Eastern waters with their prime mover. It will naturally be asked, if petroleum is found in such abundance in the Baku district, cannot it be obtained in paying quantities in other parts? The answer must undoubtedly be in the affirmative, with the addendum that more profit will be reaped than has hitherto been the case at Baku. In Burmah, as is well known, the oil fields cover a large area, and many parts of India are known to be sufficiently rich in oil to warrant the outlay of a good deal of capital in prospecting. Mr. Crew does not enter at length into the question of distribution; but he shows that petroleum is found in many parts of the world, and as he has dealt fully with the methods of treating it, and of utilising its different components, his work will be read with interest by many who are taking up the business of prospecting for oil.

---

n Petroleum. By BENJAMIN J.
ary Carey Baird and Co.; Lon-
151.

DUPLEX TELEPHONY.

ALTHOUGH the telephone has been in use for ten years, little has yet been done in "duplexing" the wires—probably because telephony is mainly carried on over short distances. The expense attending the erection of copper lines has, however, led those engaged in the work of promoting long-distance telephony to seek some means of increasing the capacity of the wires, and we believe experiments have been made by the American Telephone and Telegraph Company between New York and Philadelphia, a distance of 90 miles or so. It is obvious that if a wire of that length can have its capacity doubled by a system of duplexing, there are advantages which will more than outweigh the necessity for complicating the arrangements at the transmitting and receiving stations. The difficulties are much greater than in the case of the telegraph; but they can be surmounted by bringing the double-wire instruments at the terminal stations into inductive relation with both sides of the circuit by means of converting or repeating coils. In a paper read by Dr. A. M. Rosebrugh before the Canadian Institute, the author gives an account of a method of duplexing telephone lines which he devised some time ago and, by the advice of Prof. S. P. Thompson, patented in this country in 1885. In long-distance telephony the best results are obtained when two line wires are used, one being employed as a return, and Dr. Rosebrugh's object was to utilise the metallic circuit so that either two telephone subscribers or a telephone subscriber and a central office operator at each end could communicate simultaneously without interference. To accomplish that object, it is necessary to render the receiving telephones at the central office neutral to the subscriber's transmitters, and also to make the subscribers' receivers neutral or irresponsive to the transmitters at the central office. Dr. Rosebrugh solved the first problem with comparative ease by adopting the following plan. At each central office, and at each end of the metallic circuit, a subscriber's line was attached; but instead of using the ordinary receiver with a single coil, a telephone with a double coil was employed—one coil being inserted in one branch and the other in the other branch of the metallic circuit, the connections being so made that electrical currents traversing one coil would be neutralised by those traversing the other. That is to say, the coils were connected differentially, and the electrical currents set up from the subscribers' transmitters passed through the two coils in opposite directions, and consequently neutralised each other. Therefore, if two subscribers, one at each end of the metallic circuit were using the line, nothing would be heard in the central-office telephone. The problem how to render the subscribers' telephones neutral to the transmitters at the central office was far more difficult of solution, and Dr. Rosebrugh made many experiments before he succeeded in devising an arrangement which would answer. He ultimately found that the only solution was to so arrange the transmitters at the central office that both branches of the metallic circuit would be charged equally, simultaneously, and in opposite directions. By charging one wire positively and the other negatively, the electrical equilibrium can be disturbed without affecting that of the subscribers' lines. Dr. Rosebrugh has discovered several ways of accomplishing that, but in his paper he describes only two, which are presumably the methods he prefers. In the first he employs a transmitter with two induction coils, the primaries being connected either in series or in multiple arc, and the secondaries connected in circuit to the respective branches of the metallic circuit. In the other method repeating coils are used with one coil in each branch of the circuit, the coils being connected with each other, and also with an independent telephone circuit. The operation in the first case is as follows. The impulses imparted to the diaphragm by the voice vary the strength of the local battery circuit traversing the primaries of the two induction coils, thus generating currents in the secondaries which, in turn, create currents in the two branches of the metallic circuit, equally and simultaneously, if the two coils are properly balanced. Adjustable cores are used, so as to obtain perfect balancing. If the connections are properly made, the electrical impulses will traverse the circuit in opposite directions, the currents generated in one coil being reinforced by those in the other. The converse is also true, for if the connections of one coil are reversed, the currents generated are opposed by those in the other, and no current will traverse the circuit. The currents will, however, meet at the subscribers' lines, and being reinforced will proceed to earth through the subscribers' telephones. Advantage may be taken of this to use two sets of transmitters at the central office or at any point of the metallic circuit, and they may be connected in such a manner that the subscribers' telephones will be responsive to one, but not to the other. Dr. Rosebrugh would, however, prefer to give the subscriber both a return wire and a ground wire; also two sets of apparatus—one for ordinary use, the other on the duplex system for long-distance work. When repeating coils are used for charging the two branches of the metallic circuit, the latter are charged indirectly through the repeaters; the advantage of which is that two subscribers at each end of the circuit can communicate simultaneously without interference, one using a line connecting directly with the metallic circuit, the other a line connecting indirectly by means of the two repeating coils. The subscribers, it will be seen, have the advantage of two conductors instead of one; the resistance of the line is reduced by a half, and the working of long-distance telephone lines is much improved. This branch is confessedly only in its infancy; but the systems devised by Dr. Rosebrugh show something of the possibilities which may become actualities when the telephone itself is free from the restrictions placed upon efforts to develop its capabilities by those who hold the governing patents. Duplex telephony paves the way for, and will no doubt develop into, quadruplex; indeed, Dr. Rosebrugh indicates a means of enabling four subscribers at each end to use the line simultaneously; but we suspect that, so far as this country is concerned, we must wait until certain patents expire before any great development of telephony will be witnessed.

THE THEORY OF MACHINES.—VII.

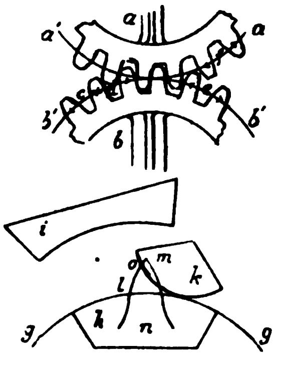
By Francis Campin, C.E.

Toothed Wheels and Racks.

WHERE large amounts of power are required to be transmitted, and more especially when the pressures between the driving and driven elements are subject to sudden and considerable variations, some more absolute means of transmission must be found than that furnished by the friction of belts, and this is admirably supplied by toothed wheels.

In Fig. 26, *a* and *b* represent portions of two toothed wheels geared together; *a′ a′* and *b′ b′* are portions of the arcs of the pitch circles of the wheels *a* and *b* respectively, and the wheels are intended to work together as they would by rolling on their pitch circles, on which must be set out the teeth to gear those of one wheel with those of the other.

FIG 26



The teeth must be so shaped as to work upon one another without friction—that is to say, they must pass over each other with a rolling motion.

The teeth are set out so that the distance between the centres of any two consecutive teeth measured on the pitch line is constant for both wheels; this distance is called the pitch of the teeth; it is indicated at *f*, and at *c*, *d*, and *e*.

If there were no clearance allowed, the pitch would be exactly twice the thickness of a tooth; but in order to allow of the free working, some clearance, greater or less, according to the degree of accuracy to be observed in the work, is allowed.

As the teeth of both wheels are necessarily of the same pitch, it follows that the number of teeth on the wheels will be as the diameters of the wheels, and therefore the number of revolutions inversely as the diameters of the wheels measured on the pitch line.

The form to be given to the teeth to insure their correct working is a curve generated by one circle rolling upon another for the point of the tooth, and within it for the root of the tooth.

If a circular arc have a point marked in its periphery, and it is allowed to roll upon the exterior of another circular arc, then will the point in its periphery trace a curve called an epicycloid, and if the first circular arc roll on the interior of the second, the curve described by the point in its periphery will
hypocycloid.

Now the way in which the teeth
out is thus. Let *g l g* be an arc of
circle of a wheel, and let it be mark
thin board or piece of metal, which
cut out to the exact curve of the p
and in this way let two moulds, or
be prepared, one having a convex
sponding to the pitch circle, and
concave edge corresponding to the sa
templates are shown at *h* and *i* in th

Let also a template *k* be prepared,
edge formed to the radius of the
circle decided upon for describing t
the teeth; this template is sho
Let the points on the pitch line cor
to the sides of the teeth be marked
l be one of them. Let *o* be the traci
the periphery of the template *k*.

Having adjusted the template *h* exa
pitch line *g l g*, place the template *k*
in such a position that the tracing p
cides with the point *l*; then let the
roll upon the template *h*, and the
will be drawn, which will be the
tooth.

Let, now, the template *h* be remov
template *i* carefully adjusted to the
g l g, and place the template *k* within
a position that the tracing point i
phery coincides again with the poi
let the template *k* roll within the
so as to trace the curve *l n*, which
required flank of the tooth. The
which the teeth will be cut off will
mined by practical convenience.

In actually setting out the patter
plates would not be shifted for eve
tooth; but several tops put in wit
plate *h* in its place; after which, the
being changed, the flanks of the te
put in, and a few teeth being thus se
can be marked out upon the wood
the pattern for the wheel is to be
the template thus obtained, and this
tinued around the pitch circle, all
will be delineated upon the pattern.

It is not, however, absolutely n
have a complete pattern of a toothe
there are wheel-moulding machines
of which, a few teeth being model
scribed above, the whole periphery
can be moulded in loam ready for
of a complete wheel.

In order to obtain correctly-form
is not necessary that the curves fo
point and root of the tooth should b
by the same generating circle, but or
generating circle of every two port
two teeth which come into actu
should be the same. Thus the *f*
driving tooth and the *face* of the d
being in contact, the face of the on
the flank of the other must be resp
epicycloid and a hypocycloid tra
same generating circle.

Again, the *face* of a driving too
flank of a driven tooth must be
the same generating circle—in
generating circle will satisfy the co
the same be used for the epicycloi
hypocycloid that is to work with it
number of wheels are required t
changeable, it is necessary that al
should be described by one genera
which should not have a diamete
half that of the smallest wheel; oth
tooth will not spread towards its ro
spreading is desirable for two reason
gives greater strength to the t
secondly, it obviates the tenden
material to crack at the root of the
cast iron is very liable to crack in
any re-entering angles that may occ

Having shown the way to draw t
is necessary to demonstate that
adopted is correct, and such that the
roll and not slide one upon the ot
obvious that if pure rolling cont
teeth is to be maintained, the pressu
transmitted from the tooth of the
that of the driven wheel must al
right angles to the common tangent a
of contact of the teeth.

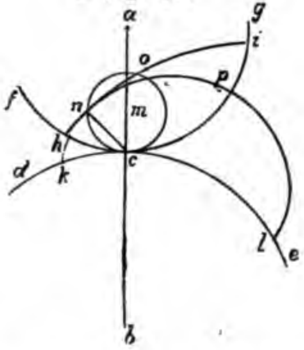
Furthermore, if the rotation of th
to be identical with that which wo
from the mere contact of their pi
the peripheral velocities must be

e their angular velocities inversely as
dii.

these points are attained by the use of
oidal curves is now to be shown.

g. 27, let *a b* be a straight line joining

FIG 27



tres of two wheels of which *f c g* and
spectively represent arcs of the pitch
and let *m* be a generating circle by
he epicycloid *k p e* and the hypocycloid
described; let also the epicycloid and
cloid be in contact at the point *n*, the
being that of contact of the pitch circles
wheels, and therefore of their inter-
by the straight line *a b*; join *c n*.

osing the tracing-point in the gene-
circle to be at *n*, then for an *infinitely*
ength both the cycloidal curves will
with (or osculate) a circle of the
n described from a centre *c*, and their
tangent at the point *n* will, therefore,
ght angles to *c n*, and the line of pres-
ll be in the direction *c n*; hence the
will roll without friction one upon the
nd a line (*n c*) normal to the common
at the point of contact *n* will meet the
rcles at their point of contact.

the osculating circle will be that
d about *c* at the distance *c n* is evident,
he position shown the generating circle
an infinitely small space, revolving
he point *c*, whether it be rolling upon
c l or within the arc *c i*, and the same
true for any other position of the point
lue of *c n* varying from *o* to the diameter
enerating circle.

each position the common perpendi-
the curves passes through the point of
of the pitch circles, it follows that the
es imparted through the curved sur-
ill be as *b c* is to *a c*, or inversely as the
the pitch circles, so that both conditions
are fulfilled.

ing at the case from a practical point of
nply, it is obvious that with any pair of
that may be made to work together, the
velocities *must* be inversely as the
the pitch circles; because the pitches
eeth on both wheels being necessarily
e (in order that they may gear together)
mber of teeth will vary as the circum-
s, and therefore as the radii of the pitch
so that the practical utility of investi-
these curves lies in enabling us to ob-
rms for the teeth, which will insure a
ling motion, and therefore freedom from
as between the teeth.

is article we purpose treating of the
ion of wheel and rack gearing to the
ation of force and velocity to produce
, varying, or intermittent movements
be required.

have a simple train of wheels, their
ill be, assuming a wheel and pinion on
termediate shaft, to establish a certain
tween the angular velocities of the first
shafts; thus, let there be four shafts,
being the driving shaft, and carrying
n, say, 1ft. in diameter (measured in
ase upon the pitch circle), and let this
gear with a wheel 4ft. in diameter, on
nd shaft; then the angular velocity of
nd shaft will be one-fourth of that of
shaft; on the second shaft let there be
yed a pinion, 1ft. in diameter, gearing
wheel 3ft. in diameter, on the third
then will the angular velocity of the
haft be one-third that of the second,
erefore, one-twelfth that of the first. Again, on the third shaft let there be keyed a pinion, 18in. in diameter, gearing into a wheel, 3ft. in diameter on the fourth shaft; then the angular velocity, or number of revolutions per minute of the fourth shaft will be half that of the third shaft, one-sixth that of the second, and one twenty-fourth that of the first shaft.

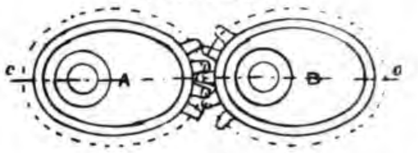
Thus a general formula may be expressed. Let *a*, *b*, *c*, &c., represent the diameters of the successive pinions, and A, B, C, &c., those of the corresponding wheels into which the pinions gear, then if R be the ratio of the angular velocities, or numbers of revolutions per minute of the first and last shafts; $R = \frac{a \times b \times c \times \&c.}{A \times B \times C \times \&c.}$ for a train of wheels of any length.

Applying this to the foregoing example, $R = \frac{1 \times 1 \times 1{\cdot}5}{4 \times 3 \times 3} = \frac{1}{24}$. The moments of force at the two ends will, by the principles already demonstrated, vary inversely as the angular velocities, and the work done will be the amount received by the machine less that absorbed by the friction of the bearings.

In many machine tools the work is only done in one direction, the return stroke being so much time lost in preparing for the next effective stroke. This is the case in planing, shaping, and slotting machines, in which the tool cuts in one direction only. It is evidently desirable to make the return stroke in as short a time as possible; the velocity of the forward or cutting stroke must depend upon the nature of the material being operated on.

One method of obtaining an accelerated return stroke where a crank motion or eccentric is used for actuating the cutting tool, consists in using toothed wheels of an elliptical form as shown in Fig. 28.

FIG 28



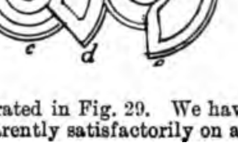
Let A be the driving and B the driven shaft. Now, assuming A to be revolving at a uniform velocity, it is evident that the angular velocity of B will vary, the relative velocities at any position in the revolution being inversely as, as the distances from the centres of A and B from the corresponding point of contact of the pitch lines of the wheels. In the position shown the shaft B will evidently have its maximum angular velocity, and this position should correspond to the centre of the return stroke. After half a revolution the point *c* on the driver will be in contact with the point *d* of the driven wheel, which latter will then have its minimum angular velocity, and will be exerting its maximum moment of force, the position corresponding to the cut being taken by the tool.

This arrangement possesses an advantage some others have not, which is conducive to smooth working: it is that although there are considerable variations in the velocity of the shaft B and its connections, they are brought about gradually: there is no sudden change such as would be likely to cause a snatching action, which is very detrimental to the joints of machines.

These elliptical wheels require to be set out with great care, in order that the proper contact of the pitch circles may obtain throughout the revolution.

Another arrangement for attaining the same end is illustrated in Fig. 29.

FIG. 29.



We have seen it working apparently satisfactorily on a slotting machine; but the change of velocity being instantaneous, must give rise to the snatching action referred to above, and this in heavy machines would probably be serious.

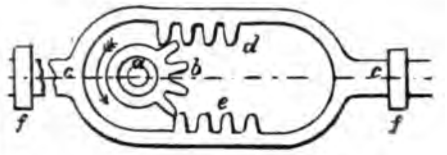
It will be seen that the contrivance consists of sectors of friction wheels combined in pairs; *a* is the driving and *b* the driven shaft.

The position shown is that corresponding to the middle of the return stroke; the segment *d d* is now acting upon the small segment *f f*, the peripheral lengths of the two segments being equal, imparting an accelerated velocity to the shaft *b*; as soon as the extreme ends of these segments are about to part, the segment *c c* gears with the segment *e e*, giving a slower velocity, but correspondingly increased force to the shaft *b*, and thus executing the working stroke; these segments must be very carefully arranged in order to insure their correct action at the points where the changes from one set to another occur.

It will be evident that by using a greater number of pairs of sectors a greater number of changes of velocity may be obtained during one revolution of the driving shaft; nor is this construction necessarily limited to combinations in which the driving and driven shaft make one complete revolution in the same time, for it will allow of an innumerable variety of movements.

The reciprocal rectilineal movement derived from a shaft revolving with uniform velocity, if obtained by means of a crank or an eccentric, will not itself be uniform in velocity; therefore, if a reciprocal rectilineal motion of uniform velocity is required, some other arrangement must be adopted. Such an arrangement is shown at Fig. 30;

FIG 30

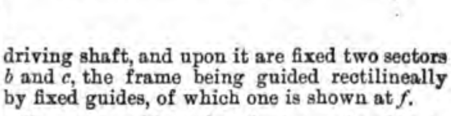


a is the driving shaft moving at a uniform velocity in the direction indicated by the arrow. Upon the shaft is keyed the toothed sector *b*, which gears alternately with the toothed racks *d* and *e* formed within the reciprocating element *c c*, carried in the guides *f f*, which secure its rectilineal movement.

The teeth on the sector *b* will act first upon the teeth of the upper rack, on leaving which they will gear with the lower rack, producing the return stroke, and throughout both strokes the velocity must be uniform, as the circumferential velocity of the pitch circle of the sector will be equalled by the rectilineal velocity of the pitch lines of the racks.

A motion similar to the above, but in which the velocities are not equal in both strokes, is shown at Fig. 31. In this arrangement *a* is the

FIG 31



driving shaft, and upon it are fixed two sectors *b* and *c*, the frame being guided rectilineally by fixed guides, of which one is shown at *f*.

Now, it is evident that the forward and backward strokes of the frame must be equal length; hence the lengths of the arcs of each sector must be equal, so that *b* being the sector of the greater radius, will have a less angle than the sector *c*; thus if the radius of *b* be twice that of *c*, the sector *b* must comprise one-third of a complete circle, and *c* two-thirds of a complete circle. Of course, in this construction the friction grooves must not be set in the same plane; the top friction groove may be set back as indicated by the shading lines at *g g*, the sector *c* being also set behind the sector *b*.

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YARROW'S GUIDE-BLADE SCREW PROPELLER.

AT the meeting of the Institution of Naval Architects in 1883, Mr. Thorneycroft described the experiments he had made with his then lately patented guide-blade screw propeller. In this invention the propeller is placed in a tube carrying guide blades at its after end, and the propeller itself has a large boss which gradually contracts the area of the stream flowing through, and at its rear end is of conical shape so as to gradually bring the stream solid again. The results obtained with these propellers, especially in launches and similar craft, have been so far satisfactory [illegible]

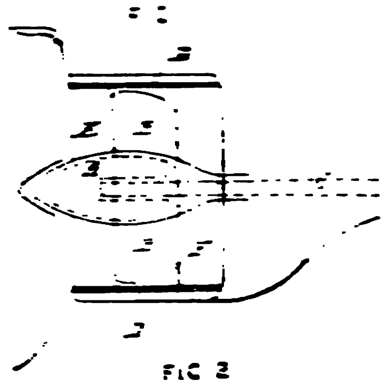
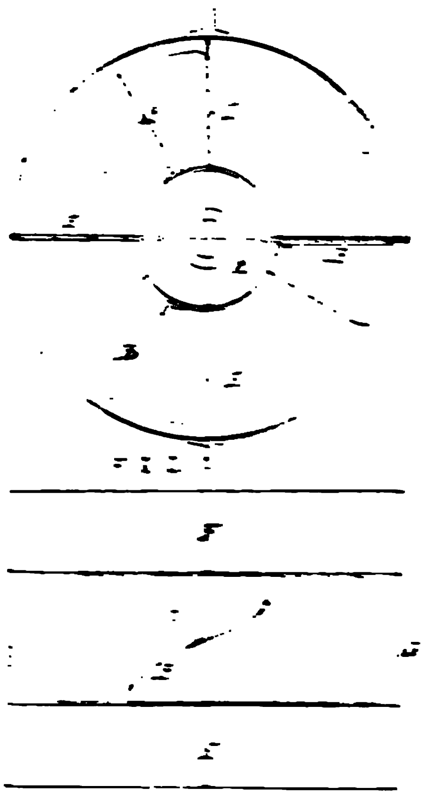


FIG. 2



from the centre line [illegible] do not cause [illegible] Mr. Yarrow [illegible] guiding surfaces [illegible] the accompanying [illegible] with guide [illegible] respectively [illegible] propeller and [illegible] propeller. [illegible] prevent [illegible] the apparatus.

[illegible]

dazzling whiteness of the nickel deposit. If this is desired, it is far better to use a separate bath, using anodes of suitable composition. The want of adhesion between the deposited coating and the article need not be feared if cleanliness be attended to and the article, while in the bath, be not touched by the hands. The bath should be neutral, or nearly so, slightly acid rather than alkaline. It is obvious that, as such a liquid has no detergent action on a soiled surface, scrupulous care must be taken in scouring and rinsing. Boiling alkaline solutions and a free use of powdered pumice and the scrubbing brush must on no account be neglected. A few words on the construction of the tanks. A stout wood box, which need not be watertight, is lined with sheet lead, the joints being blown, *not soldered*. An inner casing of wood which projects a few inches above the lead lining is necessary in order to avoid any chance of "short circuiting" or damage to the lead from the accidental falling of anodes or any article which might cut the lead. It is by no means a necessity that the lining should be such as to prevent the liquid getting to the lead.

PORTABLE DARK TENTS.*

THERE is very little doubt that the "box" form of tent, such as is now in general use, is the best that could be devised. Rival forms are few and by no means formidable competitors from the point of view of general utility. The "umbrella" (both for changing and development) is obviously open to many grave objections which it would perhaps be invidious to enumerate, while the changing box that compels the operator to handle his plates per a pair of armholes, and watch his movements through a pane of ruby glass, possesses what, to the writer, appears a fatal defect in interposing a barrier between the visual orb and its objective. In transferring an exposed plate from the dark slide to a light-tight receptacle pending development, only a very slight amount of skill would be necessary; but in taking an unexposed plate from its original package and putting it into the slide, considerable uncertainty would exist in the average mind as to whether it had been turned right side out or not. This is surely a big nail in the coffin of the "armhole" changing box, for the presence of the least qualm in connection with such an important matter destroys at once whatever other useful characteristics the well-intentioned piece of apparatus may possess.

Accepting then the box type of developing tent as the standard, and on the whole the most desirable for the purpose, one's remarks will necessarily be held as referring exclusively to it when dealing with the subject indicated by the title at the head of this article. Throughout the trade the words "dark tent" are taken to imply a similar concrete meaning. This points to the view that a consensus of experts are agreed upon the principle that what is, is best, in regard to the dark tent. Exception cannot readily be taken to this; it is only upon matters of detail that a fair quarrel can be picked with the makers. Some very peculiar notions as to the amount of space essential to the operations of development are in vogue amongst them. I have before maintained that anything under a 10 by 8 tent is practically useless. One made to this size permits elbow movement within a space 2ft. 4in. by 1ft. 7in.; little enough in all conscience. One maker, however, thinks this a prodigal waste, for he offers us a tent which, though blessed with most exemplary qualities in the way of what reads like phenomenal portability and lightness, is utterly spoilt by the paucity of movement it allows; for I submit that a working space of 18in. by 12in. is totally inadequate. True, the flexible adjunct is said to increase that space to 33in. and 48in. respectively; but, be it remarked, only when extended on a table. Such a tent, however serviceable in a room, would be of little use in the open air, or on the deck of a ship, or, indeed, in any outdoor situation. My ideal tent is one that could be laid under contribution either in or out of doors impartially.

Elbow-room, and plenty of it, is always necessary when developing. So, too, is water. The method of providing a reservoir of this indispensable fluid is usually crude, and never satisfactory. A small tank, with a hole in the bottom, is placed on the top of the tent when open, over another hole, and the supply is obtained and regulated by a piece of rubber tubing and our old friend the American water-clip. I could never understand why this tank—flatter, of course, but of increased area—should not be fixed inside the tent. It might be supplied as now from the outside, and controlled inside by a small tap—a neater and handier arrangement than the tube and clip from all points of sight. I understand that some such improvisation has been adopted by one maker. In regard to shelf accommodation, our tent is, as a rule, rather too generously treated. This is the age of concentrated developers and percentage solutions, and all that is needed for the bottles is a small ledge with a thin wire rail to hold them in their places. Space might thereby be economised and weight avoided. Turning to the sink, little more than sufficient outlet for six ounces of liquid is needed, whilst it seems to me that the flexible tray might be dispensed with altogether, and a double frame, made to size, which, when clamped, makes the plate to be developed from its own bottom, substituted for it.

VARNISHING INCANDESCENT LAMPS.

By NELSON K. CHERRILL.

IN a recent number of the *Electrician* it is mentioned that Messrs. Siemens and Halske have recently adopted the system of dipping lamps in a thin semi-transparent varnish to obtain the effect of ground glass. As the writer has had much experience in this class of work, a few notes of the best mode of procedure may be of interest. The application of various modifications to the normal appearance of a lamp by means of varnish either coloured or plain is by no means a novel expedient, and a similar plan has, I believe, been commonly employed in many places for decorative work. The most important point in the application of varnish to a lamp is to get it to dry just in the right condition. Most kinds of varnish that will dry "bright" under ordinary circumstances will become "matt" if subjected to a chill, or to the action of damp during the drying, and at the same time many varnishes intended to dry with a "matt" surface, that would represent ground glass, dry "bright" if the conditions of drying are not quite suitable. The class of varnish best adapted to this kind of work is what is known as photographer's negative varnish. This class of varnish dries almost as hard as the glass itself, and when well applied is very durable. When coloured lamps are needed the varnish should be of a quality to dry "bright," but when the effect of ground glass only is required the simplest way is to use what is known as "retouching" varnish, which gives a "matt" surface at once. In default of this, the ordinary negative varnish can be easily modified to give the desired surface by the addition of a little weaker alcohol, which almost always has the desired effect; but if there is any difficulty a little common resin, which chills very easily in drying, may be added to the varnish. As to the mode of applying the varnish to the lamps, the best plan is to hang them on a frame by their contacts, so that a current can be passed through them during the operation. The lamps should be well washed in warm water in which there has been dissolved a liberal dose of soda; a thorough rinse with fresh cold water should be given, and the bulbs should then be carefully wiped quite dry with clean linen rags. If the work is to be very nicely done, the operator who hangs up the lamps on the screen should have on linen gloves, as finger marks on the glass are apt to show when the whole process is finished. The varnish is poured into an upright glass vessel large enough to contain the lamp; a common drinking glass is as good as anything if large enough to admit the lamp. In pouring out the varnish care should be taken not to disturb any sediment which may be at the bottom, and if not quite clear it should be filtered, as it is of the greatest importance to avoid any small floating particle, which would cause spots or streaks on the finished surface. All being ready, if the varnish is to dry bright, *i.e.*, for coloured lamps, &c., switch on the current to the lamp for a few moments, so as to render it slightly warm. Then turn it off, and taking the glass of varnish in the left hand, raise it under the lamp until the whole globe is immersed. If the lamp is in any kind of rigid fitting it will be very easy to immerse it, but if it is merely hung on a couple of wires, it will require the aid of a little instrument, consisting of a forked piece of wood, to push the globe down into the varnish. As soon as the varnish entirely covers the globe lower the glass with one steady movement, so that the draining off the superfluous varnish shall be commenced in one even wave all over the globe; any hesitation or pausing in the motion of the glass will be almost sure to cause a line on the finished lamp. As soon as the tumbler of varnish is quite clear from the lamp turn on the current again, and leave it running, while several more lamps are being done. When about twelve lamps have been varnished the first will be ready to come off. But a little care must be taken till the lamp is quite cold, as some varnishes will finger mark readily at this stage. If the varnish is to dry "matt" the lamp should be plunged quite cold, and no current should be put into the lamp till the varnish has chilled all over, then a little warmth will aid the drying, and will also harden the varnish. Almost any colour can be given to the varnish by the simple use of Judson's dyes, which will readily mix with the varnish and impart their char
tints. Blue is the most difficult colour to
satisfactorily, as the dye does not seem to
well with the varnish as the other colc
besides, the colour is spoilt by the yellov
the light. To avoid this part of the diffi
lamps which are to be used blue should l
hot as possible, while those for red o
colours may be comparatively cool, th
especially so. It goes without saying th
testing of the lamps must be finished b
varnishing is commenced. A pleasing
sometimes produced for purely decorative
using a little dye with the "matt" varni
Electrician.

THE ACTION OF CERTAIN W.
ON LEAD PIPES.

THE following communications relati
action of Sheffield water on le
have been addressed by Mr. A. H. A
borough analyst, to the local papers. His
apply to other waters besides that su
Sheffield:—

"As I find there exist many misconce
the subject of the action of Sheffield wate
pipes, I shall be glad if you will afford me
place the facts plainly before your readers
summer of 1885 a medical man in the tov
the attention of Dr. Sinclair White (the
Officer of Health) to certain cases of u
lead-poisoning, of which the origin was ob
endeavouring to discover the source of the
Dr. White was led to suspect the Compan
Dr. White consequently instituted a sy
inquiry on the subject, and submitted t
analysis samples of water, amounting in t
gate to upwards of three hundred. The r
the investigation and the conclusions t
were embodied in a report presented by D
to the Health Committee on January 2
The investigation showed that at the tim
periments were made (i.e., the summer and
of 1885) the water derived from the A
Strines reservoirs, and distributed to th
lying parts of the town by means of the
Dam, had practically no action on lead p
water drawn from ordinary house taps co
no appreciable quantity of lead, even
where it had stood in the pipes al
On the other hand, in every instance i
water was drawn from taps in houses
with the Redmires water, distributed
higher districts of the town by means
Hadfield Reservoir, a very notable qua
lead was present. When the water had s
the lead pipes all night the proportion of
some cases exceeded half a grain per gal
water drawn from the same taps in the af
the proportion of lead was considerably l
still such as deserved consideration. Alth
the time the waters were submitted to m
ignorant of their origin, in every insta
results of the analysis enabled the wate
distinctly classified, the samples obtaine
houses supplied with the high-level water al
taining serious quantities of lead.

"Meanwhile, Dr. White had heard of an
tigated some scores of cases of undoubte
poisoning, which were not traceable to the
tion of the persons affected. On the othe
every one of these cases occurred in hou
plied with high-level water, and analysis
the tap-water to be contaminated with le
serious extent. The effects of chron
poisoning vary greatly with different indi
In the milder forms indigestion, constipatio
in the abdomen, and pains in the limbs wi
most prominent symptoms. In severe case
sis of the wrist and hand will be prod
granular disease of the kidneys appears to b
connected with the graver cases of lead-po
Some of the symptoms being obscure, and
to various other diseases, the existence
poisoning is liable to be overlooked. A
blue line along the edges of the gums is o
most constant and characteristic sympton
proportion of lead which is generally consi
render water seriously objectionable
twentieth of a grain per gallon: but there
reason to believe that in cases in which
effects have been observed, the proportion
has considerably exceeded this limit. But
not be supposed that there is any danger i
ing a glass of water. It is not the single
a dozen doses, which will produce any ill
but the constant use of such contaminate
Lead is a cumulative poison, and each su
dose becomes stored up in certain organs
body until the poisonous effects ensue. F
it must not be supposed that every one is
susceptible to the effects of lead, there being
difference in this respect. If it were not
should not find the authentic cases of lead
ing produced by Redmires water limited t
scores, but we should have sufferers in

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* Extracted from a paper by MARSTON MOORE, in the *British Journal of Photography*.

This consideration shows that there
ion for a public scare in Sheffield on
t of lead-poisoning; but it equally
those who pooh-pooh the whole subject,
ey are in the happy positión of being
forget that what is sauce for the goose
ocessity sauce for the gander.
ing instance of the way in which lead-
nay occur is to be found in the follow-
tion of my own domestic experience.
ear since a member of my family
m symptoms which her medical adviser
due to lead-poisoning. The blue line on
vas well marked, while the pains in the
nd limbs were very severe. The water
the tap the first thing in the morning
alf a grain of lead per gallon, and about
roportion after being allowed to run.
the water through a Maignen's carbon
trace of lead was removed; but tea
such pure water sometimes contained
ers of a grain of lead per gallon.
owed that the tea as bought was free
, and for some time I was puzzled
t for its presence. It was after-
d that the furr or deposit inside
contained a considerable proportion of
of which became dissolved in the water
. The kettle being replaced by a new
mptoms of lead-poisoning disappeared
er treatment. I attribute the lead in
to a servant having habitually filled
rom the hot-water tap. Hot water acts
pipe much more vigorously than cold.
e present time, the water drawn from
ter taps at my house in Park-lane con-
an insignificant trace of lead, except
ing all night in the pipes, while on the
the hot-water taps give water contain-
alf a grain of lead per gallon, however
vater may be permitted to run. The
ordinary householder should deduce
foregoing description is sufficiently
Vhether it would be practically possible
some substitute for lead pipes, or to
water supplied to Sheffield from acting
ithout affecting its softness and other
ties), are questions which I propose to
second letter, should you consider this
publication."

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revious letter I described the extent to
Sheffield water had been found to act
explained that the experiments made
wed that the injurious action on lead
found practically to be limited to the
ed from the Redmires reservoirs, dis-
the higher parts of the town by means
lfield dam. I further stated that hot
up the lead more readily than cold, that
action of repeated small doses which
eared, and that certain kinds of domestic
ved the lead from the water entirely.
course, be fully understood that the
vater, as delivered from the company's
bsolutely free from lead; but it takes
ble and sometimes dangerous quantities
tal from the lead service pipes with
fterwards comes in contact. Why the
water from Redmires should have this
nd the water from Strines and Agden,
o the low-lying districts of the town by
e Godfrey reservoir, should be inert, is
only point in dispute, and is evidently
nce in relation to the means proposed
tment of the water. I may add that I
being convinced that the tendency of
res water to act on lead is a constant
rtainly is much less active now than it
autumn of 1885, and there is some
ppese that the tendency to act on lead
come grave during recent years.
to avoid the corrosion of service pipes
some substitute for ordinary lead has
proposed. Thus, tin-lined lead pipes
y efficient in cases where it is possible
complete interior protective coating of
however, in practice is very difficult,
oy of lead and tin is as bad or worse than
Pipes made wholly of tin I believe cost
ur times as much as lead pipes. Iron
t readily lend themselves to the require-
nternal plumbing, and there are other
es connected with their use. Anything
lesale substitution of the lead pipes
been generally used in the past would
ormous expense on the property owners
l, and the adoption of such a course
inly be avoided if any suitable alterna-
It would seem on all grounds far pre-
subject the Redmires water—which is
art of the Sheffield supply the experi-
Dr. White and myself have shown to
ious tendency to act on lead pipes—to
before it enters the Company's mains
to change the nature of the service
ust to domestic filters or other means of
he lead which the water may have taken
up. It is admitted on all hands that such treatment of moorland water liable to act on lead is perfectly practicable, the only difference being as to the most efficient and simple means of treatment that can be adopted. At this point a short history of the subject may not be out of place. At the time when it was proposed to supply Glasgow with the extremely pure and soft water from Loch Katrine, it was held by many that the tendency of the water to act on lead would be a serious danger to the inhabitants of Glasgow. On the other hand, it was found that the power of the water to corrode lead was entirely destroyed by previously subjecting the water to contact with old red sandstone or with limestone, and it appears highly probable that the practical immunity of the inhabitants of Glasgow from lead-poisoning is due to the conveyance of water for considerable distances through an aqueduct composed in large part of these materials. Some years ago a very serious epidemic of lead-poisoning arose in Huddersfield. Investigation showed the cause to be confined to those districts of the town supplied with water from either one or two of the fonr reservoirs on which Huddersfield is dependent. The question was investigated by Mr. Jarmain (the Borough Analyst for Huddersfield), who attributed the action of the water of these two reservoirs on lead to the presence of traces of acid derived from the peat and ochreous springs of the collecting grounds, and he advised the Corporation, who were the suppliers of the water, to adopt a system of neutralising the acid by treating the water with a small quantity of lime or limestone. In 1882, Mr. J. J. Milnes, a solicitor practising in Huddersfield, was wholly disabled by lead-poisoning, his limbs being completely paralysed. He consequently brought an action for damages against the Huddersfield Corporation. The fact of lead-poisoning and its origin in the Huddersfield water was admitted, and I believe the jury gave damages for Mr. Milnes accordingly; but the Corporation appealed on a point of law—namely, whether they were liable for the action of the water on the lead service pipes, which were not under their control, the water as supplied by them from the iron mains being free from lead. The case was carried from court to court, and ultimately a decision was given by the House of Lords in favour of the Corporation. A year or two later an outbreak of lead-poisoning occurred at Keighley when the inhabitants were supplied with water from a new reservoir. In one instance actual death occurred, which the coroner's jury considered to have been accelerated by lead-poisoning. On the recommendation of Mr. Jarmain, the reservoir water was caused to pass for eighty yards through an aqueduct built of limestone, and into which a certain small amount of quicklime was thrown every day. Since this simple and economical remedy has been in use the Keighley water has ceased to act on lead, and the lead-poisoning there has wholly disappeared. The limestone is readily kept in order by brushing its surface every few weeks with a coarse broom, which clears the surface from the deposited peaty matter, and this subsequently settles readily into a small depositing tank. It is an interesting and important fact in connection with the method of treatment adopted at Keighley, that the hardness of the water is not materially increased, the alteration never exceeding one degree, an amount quite insignificant either from a domestic or manufacturing point of view."

PHYSIOLOGICAL ACTION OF NITROUS-OXIDE GAS.

DR. DUDLEY BUXTON has communicated two valuable papers upon the above subject to the Odontological Society, based upon numerous clinical observations and experiments. The effects of nitrous oxide inhalation upon the mammalian organisms are, he says, broadly speaking—(1) a condition of anæsthesia; (2) an emotional state, provoking a sensation of exhilaration—in fact, it plays the *rôle* of a stimulant; (3) it gives rise to modifications of the respiratory and (4) circulatory systems; and (5) provokes marked muscular movements, which may be classed as (*a*) rigidity and (*b*) jactitations. The anæsthesia produced by nitrous oxide is not dependent upon analgesia or loss of sensation of painful impressions of the sensory end-organs, such as that produced by cocaine, &c., or upon failure of the conducting sensory nerves, for sensation is retained until the perceptive powers themselves cease to receive; moreover, there is immediately anterior to the loss of consciousness a hyper-æsthetic stage, therefore it may be concluded that the nerve centres are acted upon. The ways by which nitrous oxide may enter the system, and is enabled to produce its special effects, are—either that it gives rise to other bodies by changes in its chemical form, or by acting as an irrespirable gas and causing asphyxia, or by exercising a specific action just as strychnine does. Dr. Frankland came to the conclusion that nitrous oxide was not decomposed during its sojourn in the body, basing his opinion upon analyses made of the air expired by rabbits when confined in an atmosphere of mixed air and nitrous oxide. In the first stage of asphyxia, that of dyspnœa, there is an increase in the respiratory movements, both inspiratory and expiratory; in the second, a dominance of the expiratory efforts, culminating in general convulsions; in the last, exhaustion, with long-drawn inspirations, gradually dying out. The blood-pressure during the first and second stages rapidly rises. Dr. Dudley Buxton has never observed an increase in the expiratory movements when HO_2 has been administered, which are merely increased in number and depth, or expiratory convulsions, notwithstanding the gas has been pushed to its utmost limit, and from a large number of sphygmographic tracings the tension in the arteries has been lower than normal. In experiments upon dogs, Dr. Buxton found that where a trephine-hole was made through the skull during the inhalation of the gas the brain pulsations became more forcible and somewhat hurried; then the brain substance was seen to swell up, until at last it actually protruded through the aperture; whereas, in a similar experiment, with the trachea occluded, the brain receded, sinking away from the opening. Other experiments showed that the heart's action was but little interfered with by nitrous oxide, even where the inhalations were pushed until respiration was interrupted; during asphyxia, on the other hand, a rapid and continuous increase in blood-pressure invariably occurred. The dose of nitrous oxide required to produce insensibility varies very considerably in different persons—a fact which supports the view that nitrous oxide exerts a specific action on the nerve centres. Dr. Buxton also discusses many other interesting points in the action of the gas, such as the occurrence of hallucinations.—*Lancet.*

THE MAKING OF BRITAIN.

IN a remarkably interesting address on the "Making of Britain," delivered in the lecture hall of the University Museum, Oxford, and published this month in *Macmillan's Magazine*, Prof. Archibald Geikie says:—

Let us try to raise a little the curtain of obscurity that hangs over that far-off time when the earliest human inhabitants found their way to this region. The first and most memorable feature in the topography of that dim antiquity is one about which there can hardly be any doubt. Britain was not yet an island. The downs of Kent ran on across what is now the Strait of Dover, and joined the downs of Picardy. A large tract of the bed of the North Sea, all the southern part at least, was then dry land—a wide plain, across which the Thames meandered northward to join the Rhine. Whether Ireland had already been separated from the rest of Britain has not yet been ascertained; but England and Scotland were parts of the Continent, and prolonged the dry land of Europe boldly westward into the Atlantic Ocean. It was over these downs now lost, and across these plains now submerged beneath the sea, that the first human population entered our region. Judged by the relics they have left behind them of their handiwork, these earliest Britons must have been a race of rude savages, fashioning their weapons and tools out of flint and out of the bones of the animals they killed in the chase: clad in skins, living in caves, rock-shelters, and holes dug in the earth; and waging incessant warfare, if not with each other, at least with a host of wild beasts of the field, and with a climate more inclement than any now to be found within the bounds of Europe.

At the time of its greatest rigour, the climate of the north-west of Europe, during these remote ages, resembled that of northern Greenland at the present day. Vast fields of ice and snow lay over all the northern and central parts of Britain. One wide glacier, descending from Scandinavia, extended across the site of the North Sea, and, joining the English ice, advanced southward nearly as far as London. The ice that streamed off the west of Scotland and Ireland went out into the Atlantic as one widely-extending wall which cumbered the ocean with icebergs. The only part of the country not then invaded by the northern ice, and, therefore, habitable by man, was the southern strip that stretched from France and the mouth of the Thames to the Bristol Channel. But so great was the cold of winter that the ground in that southern tract was probably frozen hard for some depth, and only melted at the surface in summer. The rapid thawing of the snows in warm weather gave rise to floods that swelled the streams and deluged the surface of the country. Truly a most inhospitable time! One might well wonder what could have brought even the most forlorn race of men to these forbidding and ice-bound shores. But, in all probability, man was in the country before the climate became so severe, and was gradually driven southward by the increase of the cold and the advance of the ice.

Of the animals that were contemporaneous with man during these dreary centuries some relics have been preserved. We know that the reindeer wandered over the west of Europe as far, at least, as the south of France. The musk sheep, too, the glutton, the arctic fox, the lemming, and other truly northern forms of life, pushed southward by the advance of the ice fields, roamed over Britain and central Europe. With these still living species others appeared which have long been extinct, such as the hairy mammoth and the woolly rhinoceros, both of which have left their bones in many parts of the south of England.

But the temperature was not continuously Arctic. There came intervals of milder seasons, when the ground thawed, and the snow disappeared, and the glaciers shrank away northward. During these more congenial periods, animals of temperate and southern climes found their way into the west and north. In the valley of the Thames, for instance, elephants and rhinoceroses browsed on luxuriant herbage. Among the glades, on either side, the stag and roe and the huge antlered Irish elk found ample pasturage. Herds of urus and wild bison moved across the plain; and in the woods the brown bear, the grizzly bear, and the wild boar found a home. In the wake of this abundant animal life came the carnivora that preyed upon it. Among the sounds familiar to human ears all along the valley were the nightly roar of the lion, the yell of the wild cat, the howl of the hyæna, and the bay of the wolf. The river itself teemed with life. In its waters the African hippopotamus gambolled and the beaver built his dams.

Slow secular changes that influenced the climate once more brought back the cold, and drove southward this abundant animal life. As the snow and ice returned, the contest between frost and warmth gave rise to floods that swept across the frozen ground and strewed it with loose deposits, among which human implements and the bones of animals, both of northern and southern types, were mingled together. How far these animals were really coeval in the country, or whether their apparent association is not the result of the accidental mixing up of their remains, is an interesting problem not yet solved. Indeed, the story of what are called the "valley-gravels" is still very imperfectly understood, and offers many attractions to the enthusiastic observer.

Let us now come down the stream of time, across the long series of centuries that intervened between the Ice Age and the beginning of history, and look at the aspect presented by the country when the Romans entered it nineteen hundred years ago. What a momentous change had in this long interval passed over it! First, and most important of all, Britain was no longer a part of the continent, but had become an island, separated then, as now, by a strip of rough sea-channel from the nearest part of Europe. The climate, too, had changed; snow-fields and glaciers had vanished; the summers and winters had become much what they are still. Of the characteristic animals, some had disappeared, others had become rare. The lion, hyæna, rhinoceros, elephant and hippopotamus, for instance, had retreated to more southern latitudes; but the wolf, brown bear, and wild boar still haunted the forests. The early tribe of men, too, who made the flint weapons found in the valley-gravels had been driven away or been swallowed up by successive waves of immigrants from the great family of the Celts, who were now the dominant race in these islands.

In trying to account for such great changes in the character of the outer aspect of Britain, a wide range of investigation opens out to us, wherein but little progress has yet been made. For example, what were the circumstances under which Britain became an island? That this geological revolution was mainly due to a subsidence of the region can hardly be doubted. To this day, between tide marks, or below low water, we can still see the stumps of trees standing where they grew, and beds of peat containing nuts and other vestiges of a land vegetation. These "submerged forests" are proofs of a comparatively recent sinking, and are, no doubt, to be regarded as relics of the general mantle of wood and bog that covered the country at the time of the downward movement. The floor of the North Sea still preserves many of the features which must have marked the former wide terrestrial plain that occupied its site. From the [illegible] the line of cliff is prolonged as a steep submarine bank for many miles towards the coast of Denmark, broken by two gaps, [illegible] the westernmost of which may have been cut by the Thames, while the easternmost gave passage to the Rhine. Was the subsidence slow and tranquil, or was it sudden, and accompanied with violent earthquakes that devastated the lower grounds of western Europe?

The last connecting link between Britain and the continent was probably the line of chalk-ridge between Dover and Calais. There is some reason to surmise that it survived the submergence of the northern plain. Along this narrow ridge the earliest Celtic immigrants may have made their way. Its ultimate disappearance is probably referable rather to erosion at the surface than to underground movements. Attacked on the one side by the breakers driven against it by the south-western gales from the Atlantic, and on the other by those of the North Sea, it would eventually be cut through. When once the tides of the two seas united, their progress for a time would be comparatively rapid in sawing down the soft chalk, in widening for themselves a passage and deepening it as far as the downward limit of their erosive power. But to this day the narrows of the strait remain so shallow that, as has often been said, St. Paul's Cathedral, if set down there, would rise half out of the water.

Since the subsidence of the great plain, other manifestations of underground energy have shown themselves within the British area. Some portions of the land have been elevated, and in the selvage of uplifted coast-line relics of the human occupants of the country have been found. In other places, renewed depression has been suspected to have occurred. But the evidence for these upward and downward movements deserves further careful investigation both from the geological and the historical side.

Though on the whole singularly free from those more violent exhibitions of subterranean activity which, as within the last few days, have carried death and destruction far and wide through some of the fairest regions of the earth's surface, Britain has from time to time been visited by earthquakes of severity enough to damage public buildings. The cathedral of St. David's, in its uneven floor and dislocated walls, still bears witness to the shock which six hundred years ago did so much injury to the churches of the west of England. But though a formidable catalogue has been drawn up of the earthquakes experienced within the limits of these islands, it is not to that kind of underground disturbance that much permanent alteration of the surface of the country is to be attributed.

At the dawn of history the general appearance of this country must have presented in many respects a contrast to that which we see now; and notably in the wide spread of its forests, in the abundance of its bogs and fens, and (through the northern districts) in the prodigious number of its lakes.

At the first coming of the Romans by far the larger part of the country was probably covered with wood. During the centuries of Roman occupation some of the less dense parts of the woodland were cleared. In driving their magnificent straight highways through the country, the Roman legionaries felled the trees for seventy yards on each side of them to secure them from the arrows of a lurking foe. So stupendous was the labour involved in this task, that they gladly avoided forests, where that was possible, and sometimes even swung their roads to right or left to keep clear of these formidable obstacles. For many hundreds of years after the departure of the legions, vast tracts of primeval forest remained as impenetrable barriers between different tribes. In these natural fastnesses the wolf, brown bear, and wild boar still found a secure retreat. Even as late as the 12th century the woods to the north of London swarmed with wild boars and wild oxen. Everywhere, too, the broken men of the community betook themselves to these impenetrable retreats, where they lived by the chase, and whence they issued for plunder and bloodshed. The forests were thus from time immemorial a singularly important element in the topography. They have now almost entirely disappeared, and their former sites have as yet only been partially determined, though much may doubtless still be done in making our knowledge of them more complete.

In connection with this subject it should be remembered that, in many instances, the areas of wood and open land have in the course of generations completely changed places. The wide belts of clay-soil that sweep across the island, being specially adapted for the growth of trees, were originally densely timbered. But the process of clearance led to the recognition of the fact that these clay-soils were also eminently fitted for the purposes of agriculture: hence, by degrees, the sites of the ancient forests were turned into cornfields and meadows. On the other hand, the open tracts of lighter soil, where the earlier settlers established themselves, were gradually abandoned, and lapsed into wastes of scrub and copsewood.

The fens and bogs of Britain played likewise a large part in the attack and defence of the country in Roman and later times. They were of two kinds. One series lay on the coast, especially in sheltered inlets of the sea, and were liable to inundation by high tides. The most notable of these was the wide tract of low, swampy land at the head of the Wash, our Fenland—an area where, secure in their amphibious retreats, descendants of the Celtic population preserved their independence not only through Roman but through Saxon times, if indeed, as Mr. Freeman conjectures, outlying settlements of them may not have lingered on till the coming of the Normans. The other sort of fens were those formed in the interior of the country by the gradual encroachment of marshy vegetation over tracts previously occupied by shallow sheets of fresh water and over flat land. It was in these swamps that the Caledonians, according to the exaggerated statement of Xiphiline, concealed themselves for many days at a time, with only their heads projecting above the mire. At a far later time the peat-bogs of the debateable land between England and Scotland formed an important line of advance and retreat to the freebooters of the border, who could pick their way through sloughs that to less practised eyes were impassable.

One of the distinguishing features among the topographical changes of the last few hundred years has been the disappearance of a vast number of these fens and bogs. In some cases they have been gradually silted up by natural processes; but a good many have no doubt been artificially drained. The sites are still preserved in such Saxon names as Bogside, Bogend, Mossflats; and where other human record is gone, the black peaty soil remains to mark where they once lay. It would not be impossible, with the help of such pieces of evidence and a study of the present contours of the ground, to map out in many districts, now well drained and cultivated, the swamps that hemmed in the progress of our ancestors.

No one looking at the present maps of the North of England and Scotland would be led to suspect what a large number of lakes once dotted the surface of these northern regions. Yet if he turns to old maps, such as those of Timothy Pont, published some three hundred years ago, he will notice many sheets of water represented there which are now much reduced in size or entirely replaced by cultivated fields. If, farther, he scans the topographical names of the different counties, he will be able to detect the sites of other and sometimes still older lakes; while, if he sets to work upon the geological evidence by actual examination of the ground itself, he will be astonished to find how abundant at comparatively recent times were the tarns and lakes of which little or no human record may have survived, and often how much larger were the areas of the lakes that still exist. Owing to some peculiar geological operations that characterised the passage of the Ice Age in the northern hemisphere, the land from which the snow-fields and glaciers retreated was left abundantly dotted over with lakes. The diminution and disappearance of these sheets of water is mainly traceable to the inevitable process of obliteration which sooner or later befalls all lakes great and small. Detritus is swept into them from the surrounding slopes and shores. Every brook that enters them is engaged in filling them up. The marsh-loving vegetation which grows along their shallow margins likewise aids in diminishing them. Man, too, lends his help in the same task. In early times he built his pile-dwellings in the lakes, and for many generations continued to cast his refuse into their waters. In later days he has taken the more rapid and effectual methods of drainage, and has turned the desiccated bottoms into arable land.

Nor have the changes of the surface been confined to the interior of the country. Standing as it does amid stormy seas and rapid tidal currents, Britain has for ages suffered much from the attacks of the ocean. More especially has the loss of land fallen along our eastern shores. Ever since the submergence of the North Sea and the cutting through the Strait of Dover, the soft rocks that form our sea-board facing the mainland of Europe have been a prey to the restless waves. Within the last few centuries whole parishes, with their manors, farms, hamlets, villages, and churches have been washed away; and the fisherman now casts his nets and baits his lines where his forefathers ploughed their fields and delved their gardens. And the destruction still goes on. In some places a breadth of as much as five yards is washed away in a single year. Hol[illegible]derness, once a wide and populous district, is losing a strip of ground about two and a quarter y[illegible] broad, or in all about thirty-four acres annually. Its coast-line is computed to have receded betwe[illegible] two and three miles since the time of the Rom[illegible] —a notable amount of change, if we would try [illegible] picture what were the area and form of the coast-line of eastern Yorkshire at the beginning of th[illegible] historic period.

But though the general result of the action o[illegible] the sea along our eastern border has been destruc[illegible]tive, it has not been so everywhere. In shelter[illegible] bays and creeks some of the material washed aw[illegible] from more exposed tracts is cast ashore again. I[illegible] this way part of the sand and mud swept from [illegible] the cliffs of Holderness is carried southward in[illegible] the Wash, and is laid down in that wide rec[illegible] which it is gradually filling up. Along the coa[illegible] of Norfolk and Suffolk inlets which in Roman and later times were navigable channels, and which allowed the ships of the Danish Vikings to penetrate far into the interior of the country, are now effaced. On the shores of Kent, also, wide tracts of low land have been gained from the sea. Islands, between which and the shore Roman galleys and Saxon warboats made their way, are now, like the Isle of Thanet, joined to the mainland. Harbours and towns, like Sandwich, Richborough, Winchelsea, Pevensey, and Porchester, which once stood at the edge of the sea, are now, in some cases, three miles inland. There appears, also, to have been a curious gain of land on the south coast of Sussex, which has considerably altered the physical geography of that district. The valleys by which these downs are trenched were formerly filled with tidal waters, so that the ancient camps, perched so conspicuously on the crest of the heights, could not communicate directly with each other except by boat. Instead of being a connected chain of fortifications as was once supposed, they must have been independent strongholds, surrounded by water on three sides, and on the north by dense forest and impassable morasses.

But the enumeration of the minor changes of surface might be indefinitely extended. Let me only add, in conclusion, that what I have tried to say generally for the whole country must be worked out for each district. A large amount of information still remains to be gleaned; and though our knowledge of the past must always be fragmentary, it need not continue to be so vague and imperfect as it is now. The field is a wide one, where many workers are needed, and where the active co-operation of the young is especially welcome.

USEFUL AND SCIENTIFIC NOTES.

Manganate of Baryta for Bleaching Solutions and Extracts. — Manganate of baryta is a green crystalline powder, which is insoluble in water. Schad, in 1865, proposed to use it as a colour in place of arsenic green; but so far it does not seem to have been applied in the printing trade. It is now proposed to use it for bleaching, and it is claimed that it acts equally as well as hydrogen peroxide, that it is cheaper and will keep better, that it acts on solutions, be they neutral, alkaline, or acid, and that it can be easily applied. The liquid which is to be bleached is heated, and the manganate of baryta, which has been previously ground together with water, is added until the liquid has been sufficiently decoloured. The manganate of baryta becomes in this reaction decomposed into manganate of baryta, a brown insoluble substance which settles out, and can be separated by means of a filter press or by decantation, and into oxygen, which is in this case the bleaching agent. This material can, naturally, only be used in a limited number of cases; but in the preparation of certain fine chemicals it might be found useful. It is proposed to use it for decolouring glue, extracts, and other substances, and it is said that it does not decompose glue or tannin.

Public Libraries in the United States.— The public libraries of the United States having 10,000 volumes and upwards number 2,981, or one to every 10,000 of the population, with an average of 3,862 volumes. New Hampshire has one library to every 2,700 inhabitants, Massachusetts, Connecticut, and Rhode Island one to every 3,000—3,500. Massachusetts is in the van as to the number of libraries—427, or rather more than 14 per cent. of the grand total. New York is close behind with 391, but of course with a marked disproportion when population is considered. The respective volume totals are:— Massachusetts, 3,569,085; New York, 3,168,508. A careful count shows that (exclusive of suburbs) New York City's libraries have 1,414,795 volumes, those of Boston 1,915,419. Forty-seven libraries have 50,000 and upwards; the library of Congress standing first, with 565,134 volumes, and Boston Public Library second (434,887).

Gas-Wells as Hot-Beds.—According to reports, around natural gas-posts at Sewickley, near Pittsburg, Pa., within a radius of 20ft., grass has been as green all winter as in summer time. For over a month pansies planted near these posts have been in full bloom. A market gardener is raising asparagus in the open air by the aid of the gas, and proposes to test its use in beds of vegetables heretofore grown in greenhouses.

As a method of cracking glass with certainty, the following is given by E. Beckmann:—"A scratch is made with a file; at both sides of this, pads of wetted filter paper are wrapped round the object, leaving a space of a few millimètres between them. The flame of a Bunsen or gas blowpipe is applied to this space, when the crack will be carried round from the scratch midway between the two pads."

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

ON Wednesday, April the 6th (Mr. Edwin Dunkin, vice-president, in the chair), Mr. G. F. Chambers read a paper on "A Catalogue of Red Stars." He said that the list of red stars he had prepared was the outcome of many hundreds of observations extending over a period of 17 years, from 1870 to 1886 inclusive. The telescope employed at first was a 4in. refractor; but the observations since 1884 had been made with a 6in. refractor. This catalogue made no pretence to being exhaustive, and must not be regarded as more than it professed to be—namely, a working list of the best of the red stars which were always within the reach of their instruments, regard being had to the season of the year and to the place of observation. In another sense the catalogue was not exhaustive, as it only included stars of tested colour and of not less than 8½ degrees of magnitude. It might be that the eyes of the present race of observers were not so sensitive to red hues as their predecessors; but he certainly had often considered that many of his predecessors in the observation of red stars had greatly exaggerated the colours that they had ascribed to them. Taking the so-called red stars all round, his opinion was that a more generally accurate generic term for them would be orange stars. Very few of them approached to red, and less than a dozen could be properly termed carmine or ruby. These remarks were requisite by way of caution in order to guard inexperienced observers from being disappointed when they came to examine stars described by Sir William Herschel, Sir John Herschel, Schmidt, and others, as red, or very red. These observers, no doubt, saw stars of a redder tinge than they had since been found to exhibit. In the case of the Herschels, this might have been due to the character of their metallic mirrors, or to peculiarity of eyesight, or to both causes combined. Speaking generally, the vast majority of the stars here catalogued were merely orange. The results of his own work included 689 stars examined by himself out of a total of 711, being virtually all those visible in England. It would not be difficult to offer many interesting suggestive reflections as the result of a prolonged study of red stars; but he would only record the fact that many of the stars which were certainly variable were red, and that many of the red stars, since they were first noted as such, had been found to be variable. The instances that could be cited in support of these statements were very numerous. It was quite impossible for the coincidence between the redness of the colour and the variability of the light of several hundred stars to be accidental. What it meant he did not presume to suggest. Amongst observers who had paid much attention to the colour of red stars, a foremost place must, of course, be given to Mr. Birmingham. It was to be remarked that the space of the heavens including the constellation Cygnus, seemed to be particularly thickly studded with red and orange stars: it might not unnaturally be called "the red region of Cygnus," and although the chance of finding a star of any special colour must be greater amongst the countless multitudes of the "Milky Way" than elsewhere, no special richness in colour of red stars had been discovered there. The reason why stars below 8½ or 9th magnitude had not been included in the catalogue was that where one was dealing with a star near to the limit of visibility, the colours were apt to become imaginary, and without any desire to impute bad faith to an observer who talked about a star of magnitude 13 being coloured red, he did not as a rule believe that it was possible to assign colour to stars of lesser magnitude than he had mentioned, unless a very large telescope was employed in viewing them. The question had often been discussed as to how far flat-surface diagrams of colour were of any use as standards of comparison of the colour of stars. For his own part he was disposed to question their usefulness. He thought a transparent disc of coloured glass arranged in gradation of colour, and mounted on a frame sufficiently portable to be held in the hand by the observer while his eye was at the eyepiece of the telescope might be used for the comparison of star colours. Probably the chief difficulty would be in obtaining a sufficiently piercing white light to illuminate the discs. If this could be obtained, either by means of electricity or otherwise, some such apparatus might be effective and trustworthy, while not very expensive nor cumbersome. The catalogue included red stars recently brought under the notice of the Society by Mr. Espin, so far as he had been able to examine them. He had also included a few which he had not been able to examine, in order to make the catalogue as fairly complete as possible.

Capt. Noble said: When Mr. Chambers was occupied in the preparation of his catalogue of red stars for his "Descriptive Astronomy," he spent a night with me in my observatory, and he brought a list of red stars which he asked me to go over with him; and I was very much struck then with the extraordinary difference in people's eyes in the perception of redness in stars. As far as my memory serves me, we made out between us that two-thirds of the stars in his list were orange, and as to the remaining one-third, with the utmost stretch of courtesy towards the gentlemen who originally called them red, we could not make them out to be anything but white.

Mr. Gill: I think that the differences in the estimates of colour may to a great extent be accounted for by the difference in the colour correction of the telescope used. I came across a curious case of difference in the estimation of colour in examining the object-glasses of two well-known opticians—Mr. Grubb and Dr. Schroeder. Mr. Grubb in his object-glasses obtains a good coincidence of the rays more towards the red end of the spectrum than in the case of Dr. Schroeder, who leaves a considerable quantity of outstanding red in order to keep the rays towards the blue end of the spectrum together. I have no doubt that both opticians were guided simply by the different sensibility of their eyes to colour, Mr. Grubb's eyes being more sensitive to red rays, and Dr. Schroeder's to blue rays.

Mr. Ranyard: Very different estimates as to redness have also been made by observers using reflectors, which bring all the colours to the same focus. For instance, Mr. Webb, using a reflector, estimated stars as much less red than the Herschels father and son, who both used reflectors. There must be something physiological. Varying degrees of colour sensitiveness, or colour blindness at the red end of the spectrum must be common.

A paper by Mr. Howard Grubb was then read on the "Choice of Instruments for Stellar Photography." In considering the important question whether a reflecting or refracting telescope is likely to give the best results, Mr. Grubb comes to the conclusion that the advantage appears to be on the side of the reflector. If the spherical aberration is properly corrected, *all the rays* are brought to the same focus with the reflector, and the field of the reflector is theoretically flatter; though, as General Tennant has pointed out, there is a considerable amount of "coma" to be found in the lateral pencils of the reflector, which causes distortion of the star discs. The value of General Tennant's paper would have been greatly increased if he had compared the lateral distortion of star discs for reflectors and refractors composed of two lenses, such as those used by the Brothers Henry. Although this has not been done theoretically, some practical guidance may be obtained. According to Prof. Pritchard, stellar images obtained with Mr. de la Rue's reflector are practically circular at 80′ from the centre of the field, while at the same distance in MM. Henry's plates, obtained with a refractor, the small star discs are ellipses, the proportion of whose major and minor axes are 9 to 4. As far as Mr. Roberts's results at present go, they tend to show that a field of about 2° by 2° is the maximum attainable with good definition.

Mr. Gill was called upon by the President to give some account of his stellar photographic work at the Cape. He said: It will probably be in the memory of the Society that in 1882, with the aid of Mr. Ellis, the photographer at Mowbray, near Cape Town, we obtained photographs of the great comet of that year, and that these photographs contained pictures of stars nearly to the ninth magnitude after 2½ hours' exposure, and those photographs gave rise to the idea that by means of such lenses or rapid rectilinear compound lenses photographs might be made on which stars in the sky to the 9th and 9½ magnitudes, according to the system of Argelander, might be rapidly secured. I laid before the Royal Society a proposal to that effect on the occasion of my visit to England in 1884, and by the generosity of the Government Grant Fund of the Royal Society, the services of Mr. Woodward were engaged, and the work has been in progress and has gone on for some time, and after we had secured a considerable number of results photographs were sent to me by the Messrs. Henry, of Paris. The quality of work which they produced was infinitely superior to anything we obtained at the Cape. The quality of the definition of a number of the stars was due in the first place to the superior lenses which they employed, and secondly, to the much more rapid plates which they used. But there is a distinctive difference between the leading idea of the photographs obtained at Paris and those which have been obtained at the Cape. The idea in Paris was, in the first place, to obtain pictures such as would enable the work of Chacornac to be carried on by Messrs. Henry in a more thorough and perfect manner, viz., to complete the Ecliptic charts which, when they reached the Milky Way, it became impossible to construct on the ordinary method, and so far that is a valuable and splendid work to accomplish; but it was a work that could be readily accomplished by them by successive comparatively small adjoining areas. The work I had undertaken at the Cape was of a totally different character. My intention was to complete for the southern hemisphere the work begun and carried out in the North by Arglander, and it was necessary in carrying out such a work to devise some system which would render that work possible within a limited number of years, and which would admit of after measurement and discussion. The plates of Messrs. Henry only covered an area which at the outside may be represented by two degrees square on the side. The Cape plates give pictures of an area of over five degrees square, which are sufficiently sharp for accurate measurement, at least to one-tenth of a minute, and we believe almost to a single second. These pictures are sufficient for that purpose. They cover an area of six degrees on the side, or 36 square degrees. Therefore, by such a process, we get comparatively quickly over the sky. I am told by Capt. Abney that the plates I employed, those of the Paget Plate Co., which were the quickest I could then obtain, can now be replaced by plates of his invention, which work eight times as rapidly; and, therefore, we shall be able to work if not eight times as quickly, at least four or five times as rapidly as at present. I wish to show how far this work at the Cape is a work that, notwithstanding the superior results of Messrs. Henry in many respects, should be still carried to completion. It is quite certain that within a very few years, probably two years now, in view of the increased sensitivity of the plates we can procure, we shall finish the photographic work I have been engaged upon.

The meeting adjourned at ten o'clock.

WESTERN MICROSCOPICAL CLUB.

THE club met on Monday last at the invitation of the hon. secretary, Mr. A. W. Stokes. The host gave an exposition of "A Rapid Method of Dry-Mounting." About nine-tenths of the objects supposed to be mounted dry are found in the course of time to have the lower surface of their inclosing cover-glass bedewed with spherules of moisture or with minute crystals; occasionally the object itself is overgrown with fungus also. In mounting an object a cell of some kind is usually needed; this may be formed of a ring of cement, paper, glass, vulcanite, or tin. In fastening this ring on to the glass-slip, or in fixing the cover-glass, some cement must be used. Such cements are usually made liquid by water, alcohol, or turpentine. Time may be given for thorough drying of the cement that fastens down the cell; but it is quite impossible, if any of these liquid cements are used to fasten down the cover-glass with, for the cell to be a dry cell, since the liquid must dry into as well as outside of the cell. What is technically called "sweating" must necessarily take place. This sweating is fatal to such objects as dry-mounted diatoms, blood-corpuscles, &c., mounted on the lower surface of the cover-glass.

Mr. A. W. Stokes takes a mixture of equal parts of paraffin wax and bees' wax; a piece the size of a pea is placed on a glass or metal slip. This is heated till it melts and forms a thin film; in contact with this are placed the rings intended to form the cells. First one side, then the other side of the rings, is brought in contact with the melted wax. The rings are taken off, and in a second or two are cold and hard. One of these is placed on a clean glass slip in the position desired, and heat applied below the slip till the waxed surface of the ring melts and adheres. It is now allowed to cool. The object meanwhile is dried in a desiccator over sulphuric acid or calcic chloride; it is then placed in the cell and fastened in position by a minute fragment of wax. Gum will not do for fixing the object, since if really dry it will not adhere at all. A cover-glass is now taken, one side cleaned and heated; while still hot it is placed on the top of the cell. This top surface having already, as described, been covered with wax, the glass at once adheres, and the object is dry-mounted permanently. There is no liquid to sweat, and no time wasted in waiting for the cell to dry. So strongly does the mixture of waxes adhere that it is not easy without applying heat to detect either cell or cover-glass. Cells can be made out of tissue-paper if required very shallow, or any of the ordinary rings may be used. Vulcanite cells expanding and contracting very nearly the same as glass with differences of temperature, are preferable. Of course, the cells may be finished off afterwards with any of the usual cements.

The method does not require any turn-table, brushes, or other of the usual apparatus; it is inexpensive, rapid, effectual, and permanent.

Slides were shown illustrating sweated slides and dry slides.

Messrs. E. M. Nelson, H. Snow, E. Swain, E. Bartlett, and Stokes showed microscopical specimens, that of Mr. Nelson being peculiarly interesting, the parasite of the bee (Stylops Spencii) having its thorax imbedded in the abdomen of its unfortunate host.

SCIENTIFIC NEWS.

ALTHOUGH Prof. Tyndall is better in health than he has been for some time past, he is not in a position to withdraw his resignation of the chair of Natural Philosophy at the Royal Institution, which he has held for thirty-four years. The managers of that institution have accordingly announced that they have accepted with the deepest regret the resignation of the distinguished successor of Faraday, and Lord Rayleigh has been nominated for election to a post which is perhaps the most honourable in the world of British science. Prof. Tyndall has declined to accept a retiring allowance; but it is stated that the managers and members, cordially appreciating Prof. Tyndall's eminent merits and being anxious to mark their sense of the benefits he has conferred on the Institution during his long connection with it, have nominated him for election as Honorary Professor—a title previously borne by Sir Humphry Davy and Prof. Brande; and one of the annual courses of lectures will be called "The Tyndall Lectures." He has also been requested to sit for his bust, in marble, to be placed in the house of the Institution, in perpetual memory of his relations with it, the cost of the bust being defrayed by the Institution.

Amongst the "after-Easter" lectures of the Royal Institution, we note that Dr. John Hopkinson, M.A., F.R.S., will deliver a course of four on Electricity on April 19, 26, and May 3, 10; Victor Horsley, F.R.S., three on the "Modern Physiology of the Brain, and its Relation to the Mind," May 17, 24, 31; Prof. Dewar, F.R.S., seven on the 'Chemistry of the Organic World," April 21, 28, May 5, 12, 19, 26, June 2; R. Von Lendenfeld, B.Sc., three on "Recent Scientific Researches in Australasia," April 23, 30, May 7. Amongst the announcements for Friday evenings we note the names of Prof. Hele-Shaw, Dr. Lauder Brunton, Dr. Burdon Sanderson, Dr. E. Klein, Dr. D. Gill, and Mr. Benjamin Baker.

A course of 12 lectures on "Botany" will be delivered by Mr. T. G. Baker, F.R.S., at the Garden of the Society of Apothecaries, Chelsea, on Saturday afternoons during May, June, and July. The lectures are open to all medical students and other gentlemen who may desire to attend. Tickets of admission can be obtained from the Bedell of the Society.

A course of six lectures on "Mechanism," by Dr. A. R. Willis, M.A., will be delivered to working men at the Museum of Practical Geology, Jermyn-street, commencing on Monday evening, April 18.

Prof. Hough, director of the Dearborn Observatory, Chicago, has published in Nos. 2,778-9 of the *Astronomische Nachrichten* a catalogue of 209 new double stars discovered and observed by him at irregular intervals during the past five years with the 18½in. refractor. Altogether 550 measures of the 209 pairs have been obtained.

At a meeting of the Royal Society of Edinburgh last week, Mr. R. Kidston made a communication on the fossil flora of the Radstock series of the Somerset and Bristol coalfields, the highest workable coal in Great Britain, and extremely rich in beautiful fossil plants, which are treasured by the miners. Dr. E. Sang read two papers—one on the achromatism of the four-lens eyepiece, describing a new arrangement of the lenses; the other on an effective method of observing the passage of the sun's image across the wires of a telescope—viz., the use of a thin piece of muslin over the object-glass. Mr. F. E. Beddard sent a communication on the structural characters of certain new or little-known earthworms, in which detailed descriptions of five apparently new species from Australia and New Zealand were given. Prof. Geikie submitted a paper on the "Geology and Petrology of St. Abb's Head."

At a recent meeting of the Physical Society, Mr. C. V. Boys, M.A., read a paper on "The Production, Preparation, and Properties of the Finest Fibres," in which the various methods of producing organic fibres and mineral fibres, such as glass, slag-wool, &c., were referred to. In producing very fine glass fibres, Mr. Boys finds it best to use very small quantities of the material at high temperatures with the velocity of separation as great as possible. The oxy-hydrogen jet is used to obtain the high temperature, and the velocity is given by means of a cross-bow and straw arrow, to the tail of which a thin rod of the substance to be drawn is cemented. Pine is used for the bow, because the ratio of its elasticity to its density (on which the velocity attainable depends) is great. The free end of the rod is held between the fingers, and when the middle part has been heated to the required temperature the string of the cross-bow is suddenly released, thus projecting the arrow with great velocity, and drawing out a long fine fibre. By this means fibres of glass less than 1-10,000th of an inch in diameter can be made. Mr. Boys has also experimented on many minerals, such as quartz, sapphire, ruby, garnet, feldspar, fluor-spar, augite, emerald, &c., with more or less success. Ruby, sapphire, and fluor-spar cannot well be drawn into fibres by this process, but quartz, augite, and feldspar give very satisfactory re-results. Garnet, when treated at low temperatures, yields fibres exhibiting the most beautiful colours. Some very interesting results have been obtained with quartz, from which fibres less than a hundredth of an inch in diameter have been obtained. It cannot be drawn directly from the crystal, but has to be slowly heated, fused, and cast into a thin rod, which rod is attached to the arrow as previously described.

The president of the Institution of Civil Engineers, Mr. Edward Woods, will give the annual conversazione on May 25, at the South Kensington Museum. The register of the Institution shows that there are 1,568 members, 2,275 Associates, and 20 honorary members, besides 484 non-corporate associates and 949 students, making a gross total of 5,296.

The abstract of the *Proceedings* of the South London Entomological and Natural History Society for the year 1886, shows that this society is doing good work, and is progressing in a satisfactory manner. The Society meets at the Bridge House, London Bridge, on the 2nd and 4th Thursday evening in each month, and the Council invite the co-operation of all naturalists.

Messrs. J. J. Thomson and Threlfall have determined that ozone is not produced when dry oxygen is placed in an electric field, not even when a spark is allowed to pass. The gas was carefully dried and purified before entering the chamber, and was tested at the outlet by a sensitive solution of iodide of potassium and starch. The same investigators have made some curious observations on the effect of passing electric sparks through nitrogen contained in a tube at a pressure less than 0·8in. of mercury. A very slow, permanent diminution of the volume of the nitrogen occurs, which, at a pressure of only 0·3in., may amount to as much as 8 to 12 per cent. of the original volume. If the tube be then heated to 100° C. for several hours, the original volume is regained. It would seem as though some modification of nitrogen were formed, bearing to ordinary nitrogen a similar relation to that which ozone bears to oxygen. The existence of such an allotropic form of nitrogen has long been urged by Mr. G. S. Johnson.

According to a large number of experiments by Dr. Krüss, the atomic weight of gold is 196·64.

Baron Nordenskiöld is preparing to conduct an expedition to the Antarctic circle, with the view of discovering, if possible, the South Pole —really an exploring voyage, as there is little hope of even reaching very high southern latitudes. The King of Sweden and Baron Dickson, the Gothenburg merchant, who has helped so much in exploring work of the kind by providing the requisite funds, are taking much interest in the project. Baron Nordenskiöld expects the expedition will occupy about eighteen months; but it will not be ready to start until the autumn.

It is said that University College and King's College have agreed to present a joint petition to the Crown praying for a charter to grant degrees for a properly constituted university in London having at least three faculties—arts, science, and medicine. The College of Physicians and the College of Surgeons will probably jointly oppose the petition; at rate, they have determined [illegible] pendently, and seek for power to grant degrees in medicine and surgery.

At a recent meeting of the Paris Academy of Sciences, a paper was read on "A Correlation between Earthquakes and the Declinations of the Moon," by M. H. de Parville. A systematic study of lunar and terrestrial phenomena continued for a quarter of a century, leads the author to infer a distinct relation between lunar declination and earthquakes, the general law being that the disturbances occur either at the equilune, the lunistice, or exactly when the sun and moon have the same declination.

Another gigantic naphtha fountain burst forth at Baku on March 22, carrying up oil, sand, and large stones to a height of 350ft., overrunning several reservoirs prepared for it, and, after forming an extensive petroleum lake, forcing its way into the sea. One stone of those thrown out with the naphtha weighed 23lb. All efforts to regulate this forcible gush of oil were vain.

In Lake Constance the waters are unusually low, and relics of lake dwellings are being energetically sought for by local authorities. A large collection of weapons, ornaments, and domestic utensils has already been obtained, part of which will go to the museum at Heberlingen, and the remainder to the Rosgarten Museum in Constance.

USEFUL AND SCIENTIFIC NOTES.

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Morse Twist Drill and Machine Co.'s Manufactures.—Messrs. Buck and Hickman, of the Whitechapel-road, having been appointed special agents for the sale of all goods of the Morse Twist Drill and Machine Co.'s make, have issued a handsomely got-up catalogue containing full particulars of the famous twist drills, with illustrated descriptions of reamers, milling cutters, taps and dies, drill and other chucks of various patterns, and sundry other tools or appliances of American manufacture. Those of our readers who desire to have full details of the drills, reamers, &c., made by the Morse Company will find them clearly set out in this handsome price list and catalogue.

A Great Balloon.—The captive balloon proposed by M. G. Yon for the French Exhibition in 1889 will have the enormous volume of 60,000 cubic mètres. The maximum altitude for the ascensions will be 1,000 mètres, and it will be possible to take 100 passengers, a winding engine of 600H.P. being employed. In the construction of this balloon, the following point is of some interest: The surface of the balloon must always be tight, in order to prevent the damage which otherwise a strong wind might cause. To preserve tightness, notwithstanding variations in temperature, another small balloon is placed inside the large one, and the volume of this small balloon, which is filled with atmospheric air, can be increased or diminished by pumping in or exhausting air by means of an air-pump, worked by an electric motor on the car, the current being supplied by a twin cable from a dynamo on the ground.

Coke-Dust Briquettes.—The Lyons Gas Company are seeking to utilise a waste material by manufacturing briquettes from coke dust. To this end they have established works capable of turning out 6,500 tons of this form of fuel per day at a cost of about 13s. per ton. The dust is first washed, and then mixed with tar and pitch in the proportion of 7lb. of the latter and 2½lb. of the former to 100lb. of the washed dust. The process of manufacture is the same as for the ordinary coal briquettes.

AT a recent meeting of the Paris Academy of Sciences, a paper was read on the direct fixation of the gaseous nitrogen of the atmosphere by vegetable soils with the aid of vegetation, by M. Berthelot. Having already described the results of the experiments made at Meudon on the fixation of atmospheric nitrogen by certain argillaceous and vegetable soils, apart from the action of vegetation, the author now gives the results of the experiments simultaneously carried on with the aid of vegetation, and under the ordinary conditions suitable for the natural development of plants. In this case the amount fixed was only 4·67 and 7·58grm., as compared with 12·7 and 28·15 in the absence of plants. From these experiments important conclusions are drawn with regard to the rapid exhaustion of the soil under the prevalent systems of forced culture.

OF pig iron in Spain the number of tons produced reached 124,868 in 1886.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆◆◆

ASTRONOMICAL.

[27083.]—THE *comes* to Σ 1830 mentioned by Mr. Holmes in letter 27049, p. 124, seems to be new; at least, it was not mentioned by Σ, Se, Du, De, or any other astronomer who has mentioned this pair. De refers to a yellow 5·8 mag. star between Σ 1830 and Σ 1831, lying at 143·2" distance from A of Σ 1830, and on an angle of 240·9°.

The change in Σ 1516 is due to the proper motion of A. Jedrzewicz gives 91·7° : 13·12" : 1886·68. The third star is probably variable, and is connected with the bright star of the pair. Argelander gives for the usual proper motion 0·435" in 285·6°.

The distance of ϕ Draconis seems constant at about 0·5" and that of ϕ Ursæ Majoris is not over 0·3' at present. Dembowski says that it was always single in his telescope. Casey gives a period of 115½ years for this pair. **H. Sadler.**

SATURN.

[27084.]—I AM much obliged for the interesting and useful summary Mr. Watson has given in answer to my question. It certainly affords satisfactory evidence of the existence of the notch, and concavity of shadow.

I am sorry if, in the desire to be brief, I have been obscure. I will not occupy space with explanations, for, I feel sure, a fair perusal of what I actually wrote will acquit me of having made statements inconsistent with one another.

Last year the bright zone on ring A appeared to me as Mr. Watson describes it; but during the last two months on the whole as Dr. Terby shows it. It would be a help to me and to other inquirers, if Mr. Watson, or some other competent authority, would give us in a connected form the recent observations of this somewhat mysterious and variable feature.

April 9. **P. H. Kempthorne.**

IS JUPITER SELF-LUMINOUS?

[27085.]—IN this distant part of the world the ENGLISH MECHANIC does not reach me until long after its publication, consequently any subject of present interest that may be under discussion in its columns will probably have become stale by the time anything I may wish to say upon it will have reached the Editor. In the number for Nov. 19th last appeared a reprint of my paper, entitled "Is Jupiter Self-Luminous?" (Royal Society of Tasmania), which, however, was curtailed by the omission of the concluding part. This I scarcely regret, as otherwise we might have missed the interesting communication of your esteemed correspondent, Mr. E. Holmes, upon the subject ("E.M.," Dec. 3rd).

In the concluding part of my paper (the part omitted) I anticipated the very objections adduced by Mr. Holmes. First, with regard to the theoretical visibility of the satellities in shadow, I quoted Prof. Newcomb:—"If we assume that the planet emits any great amount of light, we are met by the fact that the satellites would shine by this light when in the shadow of the planet. As these bodies totally disappear in this position, the quantity of light emitted by Jupiter must be quite small." Upon this I remarked:—"If these satellites were projected upon a *dark sky* when in shadow, I, too, think they would be visible. . . . Taking my own estimate of Jupiter's brightness, I find that his first satellite would receive from him about 50 times the light which our new moon receives from earth-shine (assuming equally reflective surfaces as between earth and moon). But it must be remembered that when Jupiter's satellites enter his shadow they are in such close proximity to the limb of the planet that such feeble illumination would be totally overpowered by his glare."

Again, as to their projection on the planet, I remarked: "The evidence of the satellites appears still further hostile (to my theory) when we consider that they sometimes appear (the third especially) as *bright* spots when entering upon his surface in transit . . . . but this is only for a short distance within the limb. As they advance upon the face of the planet they become *dark* by contrast—sometimes as black as their shadows. . . . We cannot argue anything definitely or positively from these bodies with regard to the question under discussion, as we know next to nothing of their physical condition. Their *variable brightness*, if nothing else, compels us to rank them among the many unsolved mysteries of astonomy."

Mr. Holmes says: "Satellites I. and II., so far as I know, are always visible as brighter beads, even upon the centre of the disc." If this is fact (and I am not in a position to contradict it, though I was not aware of it), it certainly is hard to reconcile with my photometry; but we are often placed in a position between actual facts that are irreconcilable. That Jupiter is actually very much brighter than he ought to be by mere sunlight, as compared with Mars and the moon, is to me as much an observed fact as is that of the brightness of his moons. It is not necessary, however, nor desirable that the question should rest merely upon my observations, which were certainly not so exact as I wished and hoped for. There are plenty of far abler observers on your side the globe who might think it worth while to take up the question by more exact and reliable experiment. I hope it will be so.

"G. P. Bond found that for photographic purposes Jupiter's surface reflects light better than that of the moon in the ratio of 14 to 1." I quote from Chambers's "Astronomy." This, by a different mode of estimation, is so singularly confirmatory of my own measures (12·7 to 1) as almost to suggest that my observations were influenced thereby. This, however, was certainly not the case, as I was at the time in total ignorance of the statement referred to.

Mr. Holmes expresses a preliminary condemnation of the wedge for photometric purposes. I would remind him that the test to which I afterwards subjected it established its reliability as to the general result. Besides which, I did not rely exclusively upon it, as a set of observations were taken without it.

I think the existence of a material sufficiently reflective to account for Jupiter's brightness (as Mr. Holmes suggests) is inconceivable. At any rate, our observations extend as far as the orbit of Mars without having discovered anything more reflective than snow. **A. B. Biggs.**

Launceston, Tasmania, 1st March.

THE APERTURE AND MAGNIFYING POWER OF TELESCOPES—SATURN—OBSERVING DOUBLE STARS BY DAYLIGHT.

[27086.]—I AM much obliged to "A Fellow of the Royal Astronomical Society" and to "Tria" for their replies (on pages 123 and 134) to my query (62034) respecting the relations between the aperture and magnifying power of telescopes under circumstances of unfavourable atmospheric definition. I had already read much that has been written on the subject; but the information thus gained was, on the whole, so contradictory that I was particularly anxious to hear the views of such a close and practical observer as "F.R.A.S."

I was also, of course, aware that with reflectors an increase of aperture is accompanied by a material increase in sensitiveness to atmospheric disturbance; but I have never had an opportunity of using refractors of from 6in. to 8in. aperture, and I was under the impression that instruments with such apertures would not be so detrimentally affected as "F.R.A.S" has explained them to be. The case appears to stand thus: With very favourable atmospheric conditions, increase of aperture prevents *increase* of magnifying power; with very unfavourable atmospheric conditions increase of aperture necessitates *decrease* of magnifying power. Therefore, it follows as a corollary that there must be an intermediate atmospheric condition under which the magnifying power which it is possible to employ will (within certain limits) practically be independent of aperture. This is just what my experiments showed; but, in the belief above mentioned, I was sceptical of their accuracy. My excuse for raising the question in the pages of the "E. M." is that, to many amateur observers who have to work in the neighbourhood of large towns, it is of considerable interest to know what size of instrument will enable them to turn their opportunities to the best account. The cost of an 8in. refractor is practically double that of a 6in., and we all, probably, desire to possess as large an instrument as we can afford, yet few care to incur an extra expenditure without probability of an adequate return.

In the course of his reply to me, "F.R.A.S." asks how often I have been able to use a power of 400 on my 4in. Cooke. I have pleasure in answering this inquiry as definitely as I can. I have never used 400 with this telescope, the highest power I have being 360 (measured). The other powers I chiefly use are 64, 122, and 252. I find, on reference to my note-book that since December 1st last (a period of 130 days to date) it has only been possible to use the 360 effectively on three nights. On 15 nights 252 has been the highest power useable; on 12 nights it has been necessary to restrict the power to 122; 9 nights were only available for observations of clusters and nebulæ, or wide doubles, with a low power; on 28 nights only a few brief observations could be made owing to clouds, rain, &c., alternately, with brief clear intervals; and on 68 nights all observations were impossible owing to total obscuration of the sky. So much for the facilities for astronomical observation afforded by a London winter. I may add that my notes refer to the periods between sunset and midnight, except in a few cases when observations were made an hour or two later. Probably a record taking in the whole of the nights would show a greater proportion of opportunities for using high powers.

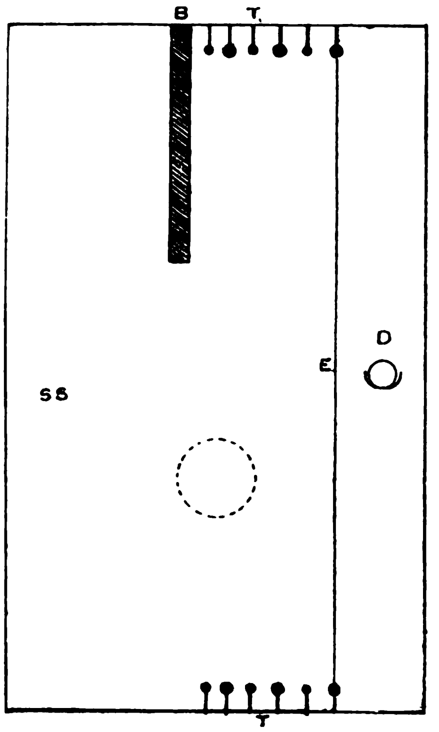
I have been very greatly interested by the remarks of "F.R.A.S." (p. 128) on his observations of Saturn with a 4¼in. refractor. Early on the evening of the 8th inst. during a period—lasting about an hour—of the very best definition I ever remember to have experienced, I was able to clearly see Encke's division in both ansæ using a power of 360 on my 4in. I have never before been able to see that detail with this aperture. The shadow of the planet on the rings was beautifully defined; but I am unable to make out the notch figured by Dr. Terby, although at moments of the best definition it could be seen that the edge of the shadow did not form a clean curve up to the south edge of the outer ring. It would be interesting to know what is the lowest power which Dr. Terby has found capable of showing the notch. On the 8in. the gauze ring was most beautifully seen.

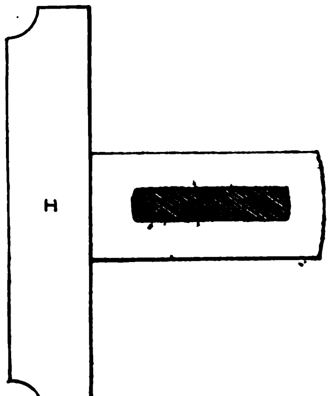
Before concluding this somewhat long letter I should like to say a few words on a subject respecting which astronomical treatises, so far as I am aware, treat very scantily: I mean the effect of daylight on the division of a certain class of double stars. Some doubles, such as Castor, for instance, are, it is well known, easily dealt with by daylight; but I do not remember to have seen it stated that the main stars of ζ Orionis are much more easily divided by daylight than on an average night. At night I have rarely seen the two larger stars of the triple clearly divided with a less power than 120, and more generally a much higher power is necessary; but in daylight I have seen it clearly double with a power of 64 and 4in. aperture. On a clear afternoon, forty minutes before sunset, I have also seen the two main stars clearly divided with a power of 122 and the aperture reduced to 2¼in. I believe that even a less aperture would have sufficed, but a cloud coming over that part of the sky put an end to the experiment. Of course, the third star was not seen. γ Leonis is another star which will repay daylight examination. I have seen this star half an hour before sunset beautifully divided with powers of 64 and 122, and with the colours as well shown as at night. I have also found ε Hydræ and ζ Cancri to be stars which can be effectively dealt with in the same way. I may mention, as a hint to those who have not paid attention to this particular class of observation, that one essential to success is that the eyepieces used should be self-focussing, or that the observer should possess a gauge by which he can focus each eyepiece accurately before looking at the object. By daylight, the fact of the eyepiece being a little out of focus will often prevent a star from being seen even if the telescope is accurately directed to it. Of course, also, it requires but a very thin film of cloud to render daylight observations impossible with ordinary apertures. **M.**

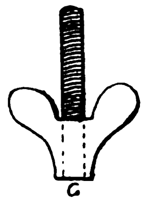
AMATEURS' SAW TABLE.

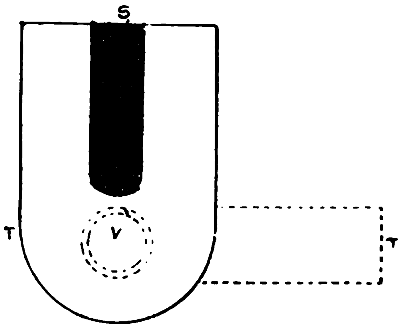
[27087.]—Some time ago I felt the want of a simple and speedy circular saw for working in metal, particularly for cutting out slots and fittings in thick brass and iron, with miscellaneous jobs in hard wood, bone, horn, and ivory. At last I achieved my *multum in parvo* for the former class of operation. I am continually making cutters from 1in. to 2in. diameter, varying in thickness; for the softer materials, saws up to 3in., fine and coarse, as required. As the whole of these appliances require to be kept free from rust spots, I rub them with paraffin oil, and keep them in an airtight sheet-metal box, varnished inside with coal tar, outside painted. Table and all are contained in this receptacle; about 16in. long by 6in. by 6in. This table is made of smoothly polished boiler plate, the post carrying it of turned wrought-iron, screwed and soldered into the same; the post fits very accurately in socket of tool rest. The plate is marked out by engraved dots and parallel lines, to any of which the screw stop can be set *instanter*. I have several small additions in my mind's eye. For thick cutters and emery wheels I use supports of the horseshoe shape; I have several sizes all mounted in the same way as saw-table, and of same material.

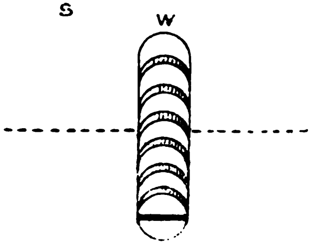
S S, shifting rest, with opening for wheel or cutter; T T, dotted lines, showing the post for fixing in socket. I use them from 1in. to 8in.











across the plate; slot of proportional cut. V, screwed head of post, filed flush with plate; W, front view of round-edged rotary cutter, teeth set at an angle of 60°. A slight bevel
edge would exactly imitate the round-
ing tool, and add to their strength
power, methinks. E on sawplate is
line useful as a parallel guide. The dott
ments denote ⅛in. and ¼in. widths. I
hemispherical holes with a hand dri
drawn with a chalk pencil from any
to opposite end must be of course corr
¼in. screw of steel standing 2in. hig
through the slot of fence gauge H, and
when desired, by the thumbscrew G.
is for circular saw. I think an adjust
V-grooves could be fitted for any chan
ness in saws for this plate.

LATHE MANDRELS.

[27088.]—I have seen a letter by
Edmunds in a recent issue, on the subj
drels for ornamental lathes. In order
changing chucks, and yet have work
proposes to make part of the nose a pla
and to have the chuck a close fit upon
drical part. This is certainly an i
upon the ordinary nose: it centres c
more truly, and it has been largely us
years by one of the leading firms of
engineers. But the fitting together of
and chuck, with the accuracy neces
ornamental lathe, is a delicate matter
skilled workman with the most accur
his disposal, and I think an ordina
would not be likely to meet with grea
fitting chucks to such a spindle. Mor
ever good the original fit, wear must ta

There is, however, a way (and, so far
only *one* way) of making fits, which is a
certain, and which allows of the parts
apart and put together as often as may
and yet always run true,—that way is
shoulder as a cone. Such a shoulde
make, and is strong; the chuck shou
easy to make, and a small error in si
great importance; as the chuck only
or less far on to the mandrel, the truth
is unimpaired.

I should suggest a mandrel of abou
proportions. Nose 1in. diameter,
screwed 8 threads per inch; V th
flattened top and bottom; cone sh
diameter, angle of 45°; parallel neck
running in hard steel collar 1¼in. lon
thrust to be taken at back bearing b
collar on spindle working between hard
Hole through spindle $\frac{5}{16}$in. diameter,
end tapered for centres, taper to be ⅝in.
would not have bearings or thrust p
able. Such parts properly proportione
and used will wear for many years w
ing any adjustment, while my experie
more harm is done to tools by "adjust
that by men who call themselves skille
than by fair wear.

I consider such a mandrel, made of
rials, to be amply strong enough for
lathe.

Finally, Dr. Edmunds appears to find
in getting work done to his satisfacti
don. Probably he has not known wher
at any rate I, and I have no doubt
engineers, would be pleased to carry
signs he might want made.

London, April 5. **John W.**

[27089.]—We are much indebted to
for his description of Niblett's screwin
which seems to be a real addition to
But I fear that, "O. J. L." notwithst
comparative silence is due to the fa
description fails to make us realise th
the apparatus. Till a working spec
visited and seen in London we shall n
come to a conclusion about it. I
whether such an opportunity is yet av

As to Mr. Wenham's screwing tack
ber his showing it to me years ago, and
much charmed with the simplicity a
with which it cut standard microscope
the Ross factory. The apparatus is
greatest reliability and practical utili
drawings and description in the En
chanic are lucid and excellent.

Lubrication of Journal.—If "O. J.
of practising his jokes upon my sugg
now fine sperm oil and now castor or h
oil for a delicately adjusted mandrel,
suggestion on his lathe he will find it
and useful device for lathe mandrels w
do universal work. Sometimes they a
turn up soft wood at the highest possi
and upon special occasions they may
turn up a big job in cast-iron or bore
engine cylinder. For such extremes
of viscosity in the lubricant is all-im
all that is needed is to have a second o
occasional insertion into the oil-hole.

Transferable Chucks.—It is very

psychologically, to see a writer like "O. J. L."—for whom we all have so much respect—showing the loose tile, and trotting out all the obsolete notions that we used to hear gravely urged against having a standard microscope nose and thread. Now no manufacturer would be fool enough to make a microscope with any but the Society's standard nose, simply because microscope users are no longer fools enough to buy such microscopes; and when lathe-users are no longer fools enough to buy costly lathes with noses screwed with a thread of "9·45 turns approximately to the inch," manufacturers will certainly cease to make them; but not before. Indeed, why should they, when "O. J. L." thinks that, "as the facilities of carriage are now so great, it is a very easy and a far more satisfactory plan to send up the headstock to have it fitted" with a new chuck, than to make such chuck one's self. The fact is that, upon the principles now laid down for interchangeable mandrels, there is no more difficulty in making chucks transferable than in making microscope objectives transferable. It is quite as important for a manufacturer to have his chucks transferable from one lathe to another as it is for an amateur to be able to exchange, sell, lend, or transfer a costly chuck to a brother amateur. In the one case the value of a costly chuck is always in hand, in the other it is absolutely sunk unless in transfer with the whole lathe. So much for the dogma, "I am morally sure it will never be done." "O. J. L." will forgive me for thus using him to point a moral and adorn a tale.

The screwed nose on the back-gear spindle is useful to carry medallion work, and for carrying change-wheel chucks for getting difficult motions on work placed on the front spindle—such work being under the action of cutters worked from the slide-rest. The third screwed nose upon the dead-centre spindle is useful for carrying drill-chucks, and work to be presented to the action of tools in the lathe-spindle.

I have to thank Mr. John W. Newall, of Arnold-road, Bow, for an interesting and apposite communication. I hope that he will assist in the discussion by means of a letter to the "E. M." The vast advantage of the "E. M." is that it is a field where practical workers and scientific amateurs may interchange ideas and become known to each other; and I am glad that my letter has made me known to him.

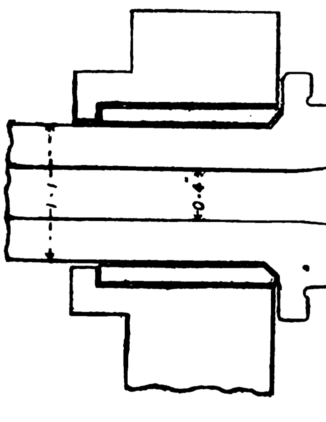
James Edmunds.

8, Grafton-street, Piccadilly.

THE "EDMUNDS" LATHE MANDREL.

[27090.]—SINCE writing my letter inserted in the "E.M." for January 21st, I have calculated the proportions necessary for a traversing mandrel suitable for a 6in. lathe worked by one man. A 6in. back-geared lathe is the largest lathe which can be comfortably worked by one man. It is a size which allows of ample strength in all its parts and accessories, and it appears to be, on the whole, the best size as an all-round lathe, such as the amateur or anyone having only one lathe for all purposes requires.

Inclosed is a sketch of a mandrel-nose embodying the essential features of the "Edmunds Standard Interchangeable Mandrel," as described by Dr. Edmunds in the "E.M." for 1884. Those essential features are—



1. A cylindrical base to the nose of the mandrel, to which the chucks are accurately fitted. By this means perfect concentricity is insured, irrespective of wear of the screw-thread, or even of its deformation.

2. A broad face, against which the chucks are screwed up. By this, angular variation from the axial line is practically prevented.

It appears to me that these essential features cannot be improved on. They provide all that is required in the simplest way. The forms required are easily reproduced by ordinary mechanical means at small expense, and when produced are extremely enduring. The chief points open to question, and which I have kept before me in my calculations, are—

1. Form and pitch of the screw-thread on mandrel-nose.
2. Diameter and length of nose.
3. Diameter and length of front bearing.
4. Diameter and length of back bearing.
5. Bore of mandrel.

If we can settle these points we shall have made a great step. Lathes up to 6in. centre may thereafter be all made with the standard nose, and all chucks fitted to one mandrel will run equally true on every other. By discussing it in the pages of the "E.M.," the question may be settled not only for this country, but also for America, and we may have the various American chucks sent over ready screwed to fit our standard mandrels. In this way the objectionable projection of these chucks in front of the nose will be in a great measure avoided.

1*a*. *Form of Screw-Thread.*—The form should be such that it can be readily and exactly reproduced by mechanical means. This condition confines us to those forms of screw-threads which are bounded by straight lines, such as V-threads, truncated V-threads, and square threads. It excludes those V-threads in which, as in the Whitworth system, the top and bottom of the thread is rounded off, since although the rounding off is nominally a function of the pitch yet practically this rounding off cannot be produced with mechanical precision. Square threads are objectionable on account of their weakness as compared with V-threads, and the greater difficulty of making them. Ordinary V-threads are objectionable on account of their incising the nose deeply, and thus greatly reducing its strength. The ordinary V-thread when truncated would serve the purpose, but it is inferior to the "buttress" or resistance-thread. The "buttress" thread is a V-thread in which one face is at right-angles to the axis, and this face is the one which bears the stress. For a given length and diameter it is as strong or stronger than the ordinary V, and it possesses the great advantage of being made to any required pitch, without necessarily increasing its depth. It is also easily made, and if slightly truncated is a form suitable for chucks either of wood or of metal. The face of the thread which takes the pressure being at right-angles to the axis renders this thread quite unsuitable for ordinary mandrels, as it has no concentring action; but in the form of mandrel we are discussing this is an advantage. The centring of the chucks should be left entirely to the action of the cylinder-base; any lateral pressure exerted by the nose elsewhere, such as would take place with a sloping thread-face, would, unless the thread both on the nose and also in the chucks was absolutely perfect, oppose this centring action of the cylinder base, and cause it to wear unequally owing to the friction produced.

1*b*. *Pitch of Thread.*—The pitch of the thread is of importance, as if the pitch is too fine the chucks not only get jammed on to the nose, but in a back-geared lathe the torsinal stress may be so great as to produce through the medium of the nose-thread enormous tension. This tension may be sufficient to strain the nose. By direct experiment with a back-geared lathe, I found that with the slowest speed a torsional stress of 120in.-lb. was produced, when used as a plain lathe, and when back geared with a power of 14 to 1 this stress rose to ten times as much, or 1,200in.-lb. (A torsional stress of so many inch-pounds means a force of so many pounds applied at a distance of 1in. from the axis in such a way as to tend to produce rotation.) This stress of 1,200in.-lb., when applied to a screw of ten turns to the inch, produces a tensional stress of 60,000lb. This would tear off the nose of a mandrel 1in. in diameter and 0·8in. at the bottom of the thread. If applied to a screw of four turns to the inch, the tensional stress would be 24,000lb.; with a screw of five turns to the inch, the stress would be 30,000lb.; and with one of six turns, 36,000lb. It is therefore desirable to have a screw of coarse pitch, as as to reduce tensional stress, surface abrasion, and the liability of chucks to jam. We are, however, limited to such a coarseness of pitch that there will not be any risk of the chucks flying off in case the lathe is stopped quickly. A screw-thread having five turns to the inch is, perhaps, as coarse as can be safely used. With a screw-thread of six turns to the inch (a 1·5in. Whitworth screw) chucks do jam when doing heavy work.

2. *Diameter and Length of Nose.*—In the description of the "Edmunds mandrel" above referred to, and illustrated in the "E. M." for April 1st, the diameter of the mandrel shoulder is given as 2in. This is quite enough. The face of the chuck fitted to it must be of the same diameter. It is desirable to make the chucks as light as possible consistently with strength, and as there is no objection to having a nose of large diameter, we can by this means reduce the weight of our chucks considerably. By making the diameter of the nose large, we also gain the advantage of an increased wearing surface of screw-thread, and by increasing the distance from the axis, at which the friction between the chucks and shoulder acts, the liability of the chucks to jam is diminished. By having a nose of large diameter, it will be possible for those who now possess costly lathes with the small noses supplied by Holtzapffel, Evans, and others, to put a standard nose over the existing one, and so be able to use chucks fitted to the standard nose. The length of nose need not be great. The screw takes no part in concentring the chucks, as in the ordinary form, but only acts as a bolt to hold the chuck upon the mandrel. It, therefore, need not be any longer than is requisite to give sufficient resistance to shearing stress. A length of 1in. is ample for this purpose; it allows three full threads with a screw of five turns to the inch. It will probably be said that a nose so large as is proposed looks heavy and out of proportion. This is almost entirely a matter of habit. To one accustomed to a large nose, those supplied by Holtzapffel and Evans seem weak and puny. The form and thread of the nose are shown in the accompanying sketch, and the dimensious are tabulated below:—

Diameter outside	$1\frac{7}{16}$in.
" at bottom of thread	$1\frac{3}{16}$in.
Pitch	0·2in.
Truncation of thread, top and bottom	0·0875in.
Angle of sloping face	45°

A safe working tensional stress for this nose, coned out as shown, would be something over 50,000lb., assuming 50,000lb. as a safe working tensional stress for steel per square inch. The other dimensions of the mandrel-head are as follows:—

Diameter of cylinder-base	1·5in.
Length of "	0·2in.
Diameter of bearing zone on shoulder outside	1·9in.
" " " inside	1·7in.
Outside dia. of mandrel-shoulder	2in.
Thickness of shoulder	0·375in.

3. *Diameter and Length of Front Bearing.*—A large bearing does not run so lightly as a small one, especially at high speeds. Apart from questions of pressure, the friction is due apparently to cohesion of the particles of the lubricant, which have to be severed as the spindle revolves. Some of the particles probably roll over the others, and act as balls do in a ball-bearing; but since these particles are surrounded on all sides by other particles, there is considerable friction involved, and it may be that when the speed is high the particles have not time to roll, but are torn from one another, one film of oil being carried round by the spindle, and one adhering to the bearing. If this is true, the friction will increase in proportion to the area of the lubricating film. It is, therefore, desirable to make the bearing surfaces as small as possible. The force required to overcome the friction of a moving body varies directly as the friction and the space traversed; inversely as the time in which the movement is effected. In the case of a journal rotating in a bearing with a given velocity, increase of the diameter increases the force required to maintain the velocity in three ways.

1. The friction acts at a point further from the axis, and its efficiency is thus increased by leverage.
2. For a given angular movement, the length of arc—i.e., the space traversed—is also increased.
3. The surface velocity—i.e., the velocity with which the friction is overcome—is also increased. We have then three factors by which the force required is increased — viz., leverage, space traversed, and surface velocity, and these three factors vary directly as the diameter. The force, therefore, varies directly as the cube of the diameter. It is, consequently, especially desirable to keep down the diameter of the bearings. The front bearing is liable to a pressure of 1,500lb. For steel bearings such as are used in lathes, well-hardened and highly polished, a pressure of 1,200lb. per square inch of diametrical section may be used with safety, provided the lubrication is ample and of suitable quality (Thurston). If we have a mandrel bored out to 0·4in., the smallest diameter which will give sufficient strength to meet the torsional and transverse stresses is 1·1in. at the front bearing. With this diameter the bearing must be 1·376in. long; but, since we cannot be sure that the lubricant will always be suitable and abundantly supplied whenever the maximum pressure is exerted, it will be safer to make our bearing 1·5in. long.
4. *The Back Bearing.*—There is but little pressure or stress on this bearing. It need not, therefore, be larger in diameter than will allow of sufficient strength behind for the attachment of the screw gear—0·875in. is enough. It may also be short—0·75in. may be sufficient length, or even 0·5in.
5. *Bore of Mandrel.*—A hollow mandrel is a great convenience, and the larger the bore the

better. With a mandrel 1·1in. at the front bearing, we can have it bored out to 0·4in. If a larger bore is required, the diameter of the mandrel must be greater.

In all these calculations, I have assumed that the mandrel must be strong enough for the heaviest work the lathe will admit. For a lathe in which the back gear is only used as a means of reducing speed and not for the sake of gaining power, such as the purely ornamental lathe, the mandrel may with advantage be lighter. A diameter of 1in. at the front bearing would be sufficient with a bore of 0·4in. The back bearing might be 0·75in. in diameter and 0 5in. long. To my mind the great value of Dr. Edmunds's mandrel lies, not so much in its interchangeability, as in the mode of chuck fitting which is its essential feature. An incidental advantage of this mode of fitting is the possibility of making the mandrels interchangeable. No chuck fitted to a mandrel on any other principle can be relied on to run true if once taken off the mandrel on which it has been turned up, except those fitted to a cone, like the centres. This mode of fitting by a cone is practically only admissible for small chucks. Chucks fitted in the usual way may run very nearly true, but each time they are taken off and put on to the mandrel again, their fit and truth of running are impaired, because the screw is the concentring agent, and the screw, both in the male and female portions, is easily deformed, not only by unfair usage, but also by wear and the great stress to which it is necessarily subjected in ordinary use. If mandrels are to be made on this principle at all, they may as well be made to standard sizes as to any other, so far as cost of manufacture goes, and so be interchangeable. The only part in which extreme accuracy as to size is required is the cylinder-base. This ought net to exceed the standard gauge adopted, nor to be under gauge by more than one quarter-thousandth part of an inch. The other parts are only required to run perfectly true, and to gauge within one-hundredth of an inch; but they must not exceed the gauge. **A. Gray.**

THE EDMUNDS LATHE MANDREL.

[27091.]—I SHOULD like to ask Dr. Edmunds (letter 27036) one or two questions about this. I don't know much about the capability of the small arms factory for making standard interchangeable mandrels, &c.; but, supposing they could turn them out by the hundred at three guineas with the hard collars — what use would that be to nine amateurs out of ten? The collars are supposed to fit the mandrel. Then they must be put into the headstock dead true in line with each other, or the mandrel won't revolve, let alone traverse—not an easy job for the average amateur. Remember the makers of ornamental lathes fit the collars to the *headstock* first and to the *mandrel* afterwards.

Then he gives 17s. for "standard taps and gauges." I think we must allow three taps for such a short screw, then we shall want two D-bits for the bottom of screw-thread and cylinder fitting, and as the screws are to be 1¼in., let alone their being buttress or other special thread — there won't be much left to buy gauges with—1¼ ordinary Whitworth taps costing about 9s. each.

Why does the amateur want "two such mandrels," and what are the "four standard interchangeable mandrels?"

If we are to do heavy metal work on an ornamental lathe, we must sacrifice light running, or else use a good tool unfairly. Now, I have pretty well worked out a traversing mandrel for amateurs, and shall be happy to send details if desired. It would be a deal easier to fit up than the Edmunds with its two collars; but there is nothing particularly "standard" about it.

N. D. F. P.

MAKING TWIST DRILLS. — TO "COUNTRY PARSON."

[27092.]—"COUNTRY PARSON" may not refuse a few hints on the subject of his query, though they only come from a nobody. I have made many drills since my first square-shanked one of the old-fashioned patterns somewhat like the side view given in letter 26993, and strongly recommended by "Eos" as no bad substitute for the twisted, though that is an opinion I could not endorse. Latterly I have made nothing but twist drills, and those only of larger sizes, from 1in. down to ⅜in., for I consider that unless very many of the smaller sizes are required, they can be bought cheaper and better than the ordinary amateur can make them. The larger sizes I think it is worth the amateur's while to make for himself, as the prices are high, and he has not in general sufficient quantity of work to be done with them to repay him for the outlay; that is if the *res angusta domi* have ever to be thought of.

My drills down to 7/16 are all forged out of good square or octagon steel. A piece of suitable size is taken, and about 3in. or 4in. flattened on the anvil, if you have fullers, and anybody to strike for you, you can run two flutes on the end instead of the flats, which is better. I made many of mine simple flats, but the difference is not great in the larger sizes.

The end being fattened or fullered, heat again to an even heat, being careful not to make so hot as to scale the steel. Take it to the vice and grip the tip of the flattened portion, and with a wrench on the other end of bar, or even with the forge tongues, twist from right to left—be careful not to twist too much; two or three turns will probably be enough. It is best to have a drill beside you that you may compare the amount of twist in it with what you are giving your drill. If you have been quick and handy, very little of the heat will have gone out of the steel, and you can now take to the anvil, and straighten the twisted part if it is bent, while at the same time you hammer it on the edges to thicken them up as much as possible without thickening the centre part. To get it to your mind, you may have to heat again. After twisted portion is right, you may cut off, and either forge the shank roughly octagon or else take it at once to the lathe. First turn the shank to some size your drill-chuck will take in, then reverse, and turn the twisted part to the exact size required, but giving it a very slight taper from lip to shank.

You may now, if you like it, with a round file of suitable size, file up the twisted groove—to thin it more in the centre, and give a better finish; but I have not found this necessary. All being done in this way, it is necessary to cut off about ⅛in. or ¾in. of the tip, which was held in the vice when twisting, as it is probable this part will be found to be straight, or, in some other respect, badly shaped. When this pinch is turned off, you can then harden and temper; and if you now take to the grindstone, and carefully grind the lips, leaving about 1/100 of the lip as left from the turning tool, you will have a drill which, in wrought iron, will give you two unbroken and equal spiral shavings.

I should say that with drills larger than ⅜in., I seldom, if ever, bore into the solid, and these home-made forged drills are not intended to do so. Mine increase in size by 1-16in., and in drilling I generally go by ⅛in., which leaves 1-16in. out all round, so that it does not matter so much, having the central part of the drill thick, as it will be in forged drills which have not been filed out.

To make the smaller sizes, if "Country Parson" decides on making the attempt, he may do so in his lathe if he will make a few not very expensive fittings. First he will need to have a spindle for mounting the different circular cutters which will be needed for milling out the grooves. Next he will need a support for the drill under the cutter. A means of holding the shank of the drill, which might might be a hand-vice, such as I think watchmakers use. It has a handle on a tail; this tail should be flattened and twisted to the amount requisite for the drills. This twisted flat portion must work smoothly and easily through a slot, so that as it is pressed forward by a screw, which must be made to abut against its end, it will give the necessary twist to the drill as it passes under the cutter. The action is the same as that used by the gunmaker in cutting out the grooves in a rifle barrel. A much better drill-holder would be a centring chuck, such as seen on small hand-drills, or self-centring braces, now to be got everywhere, but which are for real work and convenience not to be compared to the old style with spring catch.

I hope this is sufficiently clear for "Country Parson" without a sketch, which, however, if he needs, I shall strive to make—i.e., if he or others don't prefer to pick holes in or scoff at what I have proposed.

"Eos" seems to have found my contemptible little contrivance for sharpening twist drills not so devoid of merit as it was desired to make it appear.

"Harrison" does not give much help on twist-drill making, and the book hardly comes up to what one might expect; the illustrations are very poor. The price is big for so small a book, and so badly got up; and unless there is a later edition than mine of 1882, though a good book enough, it is not up to date.

Would "Eos" kindly give some particulars of Costa's blowpipe? I got some time ago a paraffin blowpipe; but I never could get it to work for me, though I saw the patentee melt copper easily with it, and platinum, only using in this case oxygen instead of air. I attributed my failure to not being able here to get the proper spirit, which in the directions is called "l'essence minéral" or "l'esprit de bois." **Fredk. Carre.**

WENHAM'S SCREWING APPARATUS.

[27093.]—FOR an apparatus with a fixed traversing bar, this certainly appears a good one, especially getting the bar itself out of the way at the back of the lathe. But a look at the drawing cannot fail to suggest the thought, "What a lot to do a little!" Now, I say this without in the least wishing to detract from the merit of the arrangement. I say the same in respect of my friend "F. A. M.'s" bar, and it was one of the defects in the ingenious lever arrangements of poor defunct Gilray. I am also fully alive to the inconvenience of a bar used as a beam compass, as Mr. Wenham calls it, the plan adopted in Mr. Niblett's apparatus. In the latter it is the adjustable swash-plate that constitutes the merits of the invention and the ingenuity of the inventor; the bar is, as usual, the weak point. The defect of the fixed bar is even suggested by the weight and cord arranged to balance it and its fittings. The weight and cord may not be absolutely requisite; but there it is, implying that the bar does not slide with perfect ease without it. To those who have endeavoured to think out a good, simple, and efficient plan, there will always occur this dilemma. If the tool traverses, *you must have a bar of some form*, or you must have gearing, or you must drive your rest or other tool-holder by cords and overhead. It is only when the traverse is given to the work that all difficulty ceases, and that you can use at pleasure either a hand-tool or slide-rest; and now comes the one drawback of not being able to chase a thread on a rod supported by the back centre. In the traversing mandrel, and in "F. A. M.'s" or in Wenham's, the arrangement is a copying machine, and for each required pitch a screw ferrule must be ready to hand. In Niblett's twelve pitches are marked and applicable in a moment, and for a chance thread a few experimental trials, setting the pointer (e.gr.) between 10 and 11, or 20 and 21, the desired thread can with little difficulty be got at. Also, as suggested by a correspondent, this apparatus can be arranged without the bar, to give motion to a traversing mandrel. The more this plan is studied the more will its merits become apparent; and I am by no means sure that this suggestion of using it on a traversing mandrel will not prove a very valuable one, as it retains the best part and gets rid of our common enemy—the sliding bar or beam compass arrangement. The patent will in this case protect the inventor, nevertheless, as it ought to do. Used thus, any pitch from 6 to 40 would be at hand, and there would be no ferrules to put on, nothing, in fact, but to remove the sleeve, set the pointer, and allow the fixed rubber to come into action.

I am writing rather lengthily, I fear; but there is another point worth consideration. "When all is set in place," says Mr. Wenham, "a wire hook," &c., and then "in order to cut screws "first," "next," "then." There are seven distinct things to be done, besides one or two secondary ones. Here it is again, such a lot to be adjusted to trace a few threads; and no fault of Mr. Wenham's apparatus, but a fault inherent in all and every sliding-bar arrangement. Verily, the screw-chasing question is one of aggravating difficulty: so little to be done, so simple a motion needed, and yet such difficulty in effecting it. If it were not for the cost, the traversing mandrel is undoubtedly the simplest of all, and there are no levers or bars or gears or cords. But the cost is terribly prohibitive, and furthermore there are thousands of lathes in use with ordinary mandrels, and for these I still hold to Niblett as cheapest, simplest, and needing no alteration of the lathe, and scarcely any additional fittings. It may have the usual up-hill battle to fight; but if I mistake not, it will be largely adopted when better known.

O. J. L.

SCRAPS FROM MY WORKSHOP.

[27094.]—*Steel Bows for Small Drills.*—I always made these of umbrella ribs, which used to be of round wire; nowadays they are grooved, and still better for my purpose. Take two of these, put the grooves face to face, secure them tightly in position by temporary ties of button thread; then get some strands of the finest copper wire—that stripped from the strings of musical instruments is the best. Lap it in a dozen folds at both ends, the middle, and also at two intermediate spaces. Do this very neatly, and fasten off securely (with an underloop like a tied fish hook), cut off the thread fastenings, brush each tie over with Baker's fluid; at a blowpipe, rub each binding with a stick of plumbers' soft solder till the wire is coated; wash your work with hot water, and dry it. Varnish over the solder with Brunswick black, cement each extremity into horn or wood, a handle at one end, a tip at the other. You will now have as good a tool as you can buy. I greatly miss the square solid whalebone ribs of olden times. I not only used them for the above purpose, but also for tops of fishing rods and such like needs of elasticity.

Softening Rods and Wires of Hard Steel.—The two primary objects to be considered in this case are—first, annealing thoroughly, so as to avoid damage to cutting tools at the lathe or die stock. Secondly, while firing bars, rods, or wires, not to burn the steel or bend it out of a straight line. With slender stuff this cannot be insured without a muffle to protect the metal. This is a piece of iron piping suited to the length and gauge of your work—1in. pipe to ½in. rod, and so on in proportion; one end is plugged with clay, then the rod is inserted, coal ashes poured in and well shaken till the case is full, then the open end is plugged with clay, and the muffle put in a clear coke fire without flame. When heated to a cherry red, withdraw, and put to cool very slowly near the fire. No steel can be burnt in this way, and if you have to screw a long mandrel or any such rod requiring the most rigid exactness of centres, you will appreciate this mode of action. Again, on softening flat and square bars to make tools, it is an advisable plan. If you smear the surface of your piping sometimes with wet fireclay, it will last long. Pieces of old musket barrels make good annealing boxes if so treated. I have frequently used discarded food canisters, unsoldered, and rolled into tubes on an iron rod, covering them with a thick coating of common clay. I have also "case-hardened" many small articles with no better covering. In remaking steel tools which have to be cautiously softened, leather scraps or leather charcoal (made of worn-out boots or harness) should be substituted for the coal ashes, and also prior to quenching. The process gives life to the steel. Razor-makers have known this before any of us were born! It is a very rare occurrence with me for work to crack—entirely owing to the use of animal carbon.

Glass Dishes.—About thirty years ago I met an amateur photographer abroad who made his own "washing" dishes. He carried deal boxes in pieces, and a lot of glass in squares, and slips all cut to match. He had a jar of waterproof cement from Paris. From its smell and appearance, made of shellac dissolved in naphtha. He used to smear the inside of his boxes, then the glass, pressing them well together.

A Wire Brush Wheel.—In preparing beaded and embossed articles of brass and copper for electroplating, scratch bushes, both hand and revolving, are requisite for penetrating and cleaning sunk surfaces and engraved lines. One of the most useful I have made consists of "wool comber's wire card," as it is called, being a roll of leather covered with fine bristles of iron wire. A roller of wood is set on a spindle; this cylinder is 2½in. diameter, 6in. long. The edges of the leather are tacked down on the wood by very small nails. I also employ the wheel for clearing the teeth of files when clogged, also for brushing off rust from chucks and lathe fittings, &c. The armourer from whom I got it used the material for scrubbing rifle barrels in browning them.

Emery Files, Cloth, &c.—I have made all kinds and forms of the former to suit my work in an easy way—viz., by cementing pure emery dust on round, flat, and triangular slips of tough wood for holes, grooves, and plate surfaces. Good glue can be used, made thick, the wood saturated with it, then dipped and rolled in the powder, shaken, and slowly dried; but these get sticky by damp, and I have always preferred for this purpose waterproof cement, made by dissolving shellac in methylated spirit. An excellent abrasive cloth, evidently made of pulverised quartz, came out two years ago, which cuts metal like a file; the rubbing side is coloured blue. In damp weather the cloth gets soft, the glue, or some other adhesive, sticks to your fingers and spoils the work, and it ceases to cut. Moreover, the price is high. I paid 10d. for a small sheet! I hope the inventor has by this time adopted some durable cement, for he must have heard many and loud complaints. I use emery cloth for finishing scratched metal by a roller on a spindle revolving in the lathe. This roller should have a slight rim on each end to prevent the tearing of cloth, which I put on with stiff glue. When worn out a new piece can be fitted over it several times. Slate dust made up in any of these ways, or merely moistened with water, is good for taking the fire mark from silver; it is much used by the Indian goldsmiths for that purpose; wood-ashes for brass by the makers of pots and pans.

Eos.

THE STAR HACK-SAW.

[27095.]—I CALL this a gem of a tool. I have had it in my workshop about 12 months, doing speedily and more exactly the old cutting work of a file, though its extreme hardness renders this saw a very fragile article. Not only must the metal you cut be fixed immovably in a parallel vice, but the hand must strictly obey the eye; abundant lubrication with soft soap, and oil to feed the cut, and no swerving of the wrist. Under these conditions, irregular shapes can be turned out, leaving little to be done with the file, as breakages of blades will occur, especially when a piece is revolving in the lathe. I keep two sizes of frames besides the original 9in.—viz., one of 6in. and one of 4in., which I can utilise for fractures. I measure off the fragment, dip the end or ends in grease, and blaze them off at a clear red fire or a candle; then bore a fresh hole or holes with a sharp-ended three-corner file stuck in a hand-drill. The very small bits cemented into a stick of deal serve to nick screw-threads, or form the outline of circular saws; thus there is no waste, and a fresh dozen of blades cost little. Cannot some of our good mechanicians come to the front with an automatic spiral twist-cutter—one of the star 6in. blades mounted diagonally on a running plane, adjustable by elevating screws to meet the lower circumference of a revolving steel rod? The V-groove being done, there will only remain the rounding out with a circular suitable cutter such as I use for grooves of segmental form.

Eos.

BURNING OF COILS IN ARMATURES.

[27096.]—I DON'T see that there is any theory to discuss. If, as seems from description, the armature was a Gramme-wound one, the touching of two adjacent commutator sections would obviously short-circuit the intermediate coil, and if the latter was cutting lines of force when s.c. occurred, a current would, of course, be generated proportional to the resistance of section. Thus, supposing section had a resistance of 0·05w. and E.M.F. four volts $C = 80$ ampères, likely enough to burn any coil out which is not made to carry more than, say, about 20 ampères with safety.

G. T. Pardoe.

A GOOD WORD FOR "OURS," AND SUNDRY OTHER MATTERS.

[27097.]—I AM glad to see that "Ours" is appreciated in America. In this country I think the paper is quite unique; at least, I know of no other paper on the same lines, and most assuredly no paper so well worth its price. I should like to point out to all inquirers that they would greatly enhance the value of the paper by an appropriate selection of titles to their inquiries and communications. To repliers I would suggest that where a query has a bad title they should quote that title, and at the same time add to it a more suitable one, so that both can be printed together and so appear in the index.

There is one matter which I would like to protest against, and that is the desire which there seems to be to manufacture patented articles not merely for experiment, which is legitimate, but for permanent use, which is, in my opinion, dishonourable. I am sure that amateurs who do this cannot reflect on the matter, or they would see it in this light. I remember a laboratory tromp in use at the School of Mines laboratory in 1879, which was somewhat similar to the one recently described in "Ours," but it was much more clumsy, although effective.

I would suggest to Mr. Wakelin that, if he used a spring balance to support the weight from, in his experiments on pressures being dynamic effects, and hoist this with the bales or other weights, he could, by watching the dial, ascertain the critical speed he desires. Finally I would point out to inquirers who write to me for advice, and who apologise to me for the trouble they give, that, whilst I have the time to spare to reply to them, so far from being a trouble it is a pleasure to me to do so, the more so as it often results in business to the satisfaction of, I believe, both parties.

Electrician.

THE MANUFACTURE OF CRYSTAL SPHERES.

[27098.]—I SEND you, as being likely to interest some of your readers, the following notes by Mr. W. E. Hidden, of Newark, N.J., on the manufacture of crystal spheres or balls:—

It has been generally conceded, by the few owners of the beautiful spheres of rock crystal (quartz) which are now considered the acme of a Japanese bric-a-brac cabinet, that they could only be manufactured in Japan; no other people having the requisite patience and the skill to fashion a mass of rock into such a perfect shape. This opinion prevailing among collectors of *chef d'œuvres* has been the sole reason for the astonishing prices which crystal balls have occasionally brought. Only lately, at the sale of a collection of Oriental curios, a perfect sphere of transparent colourless quartz, 4½in. in diameter, brought the sum of 1,725dol. The writer also remembers the sale of a ball of about the same size, in 1877, for 2,000dol. An extraordinary one, in point of size, being nearly 7in. in diameter and quite perfect, is held by its owner at a valuation of 5,000dol. Now, such prices and valuations are founded only upon the mistaken idea of the rare skill and great patience thought to be necessary to shape such objects to such perfect results. A halo of mystery surrounds these objects of Oriental workmanship, too, and helps to give absurd ideas of value to them. The word "Oriental" is also pushed to extreme uses by the dealers in Japanese bric-a-brac, as, for instance, a dealer possessing a crystal ball will confidently assure you that rock crystal from the Orient (India, China, or Japan) is very much harder than the same material from other regions; which assertion has no foundation in fact. The hardness of quartz is an essential constant of the mineral, as are also the elements of its crystalline form. Wherever found, quartz crystals are identified by their uniform hardness, density, and shape. Appreciating the several facts above mentioned, Mr. Hidden saw no reason why America could not produce these crystal spheres equally as beautiful as the famous Japanese productions; and with this end in view, he first sought the material suitable for the purpose, being confident that the labour of shaping and polishing was but a secondary matter, a mere mechanical operation. As early as 1878, he says, my attention was directed to the Southern States, as a probable region wherein to procure clear crystal masses for art purposes. It was in 1879 that I had my first success in discovering a locality of really fine and perfect material. This was in Sharpe's township, Alexander Co., N.C. Since then, I have found occasionally very fine masses in other parts of North Carolina, and also in Virginia, South Carolina, and Georgia, though in none of these places in any great abundance. California and Arkansas have furnished great quantities of clear rock crystal; but perfect pieces of large size were very exceptional. Opportunity for trying the experiment did not occur until the summer of 1884. I then enlisted the services of a skilled lapidary, putting into his hands a piece of clear material from North Carolina, suitable for cutting a small sphere, and urging him to lose no time in completing the work. I was somewhat surprised and pleased to receive from the lapidary the finished ball within a week from the time the rough mass was put into his hands, the ball being perfect in every particular of roundness, polish, and pellucidity. It measured 2in. in diameter, and possessed every perfection and attraction belonging to a Japanese crystal ball. This perfect sphere of quartz, the largest ever cut in America at the time, was exhibited at the North Carolina State Exposition of 1884, and at the New Orleans Industrial Expositon of 1884-5, at which places it received many encomiums from the press, as evidencing the resources of our country and the skill of American labour. After ten days' labour, a superb crystal sphere measuring $3\frac{1}{16}$in. in diameter, and weighing exactly 1½lb. was produced. As a piece of American workmanship in crystal it stands alone, at this time; and in its various perfections is unexcelled, excepting in size, by any similar Japanese effort that has come under the writer's notice. Therefore, possessing the requisite material, we can henceforth make crystal spheres, lenses, or even "bottles of stone," here within the United States, if the dilettanti should require them, or fashion demand such articles of luxury. Have any of your readers tried their hands at making prisms and lenses of rock crystal?

Dayton, Ohio. **R. J. M.**

ON PRIMARY BATTERIES, AND ON CHARGING ACCUMULATORS FROM THEM.

[27099.]—IN reply to "Kalon," whom I thank for his kind remarks on my letter, I may state that the great point in the battery I described is the depolarising solution, which is of astonishing power, so much so that only special forms of carbon can withstand it. The cubic contents of the cell are about 1,000 cubic inches. The negative electrode consists of a number of carbon rods, thereby giving very large surface, and these are arranged around the zinc, which is cylindrical and contained in a porous cell, which also contains about a gallon of dilute acid. The internal resistance averages ·05 ohm. per cell. This is the cell for direct lighting. The 11d. in my letter is a misprint for 1·1d. (one and one-tenth); I thank "Kalon" for drawing my attention to it.

So far as I can see, "Kalon's" battery is exactly the ideal battery I outlined in my last letter. There are, however, several points which need to be considered in a primary battery.

First, as to low resistance. The ideal battery should be a single fluid, both to obviate trouble in charging, and to enable the largest possible surface to be obtained in order to minimise the internal resistance. This is specially important in a cell of low E.M.F.

The only other reasons for high E.M.F.—viz., cheapness of first cost, and avoiding waste of zinc, are both overcome in "Kalon's" battery. Cheapness of first cost is quite beside the question in this case, as the consumer does not buy the cell (I am speaking from the consumer's point of view), and waste of zinc, because the more zinc is consumed the more waste product in a marketable form remains. I assume that the residue is in itself valuable, as I do not suppose he means to reconvert the zinc salt into metallic zinc. If I am wrong here, I trust "Kalon" will correct me. I should be glad to hear a little more of this battery, which seems to me to be a very dangerous rival to lighting by machinery. This battery, however, could only be used in large towns, unless the substances employed are easy transport. I will not give my reasons for thi they are so obvious, and space is valuable. "Kalon" says I have considerably under-estimated the cost for lighting by machinery, and here I disagree with him. He will doubtless be surprised to learn that I can produce a horse-power hour for considerably under one halfpenny by employing a suitable engine. This I can guarantee. This engine will also run steadily for hours without attention, so that no special attendant has to be paid. I can also guarantee twelve lamps (sixteen candle power), and in some cases thirteen, to the horse-power, so if at all, I over-estimated the cost. I also omitted the saving in furniture and decorations insured by using the electric light, as this is patent to everybody.

I think that lighting by primary batteries instead of being, as "Kalon" so justly remarks "pooh-poohed" by electricians, ought to be greatly supported by them, since such small installations very often pioneer the way to more important work. I do not believe that any really unprejudiced man, who knows what he is talking about, would condemn primary battery lighting under certain conditions. Finally, I am very pleased to see that a company is taking this matter up, and I wish it every success. I mean to investigate this matter thoroughly, and if I find that the battery satisfies the conditions laid down by me, I shall have the greatest pleasure in assisting "Kalon" in any way I can, and so, I doubt not, will others.

Electrician.

ON PRIMARY BATTERIES.

[27100.]—The letters on primary batteries by "Electrician," p. 98, and "Kalon," p. 128, would be immensely more interesting than they are if the writers would describe, or give some definite idea of, the nature of the wonderful batteries they hint at and commend. "Kalon" thinks that "Electrician" should describe more minutely the battery he favours, but omits to describe the arrangement which will run for 120 hours "without any attention whatever." It is not so many years ago that it can have passed out of the memory of your readers that similar statements were made (about the time of the Crystal Palace electric lighting exhibition), but the batteries are not yet forthcoming. The cost of a battery will depend on the price of zinc and acid, when you reduce it to its lowest function; and if you can recover the zinc or produce something commercially valuable in your battery cells, you may have your current for nothing. It may be that "Kalon" and "Electrician" can explain how we may arrive at so desirable a consummation of all our labours; but I would ask how is it we have not already reached that point? Has anything of any real value been discovered since Mr. Sprague arranged his Table VI. p. 171, of the second edition of "Electricity: its Theory, Sources, and Applications," in which he gives the "cost of battery working," and on p. 142 explains how the "actual cost of the cell will be reduced to nothing in many cases"? Mr. Sprague deals with principles, and puts it within the power of readers to see exactly what can be and what cannot be done; the correspondents above referred to give us nothing but stale news tempered with hints that they could explain a lot if they liked.

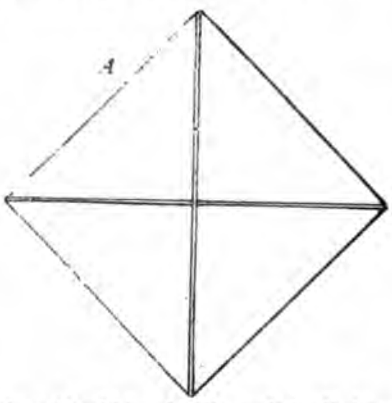
Now, I fancy I know which is the cheapest existing battery in working cost: it is the Upward or chlorine cell; but, judging by prices charged by those who have it in hand, it cannot be installed by everyone who wants an electric light, though cheap enough, as batteries go, for those who have capital. With the help of Mr. Sprague's book, the working cost of any arrangement can be calculated, so if "Electrician" and "Kalon" will kindly tell us of what their batteries consist, and, so far as the latter is concerned, how the zinc is recovered, we shall be in a better position to understand where we are, for, speaking with all deference, I have been unable to obtain any information whatever from their letters that I could not also have obtained from "circulars" descriptive of many "new" batteries which seem to have gone into the Ewigkeit.

Nun. Dor.

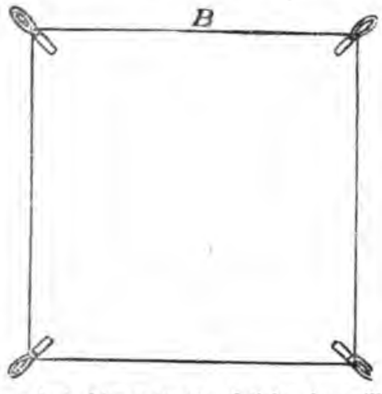
INDIAN KITES.

[27101.]—From time immemorial kite-flying has been a popular recreation in Hindostan. The article may be seen perpetually afloat in the air. or attractively arranged in the rude mat-built shops of the petty dealer in native wants. The starved urchin, nude and reckless of fate, will invest his often illgotten halfpenny in a tissue paper affair of two cross sticks and a sheet of the above material, the string, too, another copper coin will obtain, of country cotton thread; but there are "kites *and* kites"—the face of a demon, or the black and white outline of its feathered namesake, or the rainbow-painted and gold-starred productions are manufactured in quantity for the youthful citizen and spectacled sexagenarian alike; whether boy out of school or clerk out of office, customers in crowds create an active demand on the toy-makers. Over forty years ago, when Maharajah Dhuleep Singh was but a child, and the victorious British army occupied his capital—the densely-built and over-populated city of Lahore—I chanced to be a dweller near one of the many gateways in this strange Sikh stronghold. Here the sport of "kite-ing" seemed of a truly national character. On every fine day in the year (and these follow each other in succession of whole months, increasing in fiery sunlight and hot dust), the whole inhabitants appear on their housetops, every building in the many square miles of city and suburbs being flat-roofed, and connected, the countless kite-flyers there exhibit their skill in the sport. "The Battle of Kites," here as elsewhere, is as exciting to our Aryan brethren as a "tennis tournament" to us. The kite strings are thickly coated with coarsely-powdered glass, put on with glue, resembling sand-paper in their appearance, and abrasive action. The aërial tactics consist in crossing the lines of opponents, and by expert handling to saw through them, at the same time, by entanglement to pull them down and appropriate the vanquished toy. More often both parties come down headlong, like Icarus, to earth, when there is a universal shout and a scramble for the pieces! The youthful princeling and his courtiers were frequent spectators and admirers of the fun; the resounding shouts of thousands on such occasions, in a city only held in awe by a European army, and ripe for insurrection, as subsequently proved by events, was no pleasing sound to English ladies and children and peaceful persons. I bethought me of a monster kite, a regular Britisher, I would let off "to astonish the natives," as Captain Cook did say. With sundry sheets of the *Times* I manufactured a giant of some 7ft. or 8ft. high, of a strong build, a grand tail, and wing tassels to match. No string I could get was sufficiently trustworthy, till I managed to find several bundles of stout fishing line (twisted hemp thicker than whipcord). I had to connect all these 50-yard pieces by knots; an immense disadvantage in fighting others, as it proved. Waiting for a good wind, a private spot, and a good day, I launched my "unexpected visitor"; he soon soared high, and I believe attracted many thousand pairs of eyes to his novel form and dimensions. The voice of a multitude could be heard on all sides in respectful admiration and surprise; however, this soon wore off, and I found myself "baited" from many quarters. The more flimsy assailants soon came to grief, and descended in fragments; paper and cotton line sometimes sticking to my cord, where the knots impeded their departure. Though my creation had mounted sky high, with a pull and tension requiring the help of my servants, I was beset by combatant kites at a lower level, crossing and tugging to saw through the connecting link. In this manœuvre they failed. Hemp v. cotton prevailed; but in time there was so much fouling that my monster lost his balance and began to grow top heavy; seeing imminent disaster, we reeled in as the united lumps of paper and sticks and string began to demonstrate gravitation. I only recovered a portion of loose line, while a jeering mob scrambled over the fallen spoils, with loud yells of triumph at having beaten a "Frank" (as they term all white men). I afterwards heard that all the princely and noble spectators of the encounter were highly pleased and amused at the result. When a schoolboy, I had witnessed the construction of an electrical kite (a dangerous plaything) on the same large scale as the one I launched at the Sikhs. Though the whipcord line was overlapped with loose folds of brass wire, it snapped like thread when fastened to a peg in the ground during a storm, the kite never reappearing! In those old days we used to attach lanterns in transparent screens, painted with alarming devices; the farmers stopped these, and our fire-balloons, too. We flew "parachute kites" also, which I have seen in India. I sent one off in that country which never descended in my vicinity; it may have gone across the ocean. This form should have been used during the siege of Paris, as it would carry a few ounces weight to balance the flight. I found wet silk better than calico in a strong wind. I sewed tape loops to each corner of a yard square; hard twisted cotton twine is fastened by knots to these loops; then the other ends at about a yard or more in length are gathered together and fastened to the wire cage, or weight desired. A high wind is requisite to float them, unless they are made of tissue-paper, when a light breeze will carry them. Native kites are a great nuisance to flower gardens, and equestrians sometimes get a sudden necklace of string and paper.

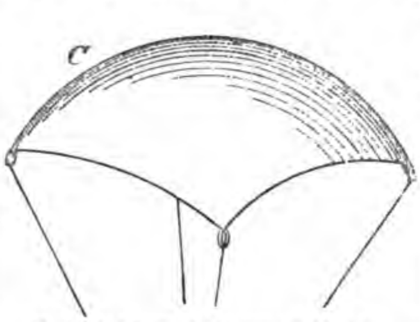
Eos.



A, the national kite of India, made in all sizes and materials, generally of thin tissue paper, with four sticks (or rather two sticks crossed); sometimes flown without tails, being so light and manageable. Occasionally they are seen of fancy shapes, probably copies of foreign patterns.



B, parachute kite, a square of light, close silk or calico, with loops of tape at the corners.



C, inflated form of the same in the air.

OPTICAL PHENOMENON.

[27102.]—On holding a piece of silvered glass horizontally between the eye and a light, the usual multiplied images are seen.

If, now, the mirror be retained in that position, and revolved in the same plane, the images composing the chain are seen to close up and open out alternately, at the same time that they seem to describe a circle around the primary image. How is this movement of the images to be explained? I may add that, on failing some time ago to get an answer to this query in our paper, I sent a note on the subject to *Nature*. It was not inserted, and the Editor informed me that this was because the subject is dealt with in the textbooks. I then inclosed an addressed and stamped envelope, asking him to be good enough to give me a single reference; but to this, and to a renewed application, no reply has been given.

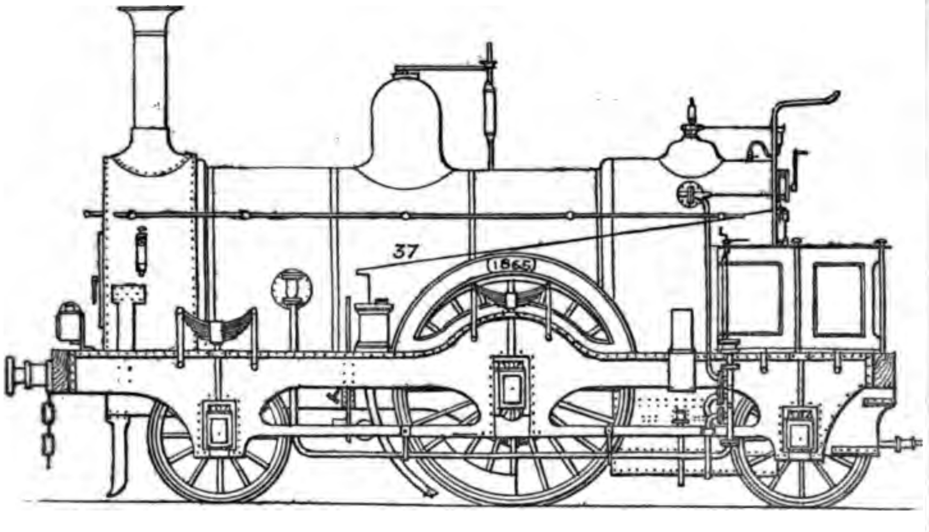
I am, therefore, compelled once more to seek help in the "E.M." Surely some of the talented contributors, to whom we are indebted for much useful knowledge, are able, and, I hope, willing, to answer this query?

W. H. Shrubsole.

METALLIC SASH-CORD.

[27103.]—A further trial of this apparently imperishable material as a band to my foot-lathe has resulted in disappointment, the core being made of poor stuff—common hemp—whereas, if the makers would only employ the strong plaited sash-cord (apparently of flax), we should have a reliable compound, one adapted to many mechanical purposes where strain and friction have to be met. I ought to mention that in remote places a thong of damp raw hide slightly twisted, the ends left flat, and beaten with a mallet, then sewn together with sinews, has done good service on a rough flywheel of wood weighted with lead.

Eos.



MIDLAND ENGINES, NO. 30 CLASS.

[27104.]—In accordance with the wish expressed by "Rover" (p. 113, No. 62182), I now beg to forward a drawing I made at Leicester Locomotive Department, August, 1865, of Midland "single" express engine, No. 37, which will, I trust, furnish the desired information. This engine was designed by the late Mr. M. Kirtley, and constructed at Derby, 1865.

Diameter of cylinders	16½in.
Length of stroke	22in.
Diameter of driving wheels (new)...	6ft. 8in.

The tractive force for each pound of effective pressure on the pistons being, therefore—

$$\frac{16\tfrac{1}{2} \times 16\tfrac{1}{2} \times 22}{80} = 74{\cdot}87.$$

The tender runs on six wheels, and carries 1,800 gallons of water and two tons of coal.

During the year 1866 I had permission to ride a few trips between Leicester, Leeds, Rugby, and King's Cross to see the working of some of these engines, and from my notes I find that upon an average, with a load of 8·75 vehicles at 41·81 miles an hour, the consumption of coal was 21·25lb. a mile. This was a very good performance; but, of course, the weight of vehicles was very different 20 years ago from what it is now.

Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.
Bedford, 9th April.

SOME EXPRESS RUNS.—I.

[27105.]—During the last few months I have made several especially good runs, some short particulars of which will probably be of interest. The following journey was made Sept., 1886, No. 1,566, and 7 coaches:—

M.	Ch.		h.	m.	s.	Speed.	Remarks.
		St. Pancras ...	5	15	57	—	due 5 15
7	0	Mile post	5	26	43	39·0	
19	69	St. Albans ...	5	41	20	52·7	
30	24	Luton............	5	52	40	55·2	
35	0	Mile post	5	57	45	55·4	
49	0	„	6	10	41	64·9	
49	65	Bedford......	6	12	22	—	due 6 15
		dep.	6	17	28		„ 6 13
99	10	Leicester ...	7	17	59	48·6	„ 7 18
		dep.	7	24	0		„ 7 23
119	68	Trent	7	49	33		„ 7 50
		dep.	7	54	23	48·6	„ 7 54
129	3	Derby............	8	7	58	40·5	„ 8 8

The engine from Leicester to Derby was No. 1,563. Between Bedford and Leicester the quickest mile was 69 miles an hour, and the slowest 42. The run would have been made in 58 minutes but for signal slacks at Irchester, Wellingbro', and Wigston.

Kappa.

RAILWAY BRAKES.

[27106.]—Mr. G. Kiernan, page 130, attempts to throw discredit upon the results obtained at the Lancashire and Yorkshire trials in 1880; but if he had been then present, or had carefully read the report, he would have known that the results were correctly obtained, and that the quotation he gives refers to the different weights of engines and brake force applied to them, whereas the slip-stops to which I referred were, of course, made without the engines, and are correct. The trials of 1880 are the last official ones on record, and therefore till others take place they furnish data which we must accept for reference.

Mr. G. Kiernan views the brake question from an entirely different standpoint from that which I consider the correct one. He states with regard to brakes, that "supreme excellence is *simplicity*." On the other hand, I maintain that the first question of vital importance is *efficiency*. He desires to have an apparatus made with the least number of parts. I consider that brakes ought to be the very best life-saving appliances than can be obtained. The brake at Penistone was very "simple" in construction; but the result of that "simplicity" was that it failed to save the lives of 24 persons and prevent injuries to 62 others.

The letter of your correspondent "M.S. and L.," page 131, shows—a fact well known—that the vacuum tri-coupling causes much trouble and numerous failures; but perhaps Mr. Kiernan will inform him that to tie the coupling together with string is about the most "simple" method that can be suggested. Would not James Watt have considered it rather unmechanical?

Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.
40, Saxe Coburg-street, Leicester, April 7.

COLOUR BLINDNESS AND COLOUR TESTS.

[27107.]—There seems to be misconception in respect to the use of skeins of wool for testing colour blindness.

When Holmgren's colour-tests are used the candidate is never asked to name colours, because many colour-blind persons know colours truly by education.

The method of using coloured skeins is to place them in a heap upon the table: the surgeon then places a pale green before the candidate and tells him to match it with colours which are in anyway similar to it.

In the case of green blindness he will match the pale green with other shades of green, pale grey, buff, and pink; if very complete, with scarlet.

In the second case, that of red blindness, a red colour will be matched with browns and greenish-browns.

In every extreme cases of colour-blindness red and green are confused indiscriminately.

Colour-blind people confuse the colours on the red side of the spectrum, and they also confuse the colours on the violet side of the spectrum, and the rest of the spectrum appears to them as a neutral stripe; but the colours on the red side and the colours on the violet side are distinguished as separate colours by them.

J. L. Kerr, C.M., M.B.
Crawshawbooth, Manchester.

COLOUR-BLINDNESS.

[27108.]—May I be allowed to offer a few remarks on the subject of testing for colour-blindness now being discussed in your columns?

The method of discovery of this defect used by oculists differs considerably from that which your correspondents unite in condemning. Persons suspected are not, or should not be, asked to *name* certain colours submitted to them, as the knowledge of the designations of colours is limited, and is, moreover, no test; but the modus operandi is as follows. Some skeins of Berlin wool of various colours, not too bright to begin with, are given to the patient, together with a large bundle of skeins of all possible colours and of the most various shades or degrees of saturation. He is then asked to *match* the ones given to him from the skeins in the bundle, and not to name their colours at all. If, now, he places side by side, say, a pale green with a fawn, or chocolate, or pink of the same degree of white saturation, or if he hesitates and says they are nearly but not quite alike, a third is given him, of the same *colour* as one of the first, but of a greatly different (darker) *shade*. If then he puts the two lighter colours together as being most alike, he is colour-blind, and is judging solely by the amount of white saturation and not by the colour.

Some of your correspondents, again, are very irate at what they term the dirty colours of some samples shown as tests at some exhibition; but that is quite intentional, and is the basis of Bull's (Christiania) quantitative test to estimate the smallest amount of colour which, when mixed with *grey*, is recognisable by the normal eye. The normal eye can always detect the colours, however much mixed with grey; but the colour-blind confuse the complementary colours more or less, according to the amount of their defect.

Colour-blindness in some degree is very common in men, nearly five per cent.; much less so in women, hardly ·2 per cent.; the red-green form is the most usual.

Just one word as to "W. A. S. B.'s" remarks on Homer and colour. We all remember Mr. Gladstone's notion that the Greeks were colour-blind because they used the word purple for almost all colours. The simple fact seems to be that for fabrics at least they had but one dye—viz., that obtained from the *πορφύρα*, or purple-fish (Murex and Purpura sp.), which gives a most varied series of colours, beginning from pale yellow, going through all the reds and brown-reds up to a true purple, according to the quantity used and the care taken in the process. The same word, "purpura," also signified dark. Surely it is a perfectly legitimate poetical license to designate the sea as dark, or wine as purple; and "W. A. S. B." must remember the deep-blue seas of Hellas are not to be compared with the article as found, say, at Southend or Margate; had Homer lived at either of these places, he would probably have used another metaphor.

G. C. K.

HARBOUR LOANS AND CONSTRUCTION.

[27109.]—The promise made by the Government that legislation shall take place to enable the Board of Trade to decide on the necessity of places, and the Loan Commissioners only upon the security, is a mere sham so far as it affords any prospect of getting proper harbours made, "the importance, nay, the necessity," of which Baron H. de Worms, of the Board of Trade, urged in my presence little more than a week ago.

We require at least two large harbours, one on each side of this island, to shelter our navy, and protect our food ships and mercantile marine both from shipwrecks and from cruisers in case of the calamity of European war. The present leader of the House of Commons (Mr. W. H. Smith) said, not long ago, "If our food ships were interfered with, we should have no employment for our working men or food to eat, but we should have riot, revolution, and a state of things too terrible to picture." A grant of half a million a year for six years is also needed (only the cost of three ironclads) to assist private enterprise to construct fishery or coasting vessel harbours, and save life. These are questions of national necessity, much more than of local benefit, and I trust that constituencies will press on their Members of Parliament to move adjournments of the House on the plea of urgency to save human life, as well as to bring the subject forward on every possible occasion. To construct these harbours would very much save the taxpayer's pocket, facilitate a volunteer organisation for coast defence, as the key whereby to promote the prosperity of commerce or trade, and give permanent employment to an enormous number of artisans and labourers. The way to put a stop to the terrible risk pictured by Mr. Smith, to the monstrous sacrifice of life, and to this mere pretence of mitigating it, is for constituencies to determine not to support the adherents of any political party which puts office before such urgently necessary work, and then, for expediency's sake, that which is necessary will be done. Perhaps I may say one word about this society, which has kept this subject constantly before the public until success cannot now be long deferred. The amount of public subscriptions and donations received during the six years of its existence does not yet reach £800, or about £130 a year. There are upon its committee, amongst others, twenty-six M.P.'s, all pledged in writing to attend four or five times in a season, whose duty it is to guard and forward public interests; but every subscriber of 5s. or upwards since the very beginning will confer a favour by seeing all the books and every separate item of receipt and expenditure. Subscriptions may be sent to Messrs. Coutts and Co., 59, Strand, for the Refuge Harbours; and if those possessed of wealth had been more liberal, we should not now be drowning 1,000 poor fellows every year, as at every public meeting held opinion has always been quite unanimously expressed that this inhuman neglect ought not to disgrace the Union Jack.

Those who cannot afford to subscribe money can contribute in work—getting petitions signed, &c., copies of which will be gladly forwarded to them. Every working-man should help in this if he desires to keep his family from the condition described by the present leader of the House of Commons, or has any sympathy for the widows and orphans of the poor men who perish because of others' neglect.

Founder and Hon. Sec.
National Refuge Harbours Society.
17, Parliament-street, April 11.

WIMSHURST MACHINE WITH DOUBLE SECTORS.

[27110.]—I am much obliged to Mr. Wimshurst for the kind suggestions in his letter (27053) last week. Perhaps I did not make it quite clear that there is no space ("spirit" is, of course, a misprint) between the revolving insulating plate and the back of the working disc against which it is secured. The solid centre is so arranged that the insulating plate may go close up to, and be in actual contact with, the sectored plate.

I am constructing an experimental four-plate multiple machine on this plan, with sundry alterations in position of sectors, &c., and shall have pleasure in reporting the exact performance as soon as I am able to finish it. **H. W. L.**

ODIC FORCE.

[27111.]—Perhaps those who are puzzled by the experiments described under this head will explain the following. Take a piece of india-rubber tube, say, ¼in. in diameter, bend it into a U-form, and hold one end in each hand. Fill the tube full of water, and endeavour to keep it so by holding the two ends at exactly the same level. If there is no such thing as "odic" force the water will remain steady in each limb; but if it should overflow first at one end then at another, the experimenter will be compelled to believe in odic force, unless he adopts a common-sense view, and recognises the simple fact that it is impossible to hold one hand still, much less two.

Jonathan Oldhead.

THE SUPERNATURAL DARKNESS ON THE FIRST GOOD FRIDAY.

[27112.]—I was one of a congregation at a service held on Good Friday afternoon in St. John's church here, and heard this declaration from the pulpit, touching on a subject I am greatly interested in.

"Whilst the deed of the Cross was being enacted on Calvary, there was a celebrated Egyptian astronomer making celestial observations, who noticed the strange darkness which fell on the earth and could make nothing of it, as it was certainly not due to any eclipse. He at once concluded that the Almighty was either suffering Himself, or was in sympathy with some sufferer."

This is certainly a strange statement; and, I confess, new to me. I cannot find any mention of this celebrated astronomer in any record, old or new. A fact like this—if it were one—would surely have been commonly known and widely commented on.

I want to know whether any reader has ever come across any mention of it? I should be glad especially to have the opinion of "our" "F.R.A.S." on the point. If necessary, you can have the name of the clergyman who is answerable for the statement.

Arthur J. Gardner, M.R.C.S.Eng.
Darlington, April 9.

ENLARGING HOLES.

[27113.]—To those young amateurs who do not possess a slide-rest, I can recommend a simple and easy way of enlarging deep holes, or turning them into tapers. The work being fixed in a chuck, or cemented into a wooden cylinder and revolved, get a three-corner file, with one inch at the end smoothed and sharpened on a grind-stone; place the T-rest across the hole, below the line of centres, just enough to allow the file to stand on one edge to meet that point. Lean the edge about ¼in. inside the hole towards you. Make slow revolution, and work gradually to the bottom of boring.

For cutting a taper, make a gauge in wood of desired proportions, hold your file diagonally, and go to work as before, occasionally testing the hole. It is best to cut this below gauge and true it out afterwards in smoothing the surface. These three-corner files, when their teeth are worn out, make the best of cutting tools, their angles of 60° being ready made, and their steel very hard. For brass, the square rod 90°, hardened, will be used in the above operation. **Eos.**

AQUEOUS VAPOUR.

[27114.]—I have not misread "A. P. S." (27003). He plainly states that "steam and aqueous vapour are totally distinct forms of water." It is to this statement that I demur.

But he also states in effect, and "F. S. C." fathers it, that vapour is in large quantity (steam, "A. P. S."), and not if it be mixed with relatively large quantity of air. "In the latter case," says "F. S. C.," "the free oxygen of air protects the molecule of water." Is this a fact? Is it true that the iron being sufficiently heated to decompose water, will, on coming in contact with molecules of water and free oxygen, be oxidised solely at expense of the latter? It seems to me that, although the oxidation would be mainly effected by free oxygen, yet when a molecule of water came in contact with the iron, it would be decomposed, and that a proportionate amount of the oxide would be thus formed. I hope "F. S. C." will not think me nasty particular; I ask for information. **Kensingtonian.**

REPLIES TO QUERIES.

⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[61255 and 61612.]—**Embrocation.—Food for Animals.**—To "Backwoodsman, Los Angeles, California."—I have put this heading in hopes of catching your eye, though I want to ask a question about emigration. I see from your address that you live very near the frontier of Mexico, and I have just read in the *Pall Mall Gazette* of the 7th April a most glowing account of the Peninsula of Lower California, in Mexico, as a field for colonisation. There we are told that English settlers are wanted, that artisans' wages average £1 a day and labourers' 10s. Most astonishing of all, that artisans seem to be wanted, and that necessaries are so cheap that a man can live on two days' work a week and save the rest, or send it home to help his poorer brethren to come out. Further, that the Mexican Government is becoming stable; no trouble with the few Indians need be feared; that by a Mexican concession the settlers escape the 45 per cent. *ad valorem* duty, and can get their supplies from England and establish a market for their produce in the mother country. We are told, too, that if a settler can bring out three months' supply he is certain almost to be able to support himself and family from that time. Can you confirm this for the benefit of the many artisans who read the "E. M."; or can you get a confirmation of it sent from the British Consul, Mr. Mortimer? Will you also give us some idea of the cost of the journey and best route from England, and anything else which might be of service to an intending emigrant?—F. A. M.

[61401.]—**Oval Chuck.**—Thanks to "C. L." and "Hyde, Florence," for replying to my query about above. I have experimented with a wooden chuck screwed on to my oval chuck, and traced the lines with a pencil in different positions, and find what "Hyde" says is quite correct. Although I am not able to do the turning of ovals perfectly, I suppose there is no remedy but "try again," as "C. L." advises.—Church-Hill.

[61498.]—**Induction Coil.**—I am much obliged to Messrs. W. Holder, S. Bottone, "Electrician," &c., for the information they have given me. I have tried three cells of Mr. Bottone's recipe without the slightest result. I have enlarged the cell, I have seen that all connections are clean and fitted properly, as advised by "Bobadil," and have followed up Mr. Conry's instructions without any action except the spark at contact-breaker; the armature did not vibrate at all. As a last resource I unwound the secondary coil, but there was no breakage or defective insulation. I do not understand anything about the making of medical coils, and therefore cannot give my instructors much knowledge concerning it. Only one size of wire was wound upon the magnet, but I always understood there was a primary coil of thicker wire. I will now have to make a primary coil myself; would a coil act without a primary one? If not, shall I connect the primary and secondary coils together. Should I connect the primary to one connection of the battery, then have the secondary connection to another? If anyone will show me the way to proceed, I shall be glad. I have the armature magnet, contact breaker, and platinum connections. It is a medical coil I want to make.—Ignoramus.

[61574.]—**The Calculus.**—I can only express my obligation to "Vladimir" for his last communication by again thanking him. I should have done this earlier but for a severe illness. The diagram from Bell's "Illustrations of the Differential Calculus," sent by "T. W.," is very instructive, and I thank him. I should much like to possess Mr. Bell's book. Immediately I saw "T. W.'s" communication, I ordered it, but my bookseller reports that it is out of print. I will advertise for it, but I have not been very successful in my attempts in this line. I quite concur with "Vladimir" in the opinion he expresses of the works of Mr. J. R. Young. Having occasion to refer to one of his books many years ago, I was so struck with its lucidity that I resolved to procure, if possible, all his works. I believe I have them all, but some of them I obtained with great difficulty. Before I could procure one of them ("Cubic Equations"), I advertised during many months in several English periodicals, as well as in two Belfast newspapers. Mr. Young is one of the few English writers on mathematics who says what he has to say in his own words. On looking over the numerous elementary works published, one cannot but be struck with the repetition, sentence by sentence and almost page by page, frequently to be met with. I have no confidence in the knowledge of an author who shrinks from expressing himself in language of his own. The following may possibly interest some of the readers of the "E.M.":—I have recently procured a number of American mathematical books, and among others works on "The Calculus," by Olney, Johnson and Rice, Bowser, and Taylor. The work by Olney appears to me admirable. His method of treatment and his style are his own. His illustrations are most apt, his warnings and cautions to the students are most opportune, and, on the whole, I am inclined, from the cursory examination I have made of it, to think it one of the most lucid treatises on the calculus in the English language. Another volume has yet to be issued to complete the work. Like Mr. Young, he proceeds as one who is conscious that he knows what he has to say, and knows how to say it, without borrowing the language of another. Such confidence in an author begets confidence in his readers. He has much to say on the subject of successive differentiation, and I do not doubt that when I apply myself to that portion of his book, what I shall find there, supplemented with the information kindly furnished by correspondents of the "E. M.," will give me that clear notion of the meaning of successive differentiation which I desire to possess, and which I have long felt the want of.—Tyro.

[61717.]—**Chemical Precipitate.**—When an excess of ammonia solution is added to a solution containing silver nitrate and copper sulphate, silver ammonio-nitrate and copper ammonio-sulphate are formed. Probably the precipitate is due to some decomposition of the silver compound. Try adding a further excess of ammonia solution, and do not allow to stand in the light; this may remedy the cause. Or may be your silver nitrate contains some organic impurity which tends to bring about decomposition. What length of time do you mean by a short time? You do not say whether the precipitate was large or only slight.—Henry J. Hardy, F.G.S., Sheffield.

[61819.]—**Painting on Polish.**—The best way to accomplish the result aimed at would be to scrape off the polish for a sufficient space; paint the initials on the wood, and then varnish over them.—Nun. Dor.

[61820.]—**Umbrellas.**—Are not the ribs made in one piece of steel?—E. G. M.

[61821.]—**Fixing Emery.**—The emery may be mixed with glue, or even with water-glass; but in such a case it is purely a matter of experiment.—J. T. M.

[61833.]—**Three-Inch O.G.**—"Amateur" will find articles on "Object-Glass Working," by "Prismatique," in Vols. XXXVI. to XXXIX. The polishing processes are described in Nos. 976, 982, 990; but it is not easy to make a *précis* of the directions, especially as they are the most important of all in connection with object-glass working. It need scarcely be mentioned that many back volumes contain information on the subject—perhaps as much as the querist requires.—Nun. Dor.

[61839.]—**Twist-Drill Apparatus.**—All "Country Parson" needs to make a good twist drill is a round file and vice; prepare his blank in lathe, place in right-hand side of vice by the shank, hold file at the required angle, and work away; but if "Country Parson" will advertise his address I can put him in possession of a drawing of a simple apparatus for cutting twist drills in his lathe, and will send on for publication in "E. M." later on.—R. T. J.

[61839.]—**Twist-Drill Apparatus.**—I am tempted to reply to "A Country Parson," as I had the same aspirations a few years ago. But I soon found that the manufacture of twist drills is a waste of time to an amateur, although I find it useful to be able to make a twist rimer or tap when required. There are two or three practical ways for an amateur with £10 or £15:—First, let a "C. P." fit on to the top plate of his slide-rest, attached to saddle, a good strong cutter frame capable of running a milling cutter at not over 60 revolutions per minute, the spindle being vertical and the driving pulley large,—not less than $\frac{1}{2}$in. leather cord-belt being used with suitable guides. The lathe then is used as the holder or spiral centres, and by gearing one revolution of mandrel is made equal to 4, 8, 16, and upwards of screw. The only trouble is to get a strong and steady enough cutter frame, and a good system of lead pulleys for belt. Second, there is the apparatus of Messrs. Selig Sonnenthal and Co., which was discussed some months ago in the pages of "Ours." Its defects are also stability and trouble in making cutters. Third, there is a small effective milling machine for use on lathe-bed to be had for £6 or £8; but it requires a spiral head, which, with gear, would cost about £5, and this is what I use at present. Fourth and lastly, there are the usual makers' plant.—VULCANITE.

[61854.]—**Willow Wood for Telephone.**—Any part of willow which can be cut into thin strips, and be plaited or woven together after the fashion of strawberry punnets, but much closer.—T. B.

[61865.]—**Kaleidoscopic Pictures on Screen.**—In Darker's lantern kaleidoscope the mirrors are of platinised glass, and are mounted with a convex lens at each end; thus mounted, the apparatus takes the place of the ordinary lantern objective, and will produce beautiful patterns upon the screen if a rotating slide containing the fragments of coloured glass is placed in the ordinary slide-stage. (From Lewis Wright's "Light.")—E. M.

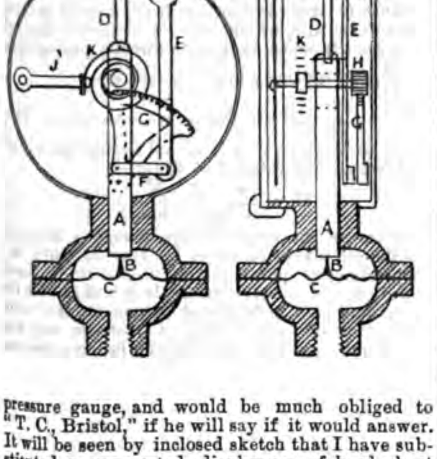
[61873.]—**Whistles.**—Yes, there are such whistles, used for signals on board ship; but it is not likely they would be wanted on locomotives.—W. S. L.

[61887.]—**Screw-Cutting, Books on.**—No books deal with the subject in the manner referred to; but there is much information in Holtzapffel, IV., and almost everything in back volumes of this paper.—J. C. P.

[61889.]—**Stability of Ships.**—I would recommend this querist to consult Macrow's "Pocket-book," published by Lockwood and Co. It contains all such information as he appears to require.—VIDEO.

[61951.]—**Legal.**—I beg to thank "Dens" very much for his answers to my query; but am afraid to act quite as he suggests, although I am capable as a regular dentist (in fact, I am doing so at the present time, for the principal is away, and I have to take his place). I do not think much of "Os's" answer and his railway comparison. I have served six years' apprenticeship to dentistry, and am now in a berth as an operating and mechanical assistant; and "Os" says I am not a dentist. Perhaps he will kindly say what I am.—DENS, Peckham, S.E.

[61967.]—**Pressure Gauge.**—Seeing "T. C., Bristol's," reply to "R. A. L., Devon," respecting the above, I herewith send a sketch of a small pressure gauge, and would be much obliged to "T. C., Bristol," if he will say if it would answer. It will be seen by inclosed sketch that I have substituted a corrugated diaphragm of hard sheet brass (similar to the top of a vacuum chamber in an aneroid barometer), instead of the indiarubber one shown in "T. C., Bristol's" sketch. The arrangement of levers is also slightly different: the movement of the brass diaphragm being less than the indiarubber one, another lever has to be introduced to give sufficient movement to the pointer. Would the expansion and contraction of the plunger, &c., affect the movement of pointer anything to speak of, and what ought thickness of diaphragm to be for a gauge to indicate to 100lb. per square inch? A, plunger resting on needle-point B; C, corrugated diaphragm of thin hard sheet brass, to centre of which needle-point B is fastened; D, short arm connecting plunger with bell-crank E; F, short arm connecting bell-crank with rack G, which rack gears into pinion H on spindle carrying pointer; J, arm for holding end of spring K.—H. H. D. B.



[61980.]—**Two Puzzles.**—This puzzle that baffled "R. H." was meant by Mr. Proctor to be no puzzle at all; but by putting an even number of cells (instead of odd) he very nearly trapped himself. His escape (which he described as "somewhat of a sell") is by a purely grammatical dodge. You are forbidden to *enter* any cell more than once, but are free to *leave* one or more times. Let "R. H.," after leaving cell A, then immediately enter the same, and leaving it a second time, enter, too, each of the other 35, and leave each. Thus he will have left 36 and entered 36, but entered none more than once. He will have left A twice, but only entered it once.—E. L. G.

[61980.]—**Two Puzzles.**—There is not much doubt that the puzzle illustrated by "B. H.," p. 133, is similar to that meant by the querist; but it may be as well to point out that, if the conditions are observed, it is impossible to solve it. The puzzle appeared in the December part of *Knowledge*, and may be solved, after a fashion, by the prisoner starting from A into either of the adjoining cells, and going back to A; then proceeding, in zigzag fashion, until the two rows are completed, when he can walk straight through the other rows, and find himself at last in B. Thus, taking the diagram, and numbering the first two rows of cells from left to right, $\begin{smallmatrix}1 & 2 & 3 & 4 & 5 & 6\\ 7 & 8 & 9 & 10 & 11 & 12\end{smallmatrix}$, the prisoner goes from 1 into 7, and returns to 1; he then goes through 2 into 8, and through 9 to 3, passing thence into 4, and then in the following order, 10, 11, 5, 6, 12, whence he enters the cell immediately below, and passes along the whole line. The rest is clear. The prisoner can enter cell 2 first, and the changes may be worked in a great many ways; but he cannot get out if he passes "through" any of the adjoining cells unless he does so twice. Mr. Proctor says that this cell puzzle is rather a sell.—NUN. DOR.

[62036.]—**Power of Engine.**—I once had a model of the same size; it produced with 30lb. pressure about one-cat power. It would drive a slowly revolving shop-window advertisement, and nothing more. Yours would do about the same, and certainly would not drive a 15c.p. dynamo. The boiler, if vertical, should be 12in. high by 6in. diam., and plate $\frac{3}{64}$in. thick.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[62061.]—**Lining Brasses with White Metal.**—Coat mandrel with a mixture of lampblack and clay water.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[62064.]—**Speeding-up of Lathe.**—I should not like such an arrangement myself, unless a powerful brake were fitted to stop the flywheel in about four revolutions. Speeding-up is all very well for circular saws, but is hardly suited for lathes.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[62065.]—**Micrometer for Drilling.**—Micrometers on hand-wheel of poppethead are unnecessary. On my lathe I have the poppet barrel divided into 90 millimètres, the length of the traverse. With these a hole may be drilled to a quarter of a millimètre deep, which is about as small as anyone requires.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[62088.]—**Utilisation of Slag.**—Slag has not up to the present been used very much commercially. Mountains of slag form the horizon all round Dowlais; and, in fact, most of the country in the neighbourhood is little else than slag. Some, but very little, is used for road making, and some for making hideous vases. At Barrow it is used for reclaiming land from the sea, and has proved most successful. In Styria, the slag flows into a separate channel from the molten metal, and meeting a jet of water is granulated or reduced to the state of a coarse sand, which is then available for either building purposes or is thrown away as waste. In Staffordshire and the Cleveland district the slag is run into C. I. boxes or moulds of shapes and sizes applicable to footpaths, street crossings, and to building purposes. These blocks or bricks are said to be hard, compact, and to make a very durable material for pavements, since they have a high crushing strength, but they are also liable to crack. Only certain qualities of slag are, however, available for the process; thus, a highly calcareous slag is inapplicable, since such would obviously absorb moisture, swell, and fall to pieces after any prolonged exposure to the weather. Slag wool or silicate cotton, sometimes employed as a coating for steam-boilers, steam-pipes, cisterns, &c., and of which much was expected, has not yet had any extensive practical application. There would be a great difficulty in remelting slag—viz., in obtaining a high enough temperature, which would have to be equal to the temperature of the blast furnace. The moulds ought to be of cast iron; sand would not do, because the slag would reduce the silica of the sand, and give a rough casting. Slag from the Bessemer converter has lately been used as manure; but it has to be very finely ground, and its value is on account of the phosphorus it contains. An average analysis of slag is as follows:—Silica, 10 per cent.; MnO, 6 to 8; Oxide of Fe, 14 to 15; Al, 5 to 6; Lime, 40 to 45; Magnesia, 9 to 10; Phosphoric acid, 18; and Vanadium (?), ·3. In Greenwood's "Iron and Steel," published by Cassell and Co., will be found general information about slag, out of which I have extracted part of my information.—C. H. C.

[62092.]—**Microscopic Stages.**—The advantage of the mechanical stage is that you can always bring youself back again to certain fixed points in the object, which you cannot if shifted by the fingers only.—T. F. S.

[62092.]—**Microscopic Stages.**—For those who really intend to work the simplest form is the best. Learn to use the left hand thoroughly, and you will see in ten minutes what will take you an hour to see with a mechanical stage. Our expensive stages are the laughing-stocks of Continental laboratories.—B.SC., Plymouth.

[62093.]—**Immersion Objectives.**—A No. 9 or one-ninth of Hartnach is suitable either way; higher powers are of no use without immersion.—B.SC., Plymouth.

[62094.]—**Bacteriology.**—A one-twelfth immersion is most suitable.—B.SC., Plymouth.

[62094.]—**Bacteriology.**—I should say by all means buy a $\frac{1}{12}$in. oil immersion for this work; but I doubt if a good one can be procured for £4. A first-class one can, however, be bought for £5 5s., and it should be remembered, in choosing between cheap foreign and English objectives, that a $\frac{1}{12}$in. of the latter is equal to about a $\frac{1}{16}$in. of the former.—T. F. S.

[62094.]—**Bacteriology.**—"Vacillus" will require several objectives for bacterial work. My own experience is that a good $\frac{1}{6}$in. is the most useful working power; such a one supplied by Zeiss for 40s., with a fairly powerful eyepiece, will give good definition with magnification up to nearly 600 diameters. I particularly recommend this objective as it does not work too close, and I can focus through a cover glass to the bottom of a drop culture, while one gets by its use the maximum of light and surprisingly good definition, even with bad daylight and a short tube. I can work with my $\frac{1}{6}$in. with unfavourable conditions of light that would render my more powerful objectives almost useless, and this without fatigue. The using of a $\frac{1}{6}$ objective requires some practice, especially at bacterial work. It is very often supposed that the greater the magnification the better an object is seen; this does not refer to bacteria. "Vacillus" will require a $\frac{1}{4}$in. for gelatines, besides a $\frac{1}{8}$th and an immersion lens, the latter for confirming definition, drawing to scale, or measuring.—CYGNET.

[62096.]—**The Crumlin Viaduct.**—In reply to "Inquirer," the Crumlin Viaduct was completed in the year 1856. The following additional particulars of this structure may be of interest:—The viaduct crosses the valley of the river (Ebbw) in seven spans of 150ft. each, the total length being 1,050ft., and the greatest height 200ft. The piers are formed of hollow cast-iron columns, 17ft. high and 1ft. diameter, built up in successive tiers, with fourteen columns in each tier, and the piers taper upwards from an area of 27ft. by 60ft. at the base of the highest pier to 18ft. by 30ft. at the summit of each. The columns are fitted into one another by socket-joints, and are connected in each tier by horizontal cast-iron girders, and by horizontal and vertical wrought-iron tie-rods tightened by wedges. The main girders are Warren trusses, each 150ft. long and 14$\frac{1}{2}$ft. deep. The compression beam forming the top member of the girder is a riveted box-girder 14in. deep and 9in. wide, formed of plates of varying thicknesses; the tension member consists of four wrought-iron bars of 6in. by $\frac{5}{8}$in. average section. There are four girders in each span, carrying a double line of rails. They are supported by the ends of the compression beam resting upon a sliding block in a saddle-casting on the top of the piers, to allow for expansion and contraction; the extreme difference of length in each span between summer and winter does not exceed 1$\frac{1}{8}$in. The cost of the viaduct was £60,000, including three additional spans of the same length in the adjoining smaller viaduct, and there was a subsequent further expenditure of about £15,000 in 1868 for strengthening the girders, and substituting a wrought-iron floor with cross girders and rail-bearers in place of the timber with which the viaduct was originally covered.—LYONS, Hetton-le-Hole.

[62097.]—**Brakes.**—The three quotations from Mr. Harold Brown's address to the Society of Arts which "Loco.," p. 112, gives show that that gentleman was not well up in his dates. The Westinghouse air brake was first fitted in this country on the Caledonian Railway, 23rd October, 1871. I was present at the trial, 28th March, 1872. The Westinghouse automatic brake was first fitted in this country on Midland engine No. 184, for the Newark trials, June, 1875. The Westinghouse vacuum brake, fitted to the Brighton engine 151 and train, and sent to Newark, I well remember was not an automatic system. A diagram can easily be constructed to show the forces applied to stop a train, and its effect represented by a gradient, thus: Set off a scale, and form a zero point on the base line, a gradient the length of which shall equal that of the distance of the stop, and its height the vertical height through which a body falling from a state of rest would attain the observed velocity of the train at the time of the commencement of the stop. If "Loco." finds any difficulty in constructing such a diagram, I shall be happy to forward one for the information of your readers.—CLEMENT E. STRETTON, C.E., 806, City-road, E.C.

[62098.]—**Dhall, Rob, and Lentils.**—The first two names are the Indian and Egyptian names for the last. There are several kinds, all excellent and nutritious, and of easy digestion, the food of millions, rich and poor alike, and of late years introduced into England, being a dietary aliment of some repute. The boasted "Revalenta Arabica," when analysed, was found to be only the flour of lentils, though sold for several times its prime cost. A halfpenny-worth in India, with another halfpenny-worth of condiments, will feed a hungry peasant. I have the dish on my breakfast-table very often, having grown fond of it.—EOS.

[62103.]—**Heating by Hot Water.**—If "W. S." wishes to have a durable, efficient, and economic apparatus, I should most strongly advise him to adopt Perkins's system. The pipes are so small (⅞in., external diameter, ⅜in. bore) that they won't be the least in the way, and they can readily be bent to suit angle or fixture, and do not disturb existing arrangements. There will be no noxious vapour from furnace if made of suitable firebrick instead of iron. "W. S." does not give height of rooms. Assuming it to be 14ft. high, then 450ft. of this tubing placed in composing-room, and 250ft. in machine-room, will keep up a steady uniform temperature of 65° Fahr. when at freezing point outside. It is understood, of course, that doors will be closed. I shall be glad to give "W. S." every information if he will let me know his address—LEE.

[62108.]—**Engine Power.**—½in. inlet and ⅜in. exhaust are much too small. If you increase the inlet to ¾in. inside diameter, and the exhaust to 1in., you might obtain about one horse-power with 800 revolutions per minute.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[62109.]—**Submarine Light.**—This has been used by foreign fishermen for some years, and I am told is very attractive. A thick glass globe containing the light is sunk either in mid-water or at bottom, according to the object of the fishers. I have found all fishes and reptiles and some animals are lured by fire. Torches held over the water in savage countries I have seen very effective. Flying fish jump at the light into nets spread across the canoes, and the choicest fish in the rivers collect on the surface—an easy haul for the casting-net. Frogs, toads, and lizards, with an occasional snake, I have seen admiring a lamp put outside on the ground.—EOS.

[62112.]—**Weight of Tubes.**—"Bad Judge" may find the weight of his tube by subtracting the square of the inside diameter in inches from the square of the outside diameter in inches, and multiplying by 2·45 for cast iron, and 2·64 for wrought iron, the result being the weight of a lineal foot in pounds. Thus, assuming the tube of the size given to be wrought iron, its weight will be

$$\left(\frac{3}{4}\right)^2 - \left(\frac{1}{2}\right)^2 \times 2{\cdot}64 \times \frac{27}{12} = \frac{5}{16} \times 2{\cdot}64 \times \frac{9}{4}$$

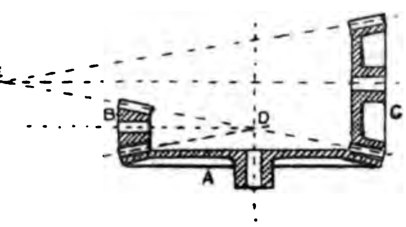
= 1·85lb. The relative weights of the metals he names are as follows:—

	Per c.ft.		Per c.in.
Steel..............................	499·1b.	...	·288lb.
Iron (wrought)..................	485·6lb.	...	·28lb.
Gunmetal (8 tin, 1 copper)...	528·05lb.	...	·304lb.
Bronze (90 to 95% copper)...	478·4lb.	...	·276lb.

The weight of iron discs will be $= 5^2 \times {\cdot}7854 \times {\cdot}25 \times {\cdot}28 = 1{\cdot}374$lb.—LYONS, Hetton-le-Hole.

[62113.]—**Legal.**—I am afraid you have no case. Although it might be held that the yearly tenancy was continued on the same terms as the previous lease, you would likely find that nineteen years "reasonable use and wear" would be sufficient to cause all the existing damage; paper or paint could not be got which would last for so long a period. A landlord in Cornwall tried the other day to get a tenant to put the house in the same condition as it had existed at the commencement of the lease; but the judge held that the "reasonable wear" was sufficient to account for almost all the damage done.—B.SC., Plymouth.

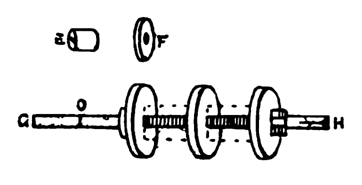
[62120.]—**Wheel-Gearing.**—You want to do an impossible task, because bevel wheels are in principle frustra of cones having a common apex. In the figure A B represent your wheel and pinion; C, the wheel you want to introduce. The apex of the wheels A and B is at D, a centre common to each; but the apex of C is at E, while in order to gear with A it should be at D. You cannot, therefore, make such a wheel as C to gear properly with A.—J. H.



[62121.]—**Saw-Bench.**—I think that any ordinary treadle saw-bench would be useless for driving three saws to cut iron; but on such a saw-bench as I use (the Britannia Co. patent) it would be comparatively easy. The saws must be suitable size and thickness, and teeth of very fine pitch, and filed straight across like a common hack-saw. A great deal depends on the form of the cutting edge of teeth, as experience will teach. Saws for cutting the thickness of iron you require should be about 18 gauge, and 15 teeth to the inch, and 3in. or 4in. diameter.—H. R.

[62123.]—**Mounting Emery Wheels.**—Cannot you make different sized sleeves to fit wheels, and all fitting the same spindle? Speed varies with diameter of wheel from 4,500 revolutions per minute for a 3in. wheel, to 280 for a 48in. one. Wet or dry grinding is a matter of opinion. I prefer wet; most people like dry.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[62128.]—**Mounting Small Emery Wheels.**—Those of 3in. and under can be easily mounted and worked three on a spindle, coarse, fine, and polishing. I give sketch of my present mode of running them. I prefer wetting the wheels, otherwise they give great heat to the steel and spoil small articles; besides, if kept moist there is less wear and tear, and no injurious dust to spoil your bearings. A small sponge occasionally wetted and squeezed is better than a water trough and its attendant mess. For single wheels of 5 or 6in. diameter I use good iron rod to make my spindles; for the lesser sizes steel only. Gauge a smooth steel wire to hole of the emery wheels; cut a nice Whitworth thread from B to × D. Turn an iron disc and tap it to same thread till you can screw it along this mandrel to ×, where it will stick fast to the shoulder or uncut part D. Now put on one of your wheels; it should travel tightly along over the screw-thread, if loosely, wrap some waxed thread along the side of the disc, and push the wheel firmly into its place beside the disc, according to the desired distance between each wheel, and prepare little cylinders of wood (I use stout thread reels cut down). Now screw on one of these till well fixed against wheel No. 1, and so on till you have mounted your last; here you will, instead of a cylinder, put on a disc of thick hide, on that a thin copper disc (made of a halfpenny piece), and against this you will screw with a wrench an octagon nut to fit screwed mandrel, at end of which must be a taper hole (hardened) to work on lathe centre. The cross line at the other end *o* is the portion entering the lathe chuck. I have tried other ways of mounting; but have finally decided on this easy bit of work.—EOS.



[62126.]—**Legal.**—It is quite legal to agree to the division of the property in accordance with the wishes expressed by "A." in his will (which is invalid through not being properly witnessed); but everyone interested must be a party to the agreement. (2) It should be stamped. (3) This difficulty is easily got over; stamp the deed before sending it to be signed, or, rather, write it on stamped paper.—B.SC., Plymouth.

[62127.]—**Finishing Repousse Work.**—The brass should be polished before it is worked. The easiest way to do this is to rub it the way of the grain with No. 0 emery cloth until all flaws and imperfections are removed, then "sand" it. To do this you require a "bob" running in the lathe —i.e., a wooden wheel about an inch wide on the face, which must have leather or felt glued on to it. Mix a little glasscutter's sand, which has been thrown away by them as useless, with lard oil, and apply it to the face of the "bob"; run the lathe at a high speed, and pass the brass to and fro under the "bob," and you will soon have the required polish. There are two methods of finishing it after the chasing and beating are done. If it is required to be bright, Sheffield lime applied with a "mop," consisting of discs of calico fastened together with leather, is necessary; this is a dirty, disagreeable process, and cannot properly be done except by steam power. Any polisher will do your work for a trifle; but you will probably find that the bulk of the fine toolings are erased from the plate. If the work is to be finished dead, dip it in "dipping aquafortis"; then put half an ounce of cream of tartar in half a gallon of water, and scratch-brush it, either with a hand scratch-brush or a circular one in the lathe; dry in beech sawdust, and lacquer with dark amber lacquer; this will give the work a beautiful soft gold appearance, and the finest markings will not be injured. The scratch-brush should be made of fine wire, and run at a high speed. I presume "F. C." understands "dipping," which has been described over and over again in "Ours."—FAL.

[62139.]—**Dynamo Commutator.**—I should recommend "Exhausted Patience" to try fine *brass* wire brushes. We had a similar difficulty when using copper plates or copper wire brushes. —T. R. D.

[62140.]—**Earth's Magnetic Force.**—The earth's total magnetic force may be easily found from the first equation you quote—viz., $H = I \cos. \delta$ where $H = {\cdot}223$ dyne (the horizontal component), and $\delta = 60°$ (the angle of dip or inclination) then—

$$I = \frac{H}{\cos. \delta} = \frac{{\cdot}223}{{\cdot}5} = {\cdot}446 \text{ dyne.}$$

The working of this will, I think, be quite clear. To determine H in absolute units it is necessary to make two observations. Firstly, suspend a small magnetic bar by a torsionless fibre and note the time (t) in seconds of one complete oscillation of the magnet to and fro, then the following formula will be true for small arcs of vibration:—

$$t = 2\pi \sqrt{\frac{K}{HM}} \text{ or } HM = \frac{4\pi^2 K}{t^2} \text{ ...... (I.)}$$

$$\text{For a round bar } K = w\left(\frac{l^2}{12} + \frac{a^2}{4}\right)$$

$$\text{For a rectangular bar } K = w\left(\frac{l^2 + b^2}{12}\right)$$

where w = mass of bar in grammes, l = length, a = radius, b = breadth (in centimètres). Secondly, to determine $\frac{M}{H}$; lay the magnet at right angles to the magnetic meridian, its middle point being at a distance (r) due south or north of a small pivoted magnetic needle, which will be deflected through an angle (θ), whose tangent is directly proportional to $\frac{M}{H}$, and inversely to r^3, therefore—

$$\frac{M}{H} = r^3 \tan. \theta \text{ .... (II.)}$$

Then dividing (I.) by (II.) and taking the square root, we get the value of H thus:—

$$H = \frac{2\pi}{t} \sqrt{\frac{K}{r^3 \tan. \theta}}.$$

To measure the angle of dip, mount a magnetic needle on pivots so as to be free to move in a perpendicular plane, place it in a magnetic meridian, and observe the angle it makes with the horizontal on a scale placed behind it; this is the inclination or angle of dip. I trust you will find the above methods both simple in practice and efficient as to results.—W. E. H.

[62143.]—**Legal.**—"A." can have the wall rebuilt, so far as the door is concerned. As to the window, that depends on whether or not "B." has acquired a right to an easement of lights through twenty years' prescriptive use. (2) He should intimate to "B." that if he does not cut off the projecting part of his roof, "A." will do it.—B.SC., Plymouth.

[62146.]—**Lifting Crabs.**—The following formula will enable "Student" to determine his question—viz., $g = \frac{W . r}{h . P}$, in which g denotes purchase of gearing, W weight raised, r radius of winch barrel, h radius of handles, and P power exerted on both handles. Hence, applying the data he gives, we get $g = \frac{2240 \times 6}{15 \times 30} = 29{\cdot}86$—that is, the gearing will have to be in such ratio as to give a purchase of 29·86 to 1.—LYONS.

[62147.]—**H.P. of Locomotives.**—If W denote the weight of locomotive in tons, S the speed in miles per hour, and $\frac{1}{n}$ the coefficient of friction, then the power exerted on a level line will be found by the formula—

$$\text{H.P.} = \frac{2{,}240\ W \times 5{,}280\ S}{30{,}000 \times 60 \times n}$$

which reduces to—

$$\frac{448 \times W \times S}{75\,n} = \frac{6 \times W \times S}{n} \text{ nearly.}$$

Hence, if we assume the weight of the engine in "Student's" example to be 40 tons, S being 40 miles per hour and $n = \frac{2{,}240}{15} = \frac{448}{3}$, we have—

$$\text{H.P.} = \frac{6 \times 40 \times 40 \times 3}{448} = 64{\cdot}3.$$

In the case of an inclined line where h denotes the rise in every 100ft., we get the following formula—

$$\text{H.P.} = \frac{2{,}240\ W\ 5{,}280\ S\ (100 + h\,n}{33{,}000 \times 100 \times 60 \times n}$$

$$= \frac{W\,.\,S\ (100 + h\,n)}{16{\cdot}74 \times n}$$

Applying the given data to this formula we get—

$$\text{H.P.} = \frac{40 \times 40 \left(100 + 1 \times \frac{448}{3}\right)}{16{\cdot}74 \times \frac{448}{3}}$$

$$= \frac{40 \times 40 \times 3 \times 748}{16{\cdot}74 \times 448} = 159{\cdot}5,$$

being 91·2H.P. more than on the level. I have merely given the formula by which "Student's" questions may be solved. He will obtain a full explanation by reference to an elementary treatise on statics.—LYONS, Hetton-le-Hole.

[62151.]—**Mechanics.**—In my last communication the expression "accumulated force" was printed for "accelerating force." The error, no doubt arose from my having written "acc." as an abbreviation for the word accelerating.—J. R. C., Charing.

[62154.]—**Rhubarb.**—A. Lloyd infers, from his question, that forced red stalks of rhubarb are unripe. This is not correct; they are quite ripe, although more tender than stalks grown in the open. The acid is the same in forced rhubarb as in the other.—B.SC., Plymouth.

[62154.]—**Rhubarb.**—The principal acidifying principle in rhubarb is potassium binoxalate, along with malic acid. In the forced varieties these are not present to such a large extent; but I am very doubtful as to whether there is really any great difference in digestibility.—S. BOTTONE.

[62155.]—**Acoustic Telephones.**—Four or more of these can be connected up in a system as you suggest, like electric telephones; but unlike the electric instruments, they cannot be arranged interchangeably, as their efficiency depends on the tension of the line wire, rendering it impossible to switch on from one to the other as can be done with electric telephones, where the line wire has no tension. Either you must have them in separate pairs, or else if all four are connected up you cannot prevent any three from hearing what the fourth is saying to either of the three. As you want them for a commercial establishment, however, this probably would not matter, and for simplicity of construction and freedom from going wrong, I think they are much superior to the electric telephones. You must join all your wires at some central point, and then arrange with each room a system of signals, single raps on the drum of the telephone for the first room, double raps for the second, three for the third, and so on. If the rooms are too large or too noisy for the raps to be readily heard, you must arrange a system of electric bells, using the line wire and earth for your circuit, and joining on to line wire by little spirals of thin wire, e.g., No. 20, soldered on.—EDWARD CONRY.

[62158.]—**Amylic Alcohol.**—To detect amyl in spirits, you distil and oxidise the distillate by chromic acid. The excess of CrO_3 is reduced by zinc, and the acids produced distilled off. The acid distillate is titrated by normal soda, evaporated, and again distilled after the addition of sulphuric acid equivalent to $\frac{1}{20}$ of the soda acid. The distillation is carried to dryness at a temperature of 130°. This operation is repeated two or three times. The united distillates are neutralised by barium carbonate evaporated and weighed. The barium salt is then converted into sulphate, and the percentage of barium determined. If ethylic alcohol alone was present, the Ba salt will be the acetate, and contain 53·72 per cent. of barium. Fusel oil yields the valerianate, which contains 40·41 per cent. of barium. The percentage of Ba is, therefore, a guide to the purity of alcohol. This is the method of Dr. Dupré.—SM.

[62159.]—**Evaporating Without Heat.**—You must evaporate in vacuo by the aid of an air pump.—SM.

[62159.]—**Evaporating Without Heat.**—"Souter" can do this under the bell-jar of an air-pump—either in the cold, or by the application of a gentle heat. On a large scale vacuum pans are made for the purpose.—ELECTRICIAN.

[62161.]—**Bent Girder.**—The girder is not so weak as it looks at D, as it only receives the extra weight due to the tendency of the steps to slide down the incline. If you require this for practical purposes you will be on the right side if you calculate it as a straight girder of a span equal to the full length of girder. A rolled joist could not be bent so sharp at the angles as you represent. But must you have a girder? I have seen great numbers of such stone staircases without such a support.—T. C., Bristol.

[62162.]—**Boiler.**—30in. by 8in. is quite unsuitable for such an engine. Is not this a misprint? You should have nothing less than 30in. by 18in. with a 9in. tube, if horizontal, or 12in. if vertical. Such a size, if well riveted, would be safe at 100lb. if of ¼in. plate.—T. C., Bristol.

[62163.]—**Engine Governors.**—If you will obtain the "E.M." for April 30th, 1886, you will find this pretty well discussed; also on June 11th. I gave a reply a few numbers previous to above, but the above are more full, and criticise my reply, I think. The correspondent, "W. J. R.," promised to write further, but has failed to do so as yet.—T. C., Bristol.

[62166.]—**Leclanche Type of Cell.**—Either form, as described, will work well if the proportion of manganese dioxide and crushed carbon be kept at equal parts by bulk. If more manganese be used, the resistance becomes greatly increased.—S. BOTTONE.

[62166.]—**Leclanche Type of Cell.**—Unless you have the outer carbon cells by you, do not buy them, because I think the carbon connection would prove troublesome unless skilfully made; otherwise a large carbon surface is a decided advantage. A mixture of equal bulk of powdered carbon and manganese is the best, lasting much longer and conducting better than powdered carbon only. Zinc plate (about 3in. wide) is better than a rod, although a rod does very well for most purposes.—AN A. S. T. E.

[62166.]—**Leclanche Type of Cell.**—1. Use small lumps of carbon—one part to two parts of manganese in grains; the larger the grains of manganese, the lower will be the internal resistance, and the quicker the cell will polarise. By adding carbon and subtracting some of the manganese the same effects will be obtained, but the contents will have to be oftener renewed. 2. I should recommend manganese only, which should be in small lumps—say, the size of sweet-pea seeds. The larger the surface of the zinc is, the lower will the resistance of the cell be; in practice, the zincs are in the form of a round rod—say, ½in. in diameter for bell work. The best cell in theory would be one in which the manganese should give out when the solution would dissolve no more zinc.—ELECTRICIAN.

[62168.]—**Model Loco.**—Cylinder 1in. stroke, ½in. diameter. Pressure required depends on workmanship of engine, but if good 20lb. should do.—T. C., Bristol.

[62168.]—**Model Locomotive, Size of Cylinders for.**—A pair of slide-valve cylinders ¾in. bore by 1¼in. stroke should suit this engine; the pressure on the boiler depends on its construction and strength. If thoroughly well made and brazed I should suggest 25lb.; but it is wisest to err on the safe side.—ELECTRICIAN.

[62169.]—**Photographic Developer.**—The reason why y u have not succeeded with Beach's developer is probably because the sulphite has turned into sulphate. The following formula may please you, as it contains carbonate of soda and no sulphite:—No. 1. Pyro, 160 grains; metabisulphite of potash, 160 grains; ammonia bromide, 80 grains; make up with water to 10oz. No. 2. Carbonate of soda (washing soda), 1oz.; carbonate of potash, 1oz.; make up with water to 10oz. For use take 1 drachm of each to every ounce of developer, but commence developing with half quantity of No. 2.—B.SC., Plymouth.

[62172.]—**Globular Lightning.**—Though vouched for by so many authorities, I did not believe in the appearance of the above until I saw it myself under the following circumstances. I was walking home at the foot of St. Boniface Down, Ventnor, when a flash of lightning and simultaneous crash of thunder occurred; at the same time what appeared to be a ball of luminous matter, about as large as a lady's parasol, seemed to fall in front of me. It rolled along the road in the direction I was walking, and turning through a private gateway disappeared. I almost immediately decided that the appearance was a purely *subjective* effect (arising from the impression made by the flash on the retina of the eye), which followed the direction of the eye as I walked on, and disappeared when the impression wore out.—F. G. LLOYD.

[62173.]—**Developing Dry Plates.**—You should stop the development when the detail can be seen through from the other side of the plate. Some plates require development to be carried on until the picture veils over. Some require it to be stopped before veiling takes place. Experience is the only guide. Develop slowly. Five minutes is not too long a time; but here again plates differ. Sulphate of soda is never used in a developer. I suppose you mean sulphite!—SM.

[62173.]—**Developing Dry Plates.**—When your pictures turn out miserably thin, no matter how you develop, and they show full detail, it is a sign you have very much over-exposed your plates. Give less exposure; try ferrous oxalate as a developer, restrained, if needs be, with a little potassium bromide; develop until the picture is plainly seen on the wrong side of the plate. The shadows should remain very nearly or quite clean, without veiling up.—S. BOTTONE.

[62173.]—**Developing Dry Plates.**—Surely it is not sulphate of soda that you use (this is the word printed); if so, I am not surprised at your non-success. The greatest bother with sulphite developer is the tendency of the sulphite to turn into sulphate; but whatever formula you use it is evident that you have not developed long enough; continue until you see the image pretty fairly on the other side. I would recommend you also to double the quantity of pyro.—B.SC., Plymouth.

[62173.]—**Developing Dry Plates.**—Your developer apparently acts too quick, and so does not have time to give density to the negative, to rectify which put in more bromide; it is absolutely fatal to stop the development when the picture is seen at its best; you must let it go on till it is almost completely lost in the fog, by which time you ought hardly to be able to see the flame of your ruby lamp through it if you use one. I suppose sulph*ate* in your query is a misprint for sulph*ite*; I doubt whether there could be a sulph*ate* developer, though I don't know Werge's. If you have been using sulph*ate* instead of sulph*ite* you have not far to go for the cause of your failure. (The same remark applies to query No. 62169, where it is evidently sulph*ite* that is meant.) If you care to write direct to me, I shall be happy to give you as much assistance as I can. You might try "Beach's" or "Sodic sulphite" developer.—R. A. R. BENNETT, Walton Manor Lodge, Oxford.

[62175.]—**Repairs.**—As you are not enjoying the benefit of a lease—viz., a certain fixity of tenure, you can't be expected to be liable for any repairs or renewals other than those (if any) incident to a yearly tenancy.—B.SC., Plymouth.

[62176.]—**Measurement of Surface.**—Why not find the volume by ascertaining the weight of water the object displaces.—SM.

[62177.]—**Etching Ivory.**—I believe all ivory-etchers use sulphuric acid on any of the suitable etching grounds—wax, for instance. Where the etching is deep no doubt it has been done in two or three times, the protecting ground being put over the parts already sufficiently eaten away. A soft etching varnish is made by boiling 8oz. of linseed-oil with an ounce each of gum benzoin (Benjamin) and white wax until reduced to about two-thirds. A hard varnish would be made by melting mastic in linseed oil—about equal parts; and a common but useful form by dissolving rosin in turpentine and colouring with lampblack. The strength of the acid is varied, too.—SAML. RAY.

[62179.]—**Lathe Centre.**—Are you quite sure the hole in spindle or chuck in which centre was turned is true. It looks very much to me as if it were not, as it would scarcely warp $\frac{1}{16}$in. if dipped vertically. Heat the centre to dull red, and cool half way up, and let colour run down to blue; then cool right out.—T. C., Bristol.

[62180.]—**Telephone.**—I do not quite understand what "Country" asks for, but think my reply to "Enswitched" (No. 61581, in "E. M." Feb. 18th) will suit him; if not, write again, and I will send what he asks for.—J. FLETCHER, Burnley.

[62182.]—**Electric Clock for Factory.**—If the querist will write to me I shall be happy to suggest a plan to him which would occupy too much space in these columns.—ELECTRICIAN.

[62182.]—**Electric Clock for Factory.**—I am afraid I am not an expert enough to answer the queries you put forward; but as I notice you sign yourself "Manufacturing Electrician," I should like to have some correspondence with you on a private matter in connection with the profession, if you would kindly communicate with me. I am advertising my address in the proper column.—S. C. C.

[62182.]—**Electric Clock for Factory.**—Bore a hole in one end of a flat strip of brass and slip this on the shaft which carries the hour hand. This will form an hour hand which circulates beneath the dial instead of above. At various points affix to the wooden (?) case contact springs, so that the brass arm just touches them as it revolves. Fasten one wire to the metal works of the clock. The other wire must embrace the contact spring. I have fitted up several clocks on this plan; but not to ring so frequently.—SM.

[62184.]—**Steam.**—The simplest rule is to make a diagram. The usual one is known as Zeuner's, and scale off that. Calculations for slide-valves are rather too long. With the data you give, I make (neglecting angularity of connecting-rod) the cut off to be at $\frac{7}{9}$ nearly, release $\frac{1}{23}$ from end of stroke, cushion $\frac{1}{9}$, and admission just before dead centre. It appears to me the valve does not do what you state, but what you actually require.—T. C., Bristol.

[62185.]—**Steam.**—4lb. compressed to 30lb. is $7\frac{1}{2}$ times; therefore, steam occupied $7\frac{1}{2} \times \frac{1}{2} = 3\frac{3}{4}$in. before compression—that is, $3\frac{3}{4} - \frac{1}{2} = 3\frac{1}{4}$in. from end of stroke. In tandem-engine expansion is three times in h.p. cylinder, and three times this or nine times in all in large cylinder, and terminal pressure in this $= \frac{100}{9} = 11\frac{1}{9}$lb.; absolute terminal pressure in h.p. cylinder is initial pressure in l.p. cylinder $= \frac{100}{3} = 33\frac{1}{3}$, and the back-pressure in h.p. cylinder ranges between $33\frac{1}{3}$ and $11\frac{1}{9}$lb. Average pressure in h.p. $= 66 - 22 = 44$lb. —T. C., Bristol.

[62186.]—**Siphon.**—To charge the siphon, you must stop both legs. But you are trying the perpetual motion dodge in thinking to raise the water by means of a siphon, which simply acts as would a pipe let in bottom of tank in the ordinary way; the only thing it does is it saves this hole. If you get a spray to rise within 2ft. of the tank (wherever the tank may be), you must be content.—T. C., Bristol.

[62186.] — **Siphon for Fountain.**—"Pipe Tongs" is now worse off than if he had run the pipe direct from cistern to fountain, since, at the level of the water in the cistern, the weight of water to be lifted up the one leg of the siphon exactly counterbalances the weight of water in the other leg; consequently the effective height of the head of water is just the same as before, whilst he actually loses some of the power by the friction of the water through the extra length of pipe employed. The difference in size of the two legs of the siphon is immaterial, provided the aperture of the jet is smaller than the smaller pipe; if larger, air will be admitted.—ELECTRICIAN.

[62186.]—**Siphon.**—You are mistaken in supposing that you gain an additional pressure by the use of this siphon, as no matter what the weight the resulting column of water in the one leg is balanced by the same in the other leg; thus the pressure at the tap remains the same as if it were connected directly to the said tank. In order to cause a siphon to start in the manner described, it is necessary that "both legs" should be filled thoroughly to the exclusion of all air. I would not suppose it to be absolutely necessary, but certainly it would be preferable to have both legs of the same internal diameter of bore.—A., Liverpool.

[62187.]—**Silica in Fluor Spar.**—Fuse the elutriated substance with four parts soda carbonate for some time, at a red heat, digest in water, boil, filter, and wash. The filtrate contains sodium fluoride and silicate. Precipitate the silica by ammonic carbonate, wash, dry, ignite, and weigh. If alumina be present, it must be separated by solution in hydrochloric acid. The fluorine may be determined as calcium fluoride; evaporate off the ammonic carbonate, nearly neutralise with HCl, precipitate with calcium chloride, filter, dry, ignite, and weigh.—SM.

[62189.]—**Settlement.**—"H." should show the deed to a solicitor, and get his opinion on the possibility of annulment. Generally speaking, however, I should say no.—B.SC., Plymouth.

[62197.]—**Nitrate of Silver Stains.**—Remove with hyposulphite of soda. Cyanide of potassium will also do this, but do not use it, as it is a deadly poison.—ELECTRICIAN.

[62197.]—**Nitrate of Silver Stains.**—Cyanide of potassium in solution is the best known reagent for eliminating silver stains; but recollect it is a deadly poison.—B.SC., Plymouth.

[62197.]—**Nitrate of Silver Stains.**—Strong solution of hyposulphite of soda will fetch them off in the majority of cases. If this is not sufficient, solution of cyanide of potassium will do it; but if you use this, wash your hands or clothes well afterwards, as it is deadly poison.—R. A. R. BENNETT.

[62197.]—**Nitrate of Silver Stains.**—Cyanide of potassium will immediately and effectually remove stains of Argent nit.; but as this is a deadly poison requiring to be cautiously used, I often, when I have accidentally stained my fingers with the caustic, remove it by moistening the skin and rubbing freely with a crystal of potassium iodide. —DOCTOR MEDICINÆ.

[62197.]—**Silver Stains.**—Cover stains with strong solution of iodine, when dry apply potassium cyanide (poison), wash well. A recent stain can be removed by the cyanide without previous treatment with iodine. For clothes, use cyanide with an after application of oxalic acid. After thoroughly washing, apply a little ammonia to neutralise any remaining acid, or to restore the colour of the material, if reddened by acid.—SM.

[62200.] — **Vertical Boiler.** — Not less than 18in. by 15in. diam., with firebox 12in. by 10in. of $\frac{3}{16}$in. plate, with ends dished $1\frac{1}{2}$in. Rivets $\frac{3}{8}$in. diam., $1\frac{1}{4}$in. apart. If well made, it should stand 60lb. safely. Safety valve, $\frac{1}{2}$in. diam.—T. C., Bristol.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

61578. Walnut Plank, p. 508.
61580. Helical Spring, 508.
61582. Chloride of Mercury for Battery, 508.
61584. Stamping, 508.
61591. Lifeboats, 508.
61596. Goniostat, 509.
61602. Pile Driving, 509.
61605. Jerusalem, 509.
61611. Improving Clay for Pottery, 509.
61618. Variable Pitch Propeller, 509.
61621. Dividing a Circle, 509.
61636. Feed Wick for Paraffin Lamp, 509.

61832. Violin Strings, p. 19.
61838. Photographic, 19.
61840. Gas-Engine, 20.
61843. Old Violin, 20.
61846. Engine, 20.
61851. French and English Locos., 20.
61853. Painting, 20.
61856. Model Screw Steamer, 20.
61858. Sectional Induction Coil, 20.
61872. Perished Vulcanite, 20.
61874. Sawing Logs, 20.
61879. Colliery Lamps, 20.
61880. G.N.R. Locomotives, 20.
61884. Arc Lamps, 20.

QUERIES.

[62201.]—**Gramme Dynamo.**—I have a wire ring armature, 4in. by 4in., wound with $2\frac{1}{4}$lb. of d.c.c. 18 B.W.G. wire, wound in six sections. Poles are 5in. by 2in.; pole-pieces are hollowed out to receive armature. They are best soft cast iron, weighing 13lb. each. Yoke also best cast iron; weight, 12lb. Will some of "ours" please say the size and quantity of wire for fields and speed to run it to obtain the best results?—J. WRIGHT.

[62202.]—**Granite Column Turning.**—Will any of your readers kindly inform how to turn granite columns, and the kind of tools to use?—J. JOHNSON.

[62203.]—**Incubator.**—I am in a difficulty. I have made myself an incubator for hatching, with a zinc tank, worked with a lamp similar in all respects to Hillier's patent, but have not been successful with the regulator. Will any of "ours" give me information as to making one of some description (the simpler the better)? I am pretty handy with tools, so that I can make almost anything you could expect of an amateur. Any suggestion will be thankfully received by—ONE OF "OURS."

[62204.]—**Pumps.**—Will some of "ours" please say if 5in. dia. suction pipes are sufficiently large for an 8in. dia. pump? Length of tail pipes, 120ft.; vertical height, 18ft. Suction or tail pipes are generally less in dia. than delivery pipes. What are the reasons for this?—E. P.

[62205.]—**Detector Galvanometer.**—Will any of "ours" kindly give me dimensions of bobbins, quantity and size of wire for above for general lineman's use, similar to those sent out by the Telegraph Co., Silvertown, with I and Q circuits? I have been told that a good one should have a resistance of 1,000 ohms. I doubt these I refer to having that resistance, as they are so small. They appear to be wound with No. 36 and No. 20 s.c. copper wire. 1lb. of No. 36 gives a resistance of about 922 ohms, and I think it almost impossible to get that quantity on the bobbins of these instruments, so ask the advice of our electrical friends. A good galvanometer is worth making, and instructions will be fully carried out and thankfully received by—QUIEPPE.

[62206.]—**Sprague's Universal Galvanometer.**—I am making one of the above from instructions in Mr. Sprague's book; but am at a stop as to thickness of the copper strip $\frac{3}{4}$in. wide, and its position on the bobbin. Does it matter on which side of the needle it is, as it just fits the channel on either side of the needle?—QUIEPPE.

[62207.]—**Legal.**—Must a settlement by deed by a husband on his wife be registered or made public in any way, and can such papers as Stubbs's or Kemp's "Gazette's" obtain any information of the deed for publication? Husband perfectly solvent, with thousands of pounds surplus beyond all liabilities. Can the husband legally be one of the trustees to the deed, and what time has to elapse prior to it becoming a perfectly legal document?—ANON.

[62208.]—**Contact Breaker.**—To MR. HIGGS.—Will you kindly oblige me with a sketch of the contact breaker of your induction coil?—HOLLAND.

[62209.]—**Relation of the Resistance of the Field Magnets to that of the Armature in all Dynamos.**—What is the theoretical proportion of the resistance of the field magnets to that of the armature in dynamos? Is this theoretical relation applicable in practice to all dynamos, irrespective of size and method of winding, series, shunt, or compound wound?—R. C. B.

[62210.] — **Celluloid.** — Can this be obtained in cylinders larger than $1\frac{1}{4}$in. diam.? I have only succeeded in buying it that diam. What is a fair retail price? Is there any method of altering the shape of a block before turning it?—MAIDEN NEWTON.

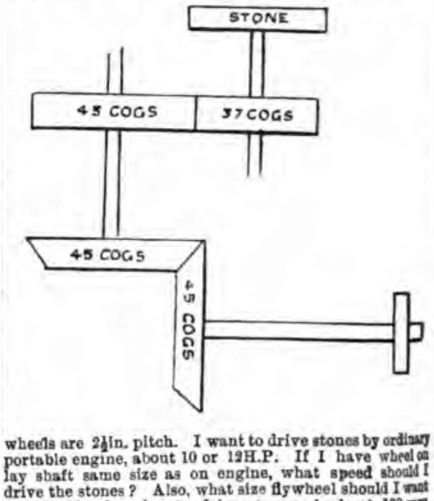
[62211.]—**The Occultation of Aldebaran.**—In the diagram of the occultation of Aldebaran (page 101), you give the times of the observer at Greenwich on the ellipse from 6 a.m. to 6 p.m. How do you find earlier or later hours, and how are they marked? You say the beginning is by inspection of the figure 12h. 2m. 3sec. Are not the seconds guesswork? More so, had it being between 4h. and 5h. The times on the moon's path are marked from west to east, and the star's hour angle is east. Would they have been marked the same if the hour angle had been west, or vice versâ?—J. W. C.

[62212.]—**Pump.**—I intend making a vertical feed-pump for a small horizontal engine $2\frac{1}{4}$in. bore 4in. stroke. Would anyone kindly tell me the bore and stroke the pump would require, and diam. of suction and discharge, valve seats, and pipes? Also, I want to make an iron steam dome on the Cornish principle, having one cylindrical furnace running right through. Information as to thickness of plates, diam. of rivets, length and diam. of shell, diam. of furnace, size of steam dome, and diam. of safety-valve seat and main steam-pipe will greatly oblige—M. M.

[62213.]—**Shafting.**—Would "T. C., Bristol," or some other reader, give the most correct plan of fitting J hangers and wall brackets and shafting? How to get the first two in position for fitting long lengths of shafting through several partitions, so that the two first may come in the right angles and level for bringing others on line? —YOUNG ENGINEER.

[62214.]—**Boring.**—Would some of "ours" kindly give a sketch how to bore a straight hole $1\frac{3}{4}$ diam., 7ft. long? Give a sketch of the boring bar and cutters. I have various sizes to bore, up to 3in. diam. They are all cored $\frac{1}{4}$in. smaller in diam. to allow for boring. They must be straight and clean.—H. S. H.

[62215.]—**Speed of Millstones.**—I have inclosed a rough sketch of gearage that drive the stones. All wheels are $2\frac{1}{2}$in. pitch. I want to drive stones by ordinary portable engine, about 10 or 12H.P. If I have wheel on lay shaft same size as on engine, what speed should I drive the stones? Also, what size flywheel should I want on left side of engine to drive stones at about 100 revs. per min.?—DUSTY MILLER.



[62216.]—**Laundry.**—Can any of our friends give me any advice respecting the fitting and management of a steam laundry using about 6 or 8H.P., and the best machines for different work, and what is to be used with them? Can I get any good books suitable for this and the different materials used?—STEAM.

[62217.]—**Promissory Note, &c.**—Suppose A. borrows £50 from B., and gives B. a stamped bill stating that he has borrowed this amount, and will pay it back with, say, 5 per cent. interest added. A. dies, can B. sue the widow, or cause A.'s property to be sold, to recover his money? If not, can it be made so that he can?—SKY LARK.

[62218.]—**Indicating Engine.**—I have an engine which is worked at low pressure with about 36lb. steam for rolling iron and steel sheets. I wish to know whether the steam the engine consumes is more than she really ought to use. Can some of your readers inform me how I ought to proceed to indicate the engine, giving full particulars?—ENGINE DRIVER.

[62219.]—**Sugar Solutions.**—Can any of our readers answer the following? (1) What degree Beaumé does cane juice crystallise into sugar? (2) What weight of sugar is got from 1c.ft. or 6·25gal. of cane juice at 23° Beaumé? (3) Is there any table of the different degrees Beaumé giving the different weights of sugar and percentage of water? If there is, in what book can I get it? —W. M.

[62220.]—**Mildew in Silk.**—I have a silk umbrella that has got most part covered with mildew by being put aside whilst wet and neglected to be well aired. Can any reader of "E. M." kindly tell me what will remove the evil without doing the silk any harm?—CHURCH HILL.

[62221.]—**Picture Frame.**—Can any reader kindly inform me what way ornamental corners are put on to large gilt frames, so as to cover the mitre, and at the same ıgthen it? Have tried plaster-of-Paris, but ery rough job.—G. B. S.

—Tempering Cast-steel Jumpers for one Boring.—Hitherto I have heated to a tempered in water to blue and straw colours, r will stand. Can any of your readers give me nation that will enable me to get them to stand? MAN.

—Dynamo.—To MR. BOTTONE.—Will you rour me with dimensions for a 100c.p. dynamo of a type for continual running, lamps of high or e, whichever is best? Sizes and quantity of use? How to coil (or shunt) and build up to get best effects? Should like to know if chine would be suitable for charging secondary so, how many?—McS.

—To "Fiddler."—Will you kindly furnish details for the making of the tenor violin on of construction? Also, you would have my best r any hints you can give as to the making of a violoncello, as I want to forward a class for nstruments.—SCREW CLAMP.

—Heating Surface.—What heating surface l for a l.p. condensing engine, 4½in. stroke, 2½in. nning 300 revs. per minute? I have allowed Is that sufficient?—A. F. SHAKESPEAR.

—Glaze for Bricks.—Would any of "ours" orm me the composition of the body and glaze bricks, and also for various colours and method the bricks? I have also some enamelled re sinks damaged through small pieces of coal them in firing. Could any of "ours" tell me or flux that I could use, say, with a blowpipe he damages (which are about the size of a large), and how to make the flux or glaze?—AN OLD ER.

—Uranus and Vesta.—Could any kind ve charts of the small stars round γ and τ s seen by the naked eye or with a small opera- ving the position of Uranus and Vesta respect- n April 22nd to 30th?—G. H. B.

WERS TO CORRESPONDENTS.

◆◆◆

communications should be addressed to the EDITOR GLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

on one side of the paper only, and put drawings ations on separate pieces of paper. 2. Put titles , and when answering queries put the numbers the titles of the queries to which the replies No charge is made for inserting letters, queries, 4. Letters or queries asking for addresses of rers or correspondents, or where tools or other n be purchased, or replies giving such informa- ot be inserted except as advertisements. 5. No asking for educational or scientific information ed through the post. 6. Letters sent to corre- , under cover to the Editor, are not forwarded, names of correspondents are not given to in-

ention is especially drawn to hint No. 4. The oted to letters, queries, and replies is meant for l good, and it is not fair to occupy it with ques- as are indicated above, which are only of indi- erest, and which, if not advertisements in them- d to replies which are. The "Sixpenny Sale offers a cheap means of obtaining such informa- we trust our readers will avail themselves of it.

wing are the initials, &c., of letters to hand up nesday evening, April 13, and unacknowledged re:—

—A. Bisset.—R. Mills.—T. Clarke.—G. Goldie.— —C. C. S.—M. Isader.—F. W. H.—W. J. R.— S. L. P.—Gerard Smith.—J. McG.—W. Jackson. stin.—T. G. Elger.—T. Wood.—Corona.—L. D. S., l Senor Ingles.—An Amateur.—Doctor Medi- Skinningrove R.S.O.—P. O. Linesman.—Elag.— Bristol.—H. C. Pocklington.—A Fellow of the stronomical Society.—Eos.

'ou will succeed better with the silver process e mercurial for such work; but it would be much to buy one already silvered. See No. 794 or No. 238. The method has been frequently described k volumes.)—BOAT. (Try zinc white or the white lead made by Freeman and Co., Grove Battersea. There are preparations of a suitable o be obtained at any large colour warehouse.)— MURRAY. (If you mean Beasley's "Druggists' l Receipt Book," it is published by J. and A. ill, New Burlington-street, price 6s. 6d.)—STU- (You were answered on p. 138, and previously. her of the books mentioned will suit you, con- teacher of the science class which you attend, through the back volumes for the titles of books ave been recommended from time to time. Also the syllabus and see what is required in the ed stage.)—SKYLARK. (By 52 Geo. III. c. 150, duty must be paid upon all articles sold as es, or held out to the public as beneficial to the ion, cure, or relief of any disorder or complaint g the human body. Such a definition would in- ny specific, such as an ointment for any express ; but not anything so simple as Brown's white tment or Jones's cod-liver oil. A license to sell required. Any name can be used, provided it is ady a well-known trade name. 2. We must refer back volumes for notes on conjuring, or to one ooks on the art of legerdemain.)—C. C. T. (Par- of the process have not yet been published; but ot rather powerful machinery would be required. not know where the "stock" can be procured in ntry. Try the Xylonite Co., Homerton, E. 2. eople would like to know how to take out the f petroleum. See indices of back volumes. There een many suggestions, and several patents.)— (A similar query inserted a few weeks ago. If there had been anything wonderful in the new telephone, details would have been published before now. It is not "crea'ing a furore" in either Paris or Brussels.)—A. V. (The only answer that can be given to such a query is advice to take the picture to an expert, and let him see if he can find out at least the "subject" if he fails to discover the artist's signature.) —J. G. W. P. (Size, or a solution of glue.)—J. M. H. (There is a work by Capt. Shaw which may give you some information, and you can write to Messrs. Merryweather, Long-acre, W.C. We believe they publish instructions of the kind.)—W. W. (You can procure suitable composition of any of the cycle dealers. It is generally a mixture of guttapercha and pitch, which is placed in the hollow rim and melted by the flame of a spirit lamp, the rubber tire being bound down until the cement is cold.)—P. E. R. (There is no means of preventing it; but why use so valuable a watch for the purpose? The Waterbury is quite good enough for any electrical experiments where a watch is liable to be affected by the magnetism, and we understand that is not affected even by proximity to dynamos.)—HEAT. (The composition of the fusible metals is given in most of the textbooks. The most fusible is made of bismuth 8 parts, tin 3, lead 2, and mercury 2 parts.)—ARCTURUS. (We do not understand what information can be given in the circumstances. Study in such cases does more harm than good, and Nature is the best judge. Any attempt to spur her into unwonted action will infallibly end in disaster if persisted in. When you feel drowsy you should sleep.)—T. COVERNEY. (See indices. There is no satisfactory remedy. Clean them well and expose to the sunlight by a window, taking care that glass is always between them and the sunlight.)—D. W. W. (See indices of back volumes, and read what was said about the "curative power of magnets" in pages 463, 507, 554, 581, Vol. XLIII., and pages 16, 20, 38, 44 of the last volume.)—CENTIPEDE. (Procure a catalogue from Van Voorst, Paternoster-row, E.C., and also from Macmillan and Co., Bedford-street, Covent-garden.)—SCIPIO. (They are not articles, but replies to questions. If you would only state what it is you want to know, we might be able to answer you or refer you to some number in which the required information has been given.)—TELEPHONE. (You hardly give enough details; but from what we can make out it is decidedly an infringement, and you would be stopped.)—J. C. (We cannot entertain the idea.)

A New Washable Truss.—An Important Invention.—Harness Xylonite Truss is the most perfect appliance ever invented. It gives complete comfort and support without irritation. It has a beautifully smooth, flesh-coloured surface, and is guaranteed to last a lifetime.—Address: MEDICAL BATTERY COMPANY (Limited), 52, OXFORD STREET, LONDON, W.

CHESS.

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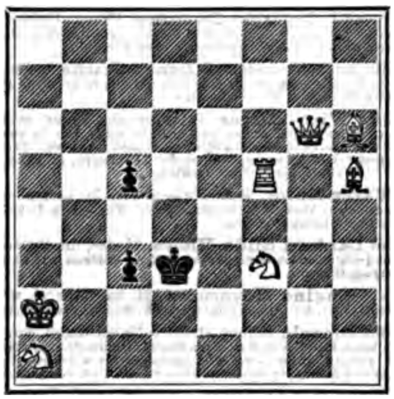
PROBLEM MXXXIX.—BY J. KEEBLE.

Black.



White. [7 + 3

White to play and mate in two moves.

SOLUTION TO 1,037.

White.	*Black.*
1. R-K B 3.	1. Anything.
2. R or B mates.	

(Four variations.)

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CORRECT solutions to 1,036 by G. A. A. Walker (2), Snowdrop (2), A. Bolus (second), Cotswold (ditto), Link (ditto), and J. Palmer (ditto); to 1,037 by A. Dean, W. Hewson-Kilbee, A. Flawn, Major, F. Krasser, A Beginner, J. J. Spence, Snowdrop, E. C. M. (Ipswich), V. S. Pochin, Link (very ingenious and well constructed), Cotswold, G. A. A. Walker, Black Pawn (piquant, but want of variety and duals), A. Bolus.

MAJOR.—Thanks for solution to Vienna Problem. It is interesting and worth inserting when this Tourney is concluded.

W. HEWSON-KILBEE.—You are right as to your proposed solution to 1,035 if $1. \frac{\quad}{\text{B takes Kt}}$. The proper defence, however, seems to be $1. \frac{\quad}{\text{K-Q 4}}$. How do you proceed then?

T. H. BILLINGTON.—Many thanks for the problem.

G. A. A. W.—If a two-mover, we shall be satisfied with the key move in case of a second solution: but with a three-mover the solution must be given in full.

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Good Value Offere kinds of sound or repairable Science Depot, Chenies-street, 1863.

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Wanted good Model St boilers. Will give a new Music Bedford-street, Liverpool.

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Engine and Boiler, ne particulars. Exchange for Screw-c 66, Victoria-road, Tunbridge Wells.

[illegible]

:d from the water, and the
'ainst the plate by an india-
ueezer to remove any air that
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; then pressed slightly in a
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nen cold it is removed from

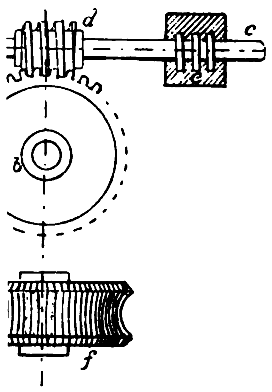
OF MACHINES.—VIII.

CIS CAMPIN, C.E.

w and Worm-wheel—
rential Screw.

liar form of screw gearing
n in Fig. 32, known as the
worm-wheel; it is a com-
reat value in some circum-
hich, from its compactness,

'2



but it has the disadvantage
good deal of friction.
ieel which has teeth cut on it
is, as is shown on the plan *f*;
aft *b*, to which it is securely
h is the barrel for the chain,
if for any other purpose,
nay be necessary to transmit

aft carrying a few turns of
vorm *d*, which fit into the
n-wheel; by revolving this
the wheel are pushed for-
l caused to revolve.
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; in the bearings is provided
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per form, when it is caused
vith the wheel. The wheel
ded as a revolving part-nut
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int out the advantages of
s compared with a train of

the power, instead of being
n *one tooth only* at a time, is
h three or four, so that,
eak, there is not the danger
t, that there is in the case
l, moreover, as more teeth
an be made smaller than in the spur-wheel. Again, as the pressure is on the entire surface of the tooth, the strain becomes a shearing strain at the root instead of a bending force at the end of the tooth.

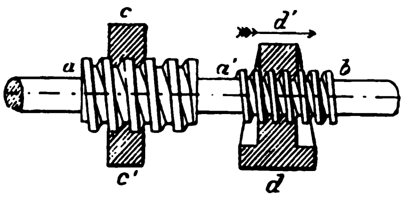
In the next place, with this combination of two elements, we can obtain an enormous multiplication of force, such as would require a long, cumbrous, and expensive train of spur-wheels to provide.

The shapes of screw-threads may be generally classed as two in number—square, and V-shaped; in the former it is evident that the pressure between the screw-thread and that of the nut will be parallel to the axis of the screw, whereas with the V-thread, the pressure being normal to the surfaces of the threads, will not be parallel to the axis of the screw, so that the friction will be greater, and there will, moreover, be a tendency to burst the nut; therefore, for mechanical movements, the square thread is much to be preferred.

In the square-threaded screw the thickness of the thread must evidently be one-half the pitch (for a single-threaded screw); therefore, the finer the pitch the thinner and weaker will the screw-thread be; but as the finer pitch corresponds in heavy machinery to a greater multiplication of force, it is evident that a stronger thread is required.

In order to get over this difficulty, a contrivance, called a differential screw, may be used, when the movement is rectilineal—it is shown in Fig. 33.

F I G 33



a a' b is a shaft on which are cut two screw-threads, *a a'* and *a' b* of different pitches; *c c'* is a movable nut, through which the work is given off, and *d d'* a fixed nut which acts as an abutment for the screw to work against.

The threads *a a'*, *a' b*, being both cut in the same direction, it is evident that while the nut, in regard to the screw, is drawn in the direction of the arrow at *c'*, the screw itself will be travelling in the direction of the arrow at *d'*—that is, in an opposite direction—so that the actual distance travelled by the nut *c c'* in one revolution of the screw-shaft will be the *difference of the pitches* of the two threads, *a a'* and *a' b*. The actual direction in which the nut will travel will depend upon which thread has the quicker pitch. If it be *a a'*, then it be move in the direction of the arrow at *c'*; but if *a' b* has the quicker pitch, the nut *c c'* will advance in the direction of the arrow at *d'*.

As in this arrangement the *difference* of pitch regulates the multiplication of force, we can have the threads of such pitch as may be required to afford the necessary strength for the force to be transmitted.

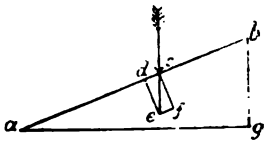
In calculating the multiplication of pressure obtained by this arrangement, let R = the radius of the crank or arm on the driving screw, P and p the pitches of the two screws respectively; then the ratio of the pressure at the working point of the machine to that at the driving point will be $= 2 \,.\, R \times 3{\cdot}1416 \div [P - p]$. For example, let R = 15in., P = 2in., and p = 1·875in., r being the ratio, then $r = 6{\cdot}2832 \times 15 \div [2 - 1{\cdot}875] = 753{\cdot}984$, nearly 754; so a pressure of 20lb. on the end of the driving arm would give a pressure of 15,080lb. on the end of the driven screw equal to 6·73 tons, less some loss for friction.

The objection to the screw and worm-wheel being due to the great amount of friction, which really precludes its use for very heavy machinery, it is necessary to examine the amount of work expended in this friction, in comparison with the total amount of work done. Let R = the resistance to be overcome in the direction of the axis of the screw in pounds; P = the pitch of the screw in inches; D = its diameter in inches; p = the driving force in pounds at the periphery of the screw, and 0·08 the coefficient of friction.

As the resistance will be overcome through a distance equal to the pitch, while the driving force moves through a distance equal to the circumference of the screw, then the pressures varying inversely as their velocities, the power required to do the *useful* work will be $p' = R \times \frac{P}{D \times 3{\cdot}1416}$.

In Fig. 34 *a b g* represents one turn of a screw unwound on to a plane, or, as it is technically

FIG. 34.



termed, developed; *a g* is a horizontal line, and *b a g* is the angle of the screw thread; *a g* is equal to the circumference of the screw, and *b g* to its pitch; at *c* a vertical resistance parallel to the axis of the screw acts. This force will be resolved into two others, one acting in the direction *b a*, and the other at right angles to it, the latter being that to which the friction is due, and the former tending to slide the inclined plane in the direction *a g*. Produce the vertical line, making *c c* equal to the resistance to be overcome, and complete the parallelogram *c d e f*. Then the normal pressure on *a b* will be $R \times \frac{cf}{ce}$; but (as shown in a previous article, No. II., on friction) *c f e* and *a g b* are similar triangles; therefore the pressure on *a b* and at right angles to it is $= R \times \frac{ag}{ab}$

$ab = \sqrt{(ag)^2 + (bg)^2} = \sqrt{(3{\cdot}1416\,D)^2 + P^2}$, hence the friction will be $= 0{\cdot}08 \times R \times \frac{ag}{\sqrt{(3{\cdot}1416\,D)^2 + P^2}}$, and this resistance must be overcome through the distance *a b*; hence, multiplying the last quantity by the value of *a b*, we get for the work done in overcoming friction during one revolution of the screw the quantity $0{\cdot}08 \times R \times ag = 0{\cdot}08 \times 3{\cdot}1416\,D \times R$ inch-pounds. The power acts through the distance *a g*; so calling the force necessary to overcome the friction or prejudicial work p'', we have $p'' \times 3{\cdot}1416\,D = 0{\cdot}08 \times 3{\cdot}1416\,D \times R$; therefore, $p'' = 0{\cdot}08 \times R$, and the total force required will be $p' + p'' = R \times \frac{P}{3{\cdot}1416\,D} + 0{\cdot}08\,R = R \times \left\{ \frac{P}{3{\cdot}1416\,D} + 0{\cdot}08 \right\} = p$ lbs., the total driving pressure required, at the periphery of the screw.

It is evident that by diminishing the diameter of the screw the factor $\frac{P}{3{\cdot}1416\,D}$ becomes larger, and, as 0·08 is constant, by so doing the percentage of prejudicial resistance is reduced.

To make this more clear, let the arm or wheel by which the tangent screw is driven be 10in. in radius, then in one revolution the driving point will pass through a distance equal to $2\,r \times 3{\cdot}1416 = 20 \times 3{\cdot}1416 = 62{\cdot}832$in., and if the *pitch* of the screw is kept constant at 1in., the ratio of velocities will be constant between the driving-point and the point at which the power is given off by the screw.

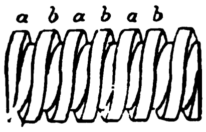
Of course, in considering this question of proportions of parts, the value of the limiting angle of friction must not be lost sight of, for when, by diminishing the circumference *a g* to a certain value of *b g*, the angle *a b g* becomes equal to the limiting angle of friction, motion will become impossible if the screw-thread is to be the driver.

This brings us to the consideration of the arrangements of screw-gearing, in which the nut or worm-wheel, as the case may be, is the driver. It is evident in this case that motion will become impossible when the angle *b a g* is made as small as the limiting angle of friction, and for the purposes for which this combination is employed it is usual to make the screw-threads with a quick pitch.

The thickness of a screw-thread being one-half the pitch when a single thread is used, this would become very clumsy with a quick pitch, and unless the screw were of great diameter, the bearing surface afforded by the depth of the thread would be scanty in proportion. For this reason the thread in such cases is divided up into two or more, thus affording a good bearing surface without the necessity of using a deep thread.

In Fig. 35 is shown a double-threaded screw, the two threads being indicated by the lines *a a a* and *b b b*.

F I G 35



The most familiar instance of driving a screw by moving the nut is furnished by the Archimedean hand-drill—a handy little tool, of which the shaft carries a quick-threaded screw having on it a nut, by moving which along the shaft (without allowing it to revolve) the shaft and drill fixed in the socket at the end are caused to rotate rapidly.

A common illustration of a tangent screw driven by a worm-wheel occurs in musical-boxes and some other light classes of machinery. The speed of the barrel of the musical-box is regulated by the resistance of a pair of vanes carried on a shaft on which is turned a quick-threaded screw driven by a small worm-wheel. The speed is regulated by altering the angles of the vanes, which are hinged to the screw-shaft, so as to offer a greater or less potential surface to the resistance of the atmosphere.

The only case in which we have seen this arrangement applied on anything approaching a moderately large scale was in a steam launch of very unique construction, which was tried on the river Thames upwards of twenty years since.

The propeller was a screw, and upon its shaft was fixed a cylinder, having cut on its surface a spiral groove returning into itself—that is to say, that starting at one end it ran as a right-hand screw to the far end, and then turning by as easy a curve as could be obtained, returned to its starting point as a left-hand screw ; thus, the cylinders being placed parallel to the screw shaft, and carrying at the ends of the piston-rods suitably formed blocks to fit and turn in the spiral grooves, the reciprocating action of the engines imparted a continuous rotatory movement to the screw shaft, for as in the forward stroke the block would be running in the right-handed hemi-spiral, so in the backward or return stroke it would be running in the left-handed hemi-spiral, and so the direction of rotation would be continuous. The pistons being so set that one was at mid-stroke when the other was at half-stroke, the same uniformity of movement was obtained as with ordinary coupled engines having their cranks placed at right angles to each other.

Although very interesting as an experiment and successful in working, the great friction was fatal to its adoption on a large scale.

(*To be continued.*)

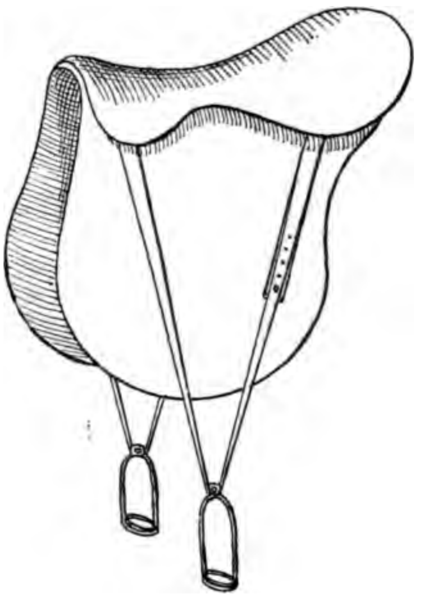
THE SAFETY SADDLE.

Invented by John Charles King.

PERHAPS there have been fewer changes in riding saddles than any other essential part of horse-gear in all countries where saddles are in general use. In England the saddle of the army has been so little altered that it may be regarded as unchanged for a century or more. The hunting, racing, or hack saddles are much the same one century after another; the "cut-back" pommel of gentlemen's saddles is the only noticeable difference in old saddles and those of modern times. An old saddle in Shottesbrook Church, Bray, Berks, is a military saddle of about as serviceable a form as modern ones. In many castle armouries old saddles are preserved, from which we can see that the only difference is in the stirrup bar being a "latch" instead of a "loop" to hold the stirrup-leather. The patents of recent times for saddle improvements have not been for the saddle, but for a modification of the "latch" or bar on which is hung the stirrup-leathers — these, of course, apply to the saddles of private users. In the army new patterns are issued, often with faults unknown in the old patterns. This seems to be the case with the pattern known as the 1884 pattern for the British Cavalry, now being withdrawn from use. Old soldiers speak of military saddles as a contrivance to hurt man and horse. No doubt there are faults, but their obviousness should suggest the remedies. Soldiers on horseback not being permitted to "jockey"—i.e., spring their bodies up to avoid the concussion of the saddle at the trot of the horse—renders the riding distressing to horse and man.

The theory of this arrangement, in military equitation, is to prevent the men bobbing up and down at a trot, which would look non-military, it is said, and the soldier is supposed to stand in his stirrups at all paces beyond a walk, merely balancing his body on his horse, his seat being to keep him from swaying backwards and forwards. This sounds fairly well; but the stirrup has a single strap to one point of fixture in the saddle, and a dangling motion with or without the rider's foot in the stirrup. This see-saw sway of stirrup prevents a soldier standing firmly in his stirrups : he rocks about in them if he attempts to stand, and the point of fixing on the saddle being forwarder than his centre of gravity, he is obliged to lean forward to try to attain it—but fails, and is bumped sometimes so violently as to be ruptured. The horse suffers as well.

The long period of time since the saddle was modified in principle of construction in any way has at last arrived at a shifting point, and the modification is one which, though simple, is likely to cause a marked effect on the saddlery trade, and also in the quality of riding generally, which has been often commented upon in the press from "Dr. Syntax's" time to the last essays on horsemanship portrayed in the comic press. The aim of the inventor, for it is an invention more than an improvement, seems to have been to improve both the standing of the military saddle and the seat of the ordinary saddle of the road or the hunting field. As the "tree" is materially altered in the form of the seat so as to get a tension seat for the rider, we describe that first. It is pretty well understood that the "tree" has its distinct parts, as pommel in front, cantle at back, and belly-pieces joining them. The several parts are distinguished by technical names, the plates back and front making the whole strong to bear the great strain to which a "tree" is subjected. The two pieces connecting pommel and cantle form two ridges, which are felt through the seat-covering of webbing, canvas, and leather. The "Safety Saddle" removes these objectionable parts, and by making them wider apart at the rider's bearing part of the seat of the "tree," it allows the open space to be webbed, so as to make a yielding seat, so that the falling of the rider is not likely to occur any more on this saddle than on an office-stool.



The other invention is to hang the stirrup-leathers from two parts of the saddle on each side, at the back part towards the end of the cantle, and in front on the points of the pommel, so that the stirrup-leathers on each side are in the shape of the letter V, the tops having suitable loops and latches by which they are attached to the saddle, and the bottom of the V holding the stirrup, which hangs vertically to the centre of gravity of the horseman seated on this sort of saddle. The stirrup hangs differently to ordinary stirrups, which have the edge to the thrust of the rider's foot when seated. With the new double-suspension hanging of stirrup-leathers, the open front of the stirrup is always to the forward thrust of the horseman's foot—a serviceable position, with a skittish or fidgety horse after dark when mounting, the right foot having always to kick at the dangling stirrup-iron till it is turned, so as to get the foot into it. The sketch shows a side view of this saddle with the stirrup-leathers and irons complete.

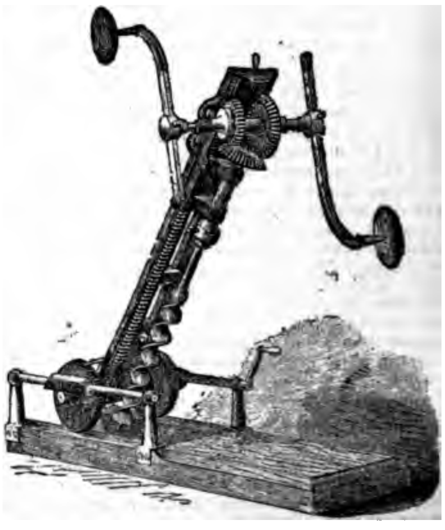
The rigidity of this suspension, compared to the slinging motion of the ordinary stirrup-hanging, only needs a trial to make the rider exclaim, "Why was not this thought of before!" The invention is patented, and includes a very simple plan of stirrup-leather "latches," in the form of long projecting "studs" of a peculiar shape, which engage into metal loops on the upper ends of the stirrup-leathers, retained there by a spring so that they are secured; but should the leathers be pulled obliquely as much as if a rider were thrown, the spring yields, and allows the loop to pass over the "stud," so that a rider with his foot hitched in the stirrup has instant release from the saddle.

The leathers are alterable in length by a hook-buckle out of the way of the rider's legs, and much simpler than the present buckle for the purpose. The advantages are more obvious to a rider than to a "tree" and saddle-maker. For instance, the horseman wants to sit as low as possible on his horse; the improved seat allows him to sit half an inch closer, and the hard-stuffed quarters of the seat are removed, so that the thighs are not hurt as in the use of an ordinary saddle if the rider happens to use long stirrup-leathers. Again, the spread of the legs on the saddle is reduced 1in. at the knees, and the stirrup-leathers being away from the knee-bearings on the flap of the saddle, the muscles of the knees inside the legs are not strained and chafed as with the slung-hung stirrup-leathers.

The inventor, Mr. John Charles King, Windsor-street, Uxbridge, has brought his military training and hunting experience to bear on all the details of this saddle. Whether for military, civilian, or ladies' riding its use has shown that it possesses all the merits claimed for it by the inventor.

DRYDEN'S BORING MACHINE.

AT the Industrial Exhibition held in Worcester, Mass., an improved boring machine was exhibited by Mr. G. W. Dryden, of that town, which has several features to recommend it to the attention of all tool users. When placed in position, it will bore the whole mortise without being



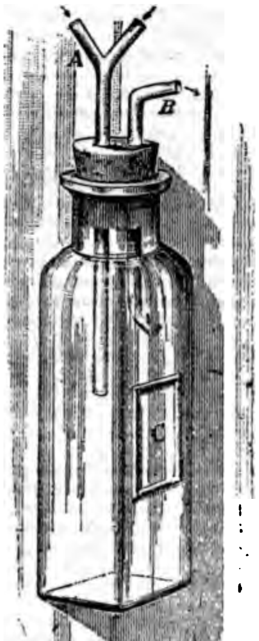
ed, thereby doing double the amount of work ie same length of time, and with greater ease .e operator, as the cranks are adjustable for or small augers, soft or hard wood, and any d may be given to the auger. The machine is ed horizontally by means of the side screw, h is cut with two threads to the inch, and eby forms a gauge. The machines may be sted to bore at any required angle. It will two or more holes to the same depth, as it has p provided for that purpose.

ORIENTING OBJECTS IN PARAFFIN.*

the *Zool. Anz.*, No. 199, Selenka has lescribed a method of keeping paraffin melted e the contained small objects are being nged under the microscope in any desired tion, and then of rapidly cooling the paraffin out disturbing the position of the objects.

nding it difficult to make tubes such as he ribes, which should be of such shape as to it of removing the hardened paraffin readily, at the same time with depressions of sufficient for any but very minute objects, I have made of the following simple device, which, though clumsy than the tube of Selenka can be used objects 1 mm. long and much larger, while g a block of paraffin of very regular shape and rectangular sides.

common flat medicine bottle is fitted with a through which two tubes pass, or if the mouth all one tube may be fastened into a hole drilled



the bottle. One of these tubes, A, is conted with hot and cold water; the other, B, is a charge-pipe for the water entering the bottle by nd raising or lowering its temperature as warm old water is allowed to flow in. On the smooth side of the bottle four pieces of glass rods or ps are cemented fast so as to inclose a rectular space, C, which forms a receptacle for the ted paraffin. As long as the warm water circus through the bottle the paraffin remains fluid, objects in it may be arranged under the roscope by light from above or below, and can oriented with reference to the sides of the affin-receptacle or with reference to lines drawn n the surface of the bottle. When the cold er is allowed to enter in place of the warm, paraffin congeals rapidly and may be easily reed as one piece. The discharge-pipe should n near the upper surface of the bottle, to draw any air which may accumulate there.—E. A. DREWS.

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is frequently a very difficult matter to proy orient small objects, especially spherical eggs, that sections may pass through any desired s. In my work on the embryology of the mon shrimp I have found the following process y convenient. Impregnation with paraffin is mplished in the usual way, and then the eggs numbers) in melted paraffin are placed in a llow watch-crystal. They immediately sink to the bottom, and then the whole is allowed to cool. The crystal, glass upwards, is now placed on the stage of the microscope, and the eggs examined under a lens. In this way one can readily see exactly how any egg lies, and then with a knife it may be cut out with the surrounding paraffin, and in such a way that it can readily be fastened to the block in any desired position. After all which have dropped in a suitable position are thus cut out, the paraffin is again melted, and after stirring the eggs the cutting out is continued as before.—J. S. KINGSLEY.

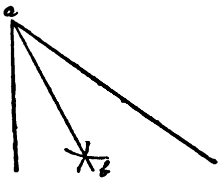

Fig 2.

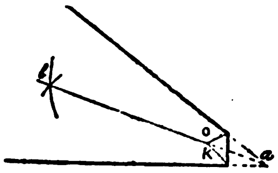

Fig 3.

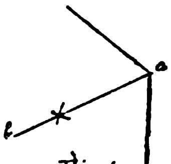

Fig. 4.

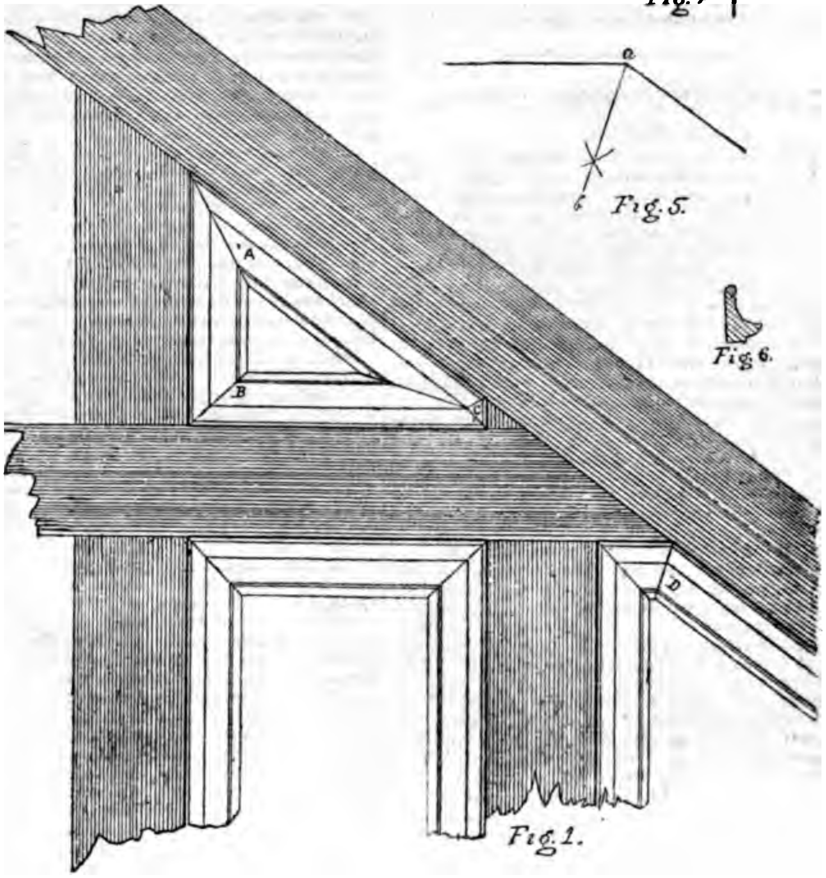

Fig. 5.

Fig 6.

Fig. 1.

VARYING MITRES.*

IN the ordinary routine of work pertaining to each of the different wood-working crafts, there are certain forms of joints, cuts, or important details of construction and decoration which are well known and occur almost daily, and other forms of the same which are varying. As those which are most in use are more easily worked and familiar to the operator, so it must of necessity follow that unusual forms will call forth more labour of brain and manual skill to effect their successful completion. This is particularly applicable in the case of the mitre-joint, which every wood-worker is in daily contact with. It is being continually employed in different parts of joinery, in all places where a continuous grain or moulding is required, but the most difficult of all its employments to execute is the mitring of mouldings, both flush and raised, in framing. Here the intersection of the profile, especially those with many members, necessitates great care in marking the mitre-box and sawing it, marking and sawing the moulding and insuring its perfect intersection before driving the pieces to their permanent place in the panel. Concerning a simple square mitre of the angle of 45°, as it is too well known to require special comment here, we will avoid its consideration, except to recommend readers to take careful heed of three important points, essential to perfect mitring.

First.—To mark the mitre-box by a bevel set to the diagonal of a square about 4in. wide, laid down with a knife on a clean board.

Second.—To mark the box also with the knife and saw, carefully, keeping the saw kerf to one side of the knife-mark.

Third.—Saw moulding exactly to the mark made on the panel, and out of one continuous piece for each panel, round the sides, and intersect perfectly before driving down.

Care and exactness will help to perfection and save trimming off afterwards.

Fig. 1 represents a piece of ash panelling, designed to stand under a stair string. It embraces four mitres of different angles, one of which involves in itself three separate intersections. By refering to Fig. 1, it will be seen that the angle A is less than the angle of 45° at B, and being thus acute or less, the moulding will form a longer intersection or mitre than B. Similarly the angle at D is greater than B, consequently the mitre is shorter, which is plainly seen in the sketch.

To find the mitre at A, strike out the angle inside the framing at A, like Fig. 2. Take any two points equidistant from *a*, Fig. 2, the apex of the angle. With the compasses, strike the crossed lines shown and draw a line joining their crossing with the apex of the angle. This line will be the exact mitre, and if a bevel be set to it and marked on a good box, the cut can be got direct from the saw.

Fig. 3 shows the compound mitre at C. It is rendered compound by the insertion of a small piece necessary to continue up the mullion below the rail shown, and the mitres are found thus. The angle at the corner of the rail and raked piece, being even less than at *a b*, will be longer; and this line is gained by the method used above. B, being a right angle, the mitre for it is cut in an ordinary 45° box, but *o* must be cut to the line, *a b*, shown at Fig. 4, which is the mitre for the upper corner at C. These two cuts will give the small piece, its length being obtained on the small piece of mullion.

It will be noticed that the point of intersection of the three combined mitres is at the apex or junction of the two main curves of the moulding represented at Fig. 6. The great length of the principal mitre in this corner rendering it unhandy for a box, it is recommended that the moulding be marked on the bottom side and the mitre cut square to the bottom to insure a close joint above. This method will always be found suitable for very long cuts. The fifth mitre, shown in Fig. 1 at D, is obtained by the same process as before, and, being short, can be marked on (Fig. 5) and cut in the mitre box.

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* From the *American Naturalist.*

* By OWEN B. MAGINNIS, in the *Journal of Progress* (Philadelphia).

Finally, experience has taught that the only way to obtain a perfect mitre is from the saw alone, as it is invariably the case, no matter how carefully the block plane is used, the joint can never be evenly surfaced or satisfaction gained.

THE OXY-HYDROGEN ZIRCONIA LIGHT.*

DURING the last twelve months I have seen several statements in various papers that Zirconia was "frequently" used instead of lime; but every effort on my part to find one such operator, who was actually using this earth, has proved fruitless. Equally fruitless have been my endeavours to procure one of M. Tessié du Motay's Zirconia pencils, such as were sold years ago, and exhibited once at the Royal Institution by Mr. Ladd. The successors in business of that gentleman are unable to assist me, and I cannot get such a thing anywhere. If any reader possesses, and can lend me one of these pencils for a brief trial, I shall feel particularly obliged to him.

I have myself tested experimentally three different samples of Zirconia; and as my sole hope of ultimate success lies in the fact that each one of the three behaved in a different and distinct manner, and therefore that the removal of the presumed impurities might improve the results more than I expect, I describe them.

1. The first was a sample considered "pure" by Messrs. Hopkin and Williams, kindly compressed for me, and for his own trial, by Mr. Chadwick; but this sample was so impure as to be useless after about a quarter of an hour. It coloured the flame intensely yellow, and the prism at once showed this to be due to a considerable portion of soda. Otherwise, the incandescence itself was pretty white (as distinct from what is mentioned presently), and the soda might in time probably have been volatilised out of the cylinders. A far worse fault was the large quantity of silica in the sample, which quickly fused into a thick yellow glaze, in which large cracks immediately appeared. After that the light was far too poor for any purpose, and was not good at the best. I may say that all the samples were tried on the flat ends of cylinders about $\frac{3}{8}$in. in diameter, giving a bright disc of that size.

2. The next sample or samples were prepared (largely by blowpipe process) by a gentleman who does not wish his name mentioned at present, but who has taken great interest in this matter. There was not much soda in his samples, and it rapidly disappeared under the jet. The sample also stood the jet much longer and better. But considerable silica (the great difficulty in preparation) remained, and through dark glasses could be seen to seethe and fuse under the heat, rising into waves and ridges. After this the light diminished very greatly, and great cracks appeared in the face of the cylinder. There began now, moreover, to appear a peculiar *reddish* glow about the light, utterly different from the sodium flame, and quite pronounced; and the peculiar properties of Zirconia were now very conspicuous, especially as regards its extraordinary *non-conducting* character. With a powerful jet playing on this small surface, the incandescent portion only extended about $\frac{1}{10}$in. back from the face, and was bounded by a nearly sharp line. Moreover, the bright surface barely extended to the edge of the small disc, and the brightest portion in the centre was only $\frac{3}{16}$in. in diameter. A further curious phenomenon was, that the cylinder rapidly began to crack all round at the boundary of the bright incandescent portion, and this crack gradually penetrated the cylinder till the slice thus separated fell away from the face. This seems to show a sudden and unequal shrinkage, which I fear will be a great difficulty in using Zirconia. This light, at its best, was considerably inferior to that from an ordinary lime with the same jet.

3. The third sample was obtained by Mr. H. G. Madan, of Eton College, from Herr Schuchardt, of Görlitz, and was stated to be prepared "especially" for the oxy-hydrogen light. It is sold at the rate of 18s. for ten grammes, of which about half is needed for one small cylinder. This powder shrank enormously when heated, showing that the oxide was very largely hydrated, and that the water was driven off when the cylinder was ignited. Otherwise the sample appeared the purest of the three, was very dry after ignition, and the cylinder was much more friable or fragile after compression. (The preceding samples were both as hard as marble after delivery from the die.) On heating in the jet, however, the plug seemed to *bake* quite hard. It behaved quite differently from either of the others, being evidently far more free from silica. After half an hour there was nothing on the face beyond a very slight and even glaze—no *mass* of glazed silica, as in the others, and the surface remained flat and sound. But the *red glow* was far more marked than in either of the two former, and I am most anxious to discover whether it is characteristic of pure Zirconia itself, or is due to some impurity which might be eliminated. Also the circular crack round the cylinder was formed far more rapidly than on the others, and the layer on the face dropped off after no more than half an hour. I much regret that this separated layer was not inserted in a loop of platinum wire, and heated by itself, as such a thin disc might possibly not crack again.

But the light was, again, far inferior to that of a lime. Mr. Madan tested the plug again, after being crushed and re-made up, at Eton, and compared the lights photometrically in the usual way. With the same jet, the light from the end of the Zirconia cylinder was to that of an "Excelsior" quarry lime in the proportion of 1 : 2·88. This is a very startling difference, and the opinion of all who have had to do with these experiments, is very decidedly to the effect that the vaunted Zirconia light is what Americans call "a fraud."

Some qualifications may, however, be made. The *surface* made incandescent upon a lime cylinder is obviously much larger than that of a disc $\frac{3}{8}$ths of an inch in diameter; in fact, probably the proportion is not very different from that of the illumination as given above—hence the *specific* brilliancy of surface may be about the same, or a little more. It may be asked, Why, then, not use more surface of Zirconia? As regards any single jet, the answer is, that owing to the extraordinary non-conduction of heat before alluded to, such larger surface *cannot be illuminated*. The gentleman whose name is not mentioned is about to try the experiment, however, of using upon a larger disc the flame from two or three nozzles, and I await the result with interest. This will, however, even if successful, lose one of the best properties of the Zirconia light. The *small* bright disc gives a parallel or other beam from the lantern, for optical work, about as "sharp" as from the electric arc. So great is this advantage for some purposes, that if I could only obtain cylinders that would "stand," free from silica, and which did not crack off, I would be thankful for them even with the less light; with the microscope, for instance, the light condensed *on a slide* for a one-eighth immersion lens would be nearly as great, and the definition better. It is chiefly on this account that I ask for any information anyone can afford on the subject of Zirconia.

It may naturally be asked, How does it happen that our experience, as here narrated, differs so radically from that stated by others as regards the "superiority" of this light? My own opinion is, that the American and Continental experimenters simply have not known *what a good limelight is*.

TREES FROM A SANITARY ASPECT.*

AS this is the usual time of the year for planting, pruning, and removing forest trees and shrubs, it is a fit time for considering the influence which trees exert on the sanitary surroundings of dwelling places. The recent Parliamentary Report on Forestry shows that trees are now of little commercial value in this country; and we may conclude, therefore, that they are chiefly grown for picturesque effect, and for the shelter from the sun and winds which they afford. The relation of forests to rainfall has been studied by meteorologists, but little attention has been given by medical climatologists to the share which trees take in determining local variations of climate and the sanitary condition of dwellings, notwithstanding they play as important a part as differences of soil, of which so much is said and written nowadays. This remark does not apply to large towns, where trees grow with difficulty and are comparatively few in number, and where they afford a grateful relief to the eye, shade from the sun, and to a very slight extent temper the too dry atmosphere, but to suburban and country districts, where it is the custom to bury houses in masses of foliage—a condition of things which is deemed the chief attraction, and often a necessary accompaniment of country life.

Trees of all kinds exercise a cooling and moistening influence on the atmosphere and soil in which they grow. The extent of these conditions depends on the number of trees and whether they stand alone, in belts, or in forests; on their size, whether tall trees with branchless stems or thickets of underwood; on their species, whether deci
evergreen; and on the season of the ye
cooling of the air and soil is due to the ev
of water by the leaves, which is chiefly dr
the subsoil—not the surface—by the roo
the exclusion of the sun's rays from th
trees themselves being little susceptible o
ing and radiating heat. The moisture of t
sphere and ground about trees is due to t
tion by the leaves and branches of a con
portion of the rainfall, the condensation o
vapour by the leaves, and the obstructio
by the foliage to evaporation from th
beneath the trees. The experiments of M
show that the leafage of leaf-bearing tr
cepts one-third, and that of pine trees th
the rainfall, which is afterwards return
atmosphere by evaporation. On the ot
these same leaves and branches rest
evaporation of the water which reaches th
and that evaporation is nearly four times l
a mass of foliage in a forest, and two and
times under a mass of pines than in t
Moreover, trees prevent the circulation
by lateral wind currents and produce st
Hence, as Mr. E. J. Symons has truly
"a lovely spot embowered in trees and
by hills is usually characterised by a dam
cold, and stagnant atmosphere," a con
climate which is obviously unfavourabl
health and especially favourable to the
ment of consumption and rheumatism,
most prevalent diseases.

Now, if we examine the surroundings
of our suburban villas and country hou
better sort, we shall find them embowered
and subject to all the insanitary climatic c
just mentioned. The custom almost ev
prevails of blocking out of view othe
roads, &c., by belts of trees, often planted
mounds of earth, and surrounded by h
walls or palings, from a foolish ambition
ing to live "quite in the country." This
unwise proceeding from a sanitary point
and should be protested against as str
medical men as defective drainage and b
supply. Many houses stand under the
and shadow of trees, and "the grounds"
are inclosed by dense belts of trees an
which convert them into veritable rese
damp, stagnant air, often loaded with th
of decaying leaves and other garden refu
dition of atmosphere very injurious to h
answerable for much of the neuralgias of
ous kind, of which we have heard so mu
A very slight belt of trees suffices to ob
lateral circulation of the air, and if the s
excluded the natural upward currents are
vented. As far back as 1695 Lancisi
the influence of slight belts of trees in p
the spread of malaria in Rome, and the c
stagnant air of spaces inclosed by tree
demonstrated by the wet and dry-bulb the
or even by the ordinary sensations of the
dry garden, on gravel, of three acres in
Surrey, surrounded by trees, is generall
four degrees colder than the open comm
the trees; and a large pond in a pine wo
miles from London afforded skating for n
secutive days in the winter of 1885-6, wh
the greater part of the time the lakes in th
parks were free from ice.

The speculative builder has more sins
for than the faulty construction of ho
generally begins his operations by cutting
the fine old trees which occupy the gr
which from their size and isolation
beautiful than young ones and are littl
be injurious to health, and ends them
mounds and sticking into them dense
quick-growing trees like poplars to hide
as possible the desolation of bricks and
has created. It is this senseless outdoor w
builder and his nurserymen which stan
need of revision from time to time in
residences, but which rarely receives it, f
notion, amounting to tree worship, which
the cutting down of trees, no matter how
ous may have been the planting of them
instance from a sanitary or picturesqu
view.

The following hints for planting and
trees may be useful to those persons
given little attention to the subject
should not stand so near a house that, if
fall, it would fall on the house; or in ot
the root should be as far from the h
height of the tree. Belts of trees may
on the north and east aspects of houses,
east side the trees should not be so n
high, as to keep the morning sun from th
windows in the shorter days of the yea
south and west aspects of houses isol
only should be permitted, so that the
free access of the sunshine and the wes
the house and grounds. High walls a
on these aspects are also objectionable,
be replaced by fences, or better still op

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* Extracted from a paper by LEWIS WRIGHT in the *British Journal of Photography.*

* By CHARLES ROBERTS, F.R.C.S., &c., in the *Lancet.*

y about houses which are occupied during
of the leaf, and in the winter. Trees for
near houses should be chosen in the
g order:—Conifers, birch, acacia, beech,
ı, lime, and poplar. Pine trees are the
ll trees for this purpose, as they collect
ıtest amount of rainfall and permit the
raporation from the ground, while their
ss stems offer the least resistance to the
irculation of the air. Acacias, oaks, and
ıre late to burst into leaf, and therefore
e ground to be warmed by the sun's rays
rly spring. The elm, lime, and chestnut
east desirable kinds of trees to plant near
lthough they are the most common. They
o leaf early and cast their leaves early, so
y exclude the spring sun and do not afford
ıde in the hot autumn months, when it is
uired. The lime and the elm are, how-
autiful trees, and will doubtless on this
often be tolerated nearer houses than is
from a purely sanitary point of view.
are often useful guides to the selection of
es. Numerous trees with a rich foliage
ık undergrowth of ferns or moss indicate
stagnant atmosphere; while abundance of
ınd fruit imply a dry sunny climate.
will be healthiest where most flowers
d old people will live longest where our
fruits ripen best, as these conditions of
ɔn indicate a climate which is least favour-
bronchitis and rheumatism. Pines and
mpanions, the birches, indicate a dry,
ındy, or gravel soil; beeches, a dryish,
ɔr gravel soil; elms and limes, a rich and
ıt damp soil; oaks and ashes, a heavy clay
d poplars and willows, a low, damp, or
soil. Many of these trees are found grow-
her, and it is only when one species pre-
es in number and vigour that it is truly
ristic of the soil and that portion of the
ere in connection with it.

TO KEEP TOOLS, &c., IN CONDITION.

following hints may be found useful,
ɔecially in amateurs' shops where tools are
ys in use:—
en parts.—The wooden parts of tools, such
ocks of planes and handles of chisels, are
ıde to have a nice appearance by French
g; but this adds nothing to their durability.
better plan is to let them soak in linseed
week, and rub them with a cloth for a few
every day for a week or two. This pro-
beautiful surface, and at the same time
solidifying and preserving action on the

ɔarts.—Rust preventives.—The following
ıre recommended for preventing rust on
steel surfaces:—
ıtchouc oil is said to have proved efficient
ıting rust, and to have been adopted by the
army. It only requires to be spread with
of flannel in a very thin layer over the
surface and allowed to dry up. Such a
will afford security against all atmospheric
es, and will not show any cracks under the
pe after a year's standing. To remove it
le has simply to be treated with caoutchouc
, and washed again after twelve to twenty-
ırs.
olution of indiarubber in benzine has been
years as a coating for steel, iron, and lead,
been found a simple means of keeping
ım oxidising. It can be easily applied with
and is easily rubbed off. It should be
out the consistency of cream.
steel articles can be perfectly preserved
ıt by putting a lump of freshly-burnt lime
rawer or case in which they are kept. If
gs are to be moved, as a gun in its case, for
, put the lime in a muslin bag. This is
y valuable for specimens of iron when
d, for in a moderately dry place the lime
want renewing for many years, as it is
of absorbing a large amount of moisture.
in use should be placed in a box nearly
th thoroughly-slaked lime. Before using
ɔ well with a woollen cloth.
following mixture forms an excellent
ɔating for preventing iron and steel from
issolve two parts crystallised iron chloride,
mony chloride, and one tannin in four of
ıd apply with sponge or rag, and let dry.
other coat of paint is applied, and again
if necessary, until the colour becomes as
desired. When dry it is washed with
llowed to dry again and the surface
with boiled linseed oil. The antimony
must be as nearly neutral as possible.
keep tools from rusting, take one-half
nphor, dissolve in one pound melted lard;
he scum and mix in as much fine black-
aphite) as will give it an iron colour.
ıe tools and smear with this mixture.
After twenty-four hours rub clean with a soft linen cloth. The tools will keep clean for months under ordinary circumstances.

6. Put one quart freshly-slaked lime, one-half pound washing soda, one-half pound soft soap in a bucket and sufficient water to cover the articles; put in the tools as soon as possible after use and wipe them up next morning or let them remain until wanted.

7. Soft soap with half its weight in pearlash, one ounce of mixture in about one gallon boiling water, is in everday use in most engineer's shops in the drip-cans used for turning long articles brought in wrought iron and steel. The work, though constantly moist, does not rust, and bright nuts are immersed in it for days till wanted, and retain their polish.

8. Melt slowly together six or eight ounces lard to one ounce rosin, stirring till cool; when it is semi-fluid it is ready for use. If too thick, it may be let down by coal-oil or benzine. Rubbed on bright surfaces ever so thinly it preserves the polish effectually, and may be readily rubbed off.

9. To protect metals from oxidation, polished iron or steel for instance, the requisite is to exclude air and moisture from the actual metallic surface; therefore, polished tools are usually kept in wrappings of oil-cloth and brown paper, and, thus protected, they will preserve a spotless face for an unlimited time. When these metals come to be of necessity exposed in being converted to use, it is necessary to protect them by means of some permanent dressing, and boiled linseed oil, which proves a lasting covering as it dries on, is one of the best preservatives, if not the best. But, in order to give it body, it should be thickened by the addition of some pigment, and the very best, because the most congenial of pigments is the ground oxide of the same metal, or in plain words, rusted iron reduced to an impalpable powder, for the dressing of iron and steel, which thus forms the pigment or oxide paint.

10. Slake a piece of quicklime with just water enough to cause it to crumble in a covered pot, and while hot add tallow to it and work into a paste, and use this to cover over bright work; it can be easily wiped off.

11. Olmstead's varnish is made by melting two ounces of rosin in one pound of fresh sweet lard, melting the rosin first and then adding the lard and mixing thoroughly. This is applied to the metal, which should be warm, if possible, and perfectly cleaned; it is afterwards rubbed off. This has been well proved and tested for many years, and is especially well suited for planished and Russian iron surfaces which a slight rust is apt to injure very seriously.

Rust Removers—(1) Cover the metal with sweet oil, well rubbed in, and allow to stand for 48 hours; smear with oil applied freely with a feather or piece of cotton wool after rubbing the steel. Then rub with unslaked lime reduced to as fine a powder as possible. (2) Immerse the article to be cleaned for a few minutes, until all the dirt and rust is taken off, in a strong solution of potassium cyanide, say, about ½oz. in a wineglassful of water; take it out and clean it with a tooth-brush with some paste composed of potassium cyanide, castile soap, whiting and water mixed into a paste of about a consistency of thick cream.

THE MONTAUD ACCUMULATOR.

THIS accumulator is of the Planté type, and is modified so as to obtain a more rapid formation, a larger surface, and a symmetrical distance of the plates from each other. If into an alkaline bath saturated with litharge (added in excess) we plunge two lead electrodes and pass in a current of suitable tension and intensity, there is deposited upon the anode a layer of peroxide of lead varying in thickness with the intensity of the current, and more or less rich in oxygen according to the intensity of the bath, while the cathode is covered with a stratum of reduced lead. The liquid of the bath supplies material for both deposits, while in galvanoplastic operations the anode supplies it to the cathode. The principle of the formation consists in introducing in an efficacious manner currents of a great intensity, and thus abridging its duration.

Of two plates thus treated, the one becomes positive, and is covered with a thick layer of peroxide of lead. On leaving the bath it undergoes various preparations and several washings, and is then fit to be mounted along with others to form an accumulator ready to be charged and to work. The second, or negative, plate is covered with a thick sponge of lead. It is carefully washed, preserved in water with exclusion of air, and submitted to a very considerable pressure. After this operation it presents the appearance of ordinary sheet-lead, but though the physical porosity has disappeared, the chemical porosity is intact, and this alone comes into play in accumulators. When a negative plate is constructed in this manner, it is ready to be combined with the positives to form an accumulator. The inventor has sometimes put into the bath at the positive pole negative plates prepared as just described. They become very easily peroxidised, but they have the grave defect of requiring two preparations in place of one. To secure an accumulator against any leakage from plate, the solderings and the entire plates must be submerged in the liquid, so that nothing projects up out of the acidulated water except two strong rods for making contact. These rods are covered with an insulating varnish from their origin to above the point where they issue from the liquid. The plates are of a rectangular form (Fig. 1). They are sloped cut at one corner, and as two plates in juxtaposition are cut together, when they are separated the sloping out of the one serves for the handle of the other. This handle is doubled back on the plate which is suspended in the bath, so that the part which has to be soldered does not undergo any preparation. A hole pierced in this corner of the plate serves to receive a square rod of lead which connects the plates together and supports one of the poles or contacts of the accumulator. At the point of soldering the doubled-down handle gives a double thickness, and the margins of the plate are folded in such a manner as to insure their solidity.

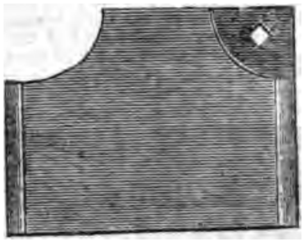
FIG. 1.

The sloped-out corner affords the free space necessary for the rod of the opposite pole, and one and the same plate may be indifferently connected either to the + or the − at the right or the left. The plates are made of four different sizes: No. 1, 19 of which serve for an accumulator of 1 square mètre; No. 2, 21, 25, or 29 of which serve for accumulators of 2, 3, and 4 square mètres; No. 3, which with 21, 25, or 29 plates compose accumulators of 5, 6, and 7 square mètres; and No. 4, which with 21, 23, 25, 27, or 29 plates forms accumulators of 8, 9, 10, 11, and 12 square mètres.

As the plates are entirely submerged in the liquid their entire surface is active, and the entire surface being absolutely flat, it is sufficient to preserve their respective distance at any one point in order to have it everywhere alike. The weight of the plate depends on the intended duration of the plate and its capacity. As for the negative plate, its thickness is the most important factor of its capacity. The proportion has yet to be established for daily practice. The inventor uses in practice positive plates of 0·002 mètre in thickness. On the other hand, the negative plates have a body of only 0·001 mètre in thickness, their greater thickness being due only to the deposit of compressed lead. The rod which fixes the plate to each pole (Fig. 2) is formed of a special alloy of lead and antimony, not attacked by acid. This gives rigidity to the rod, and hinders it from binding when the accumulator is taken out of its case. The copper piece which surmounts it is fitted at its base with an iron cramp which is fixed in the lead, and above which is a wide furrow with two grooved parts, which, being immersed in the lead, hinders the copper from slipping round under the action of the screw. The rod is square, and is cast in a single piece. Against one of its surfaces the ends of the connected plates press flatly up. A square form has been selected to give more surface for soldering. The soldering is autogenous (as in the lead chambers at vitriol works). The soldering, as well as the entire plates, is entirely immersed in the liquid, and to prevent any leakage an insulating varnish, perfectly proof against the acid and the current, is laid over the rod from the part soldered upward.

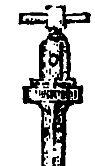
FIG. 2.

If it is wished to lift the accumulator from its chest for any verification, hooks passing between the plates seize hold of the rods, and thanks to the rigidity of the antimony lead, they effect the removal of the apparatus without bending the rods in the least. All the parts of the plates must be kept at exactly the same reciprocal distances, and a difference of only 0·001 mètre between two points is sufficient to affect the yield considerably. For an insulating material, wood, when plunged in dilute acid, is preferred by the inventor. He makes a comb of wood, the teeth of which vary according to the thickness of the plates to be lodged between them. Fig. 3 represents a comb having $\frac{15}{10}$ths of a millimètre for the negative plates and $\frac{7}{10}$ths for the positive plates.

This appliance, which is 0·01 mètre in thickness and 0·02 mètre in width in the back, is made very cheaply by machinery. The weight of the accumulator bears entirely upon the back of the combs, which are all placed back downward, and the number of which varies according to the size of the plates. Small combs of wood clasp the plates at their extremities, and make the entire accumulator quite compact and manageable. The entire accumulator is shut up in a wooden chest, which the outer teeth of the comb serve to insulate from the leaden chest, and to prevent any loss of electricity along the sides.

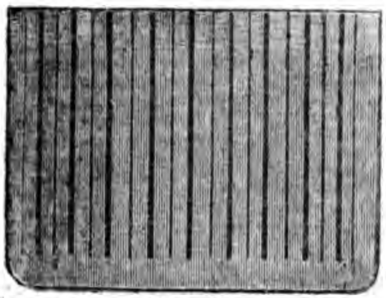

FIG. 3.

Fig. 4 shows the arrangement of the side combs. A single glance at this figure shows that it would be difficult to have more surface without having recourse to curved, undulated, or folded plates, in which the distances are variable, and consequently defective. In the Montaud accumulator, the weight is simply proportional to the intended duration. For the notion, "So much capacity and so much yield per kilo.," Montaud substitutes the notion, "So much capacity or yield per square mètre, the weight not being taken into consideration." These Montaud accumulators are classified as follows:—They have from 1 to 12 square mètres of surface, and the number corresponding to the surface indicates its weight of useful lead, its manner of charging, its capacity, and its manner of discharge.

According to the inventor's experiments, the square mètre of active surface can receive a charging current of 10 ampères, and furnish on discharging a current of the intensity of 20 ampères. For a "No. 10" accumulator we have an active surface of 10 square mètres, a charging current of 100 ampères, and on discharging a current of 200 ampères. A square mètre of lead of the thickness of 0·001 mètre weighs about 11 kilos. As both surfaces of the lead are utilised, their weight is reduced to 5½ kilos. A No. 10 therefore requires 55 kilos. of useful lead. It will be seen that to increase the thickness of the sheet of lead merely augments the duration of the accumulator, without affecting its capacity or its manner of charging and discharging. Nos. 1, 2, 3, and 4 may be placed in vessels of stoneware, glass, or ebonite, or in boxes of pitch-pine, painted with three coats of gum-lac and lined with sheet-lead. Nos. 5 to 12 are only sent out in pitch-pine boxes lined with lead. The box is supported on feet of porcelain of the shape of a mushroom. If a drop of water falls upon this foot, it cannot give a communication with the earth, since, falling upon the broad part of the mushroom, it will glide off without running along the foot, which serves as the stalk of the mushroom. A slip of glass is placed under each foot; the part which supports the mushroom is covered with an insulating varnish, which prevents the formation of climbing salts and preserves the screws from rust. A common layer of insulating varnish is applied under the head of the mushroom.

As regards the advantages of the Montaud accumulator we notice, first, its longevity. Dr. D'Arsonval points out that the accumulators of the Planté class have a great advantage over the Faure type as regards duration, and that the most striking quality of the Montaud accumulator is its longevity. The inventor has in his possession positive plates, five to six years old, completely peroxidised, though there remains in the interior a thin core of metallic lead sufficient to give passage to the current. The adhesion of the peroxide is such that to detach it, it must be beaten with a hammer upon an anvil. The next four points—i.e., the rapidity of charge, the yield, much greater than that of any other system in proportion to its surface; its small weight in comparison with its yield; and its capacity, which for an equal weight is greater than that of any other accumulator. In his experiments in September, 1885, Dr. D'Arsonval obtained with an accumulator of 2 square mètres of surface—

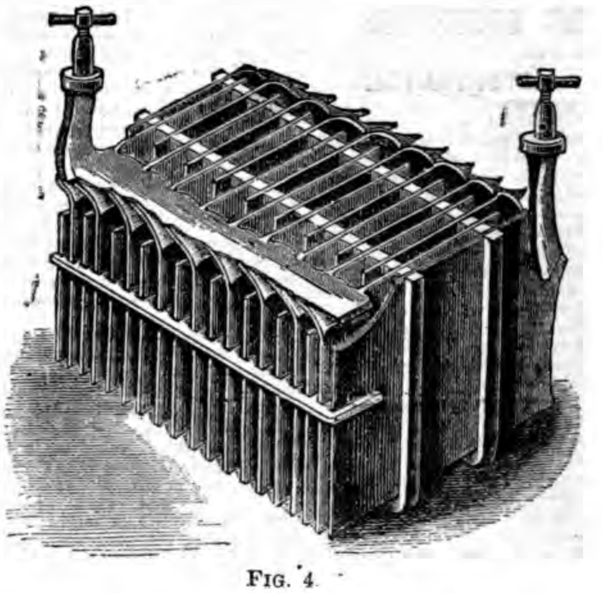

FIG. 4.

Useful capacity............	40 ampère hours.
Total............................	62 " "
Surface.........................	2 square mètres.
Charge	10 amp. per sq. mètre.
Discharge.....................	20 " " "
Useful weight of lead...	10 kilos.

Representing a total capacity of six ampère hours per kilo., and of a discharge of 5 ampères per kilo., or a total capacity of 31 ampère hours per square mètre, and a useful capacity of 20 ampère hours per square mètre. Subsequently the modification of the negative plate has greatly improved these figures, which will certainly become much more advantageous in future. The total capacity of an accumulator having exactly 1¾ mètre of surface has become 87 ampère hours, which, if referred to an accumulator of 2 square mètres of surface, would give the following results:—

Useful weight of lead per sq. mètre	5½	kilos.
Total capacity of useful lead per kilo.	9·1	amp. hr.
Total capacity per square mètre	50	"
Useful capacity of per kilo. of useful lead	6·23	"
Useful capacity per square mètre ...	34·30	"
Current of charge per square mètre	10	amp.
Current of charge per kilo. of useful lead	2	"
Current of discharge per sq. mètre ...	20	"
Current of discharge per kilo. of useful lead	4·56	"

The next advantage of the Montaud accumulator is the ease with which it can be taken out of its box and repaired without special tools and experience. A capital defect in this respect has hitherto much interfered with the use of accumulators. In case of accidents, several kinds of which are possible, it is found very difficult to rectify the apparatus. The Montaud accumulator is much less liable to accidents, on account of the firmness and compactness of its construction, and if any accident happens, the repairs are simple and easy. Lastly, the stout framework secures the apparatus from any accident due to a disproportionate charge or discharge. The peculiarities of the combs and rods already described solve this problem. On September 8, 1885, Dr. D'Arsonval, Professor at the College of France, wrote as follows:—"The Montaud accumulator is of the Planté type, and is extremely well conceived from a mechanical point of view. The wooden combs prevent the plates from coming in mutual contact, and give the apparatus great solidity. The process of formation is ingenious and rapid. To give 1 square mètre a capacity of 20 ampère hours, there is required only a quarter of an hour's treatment. To obtain the same result by Plante's method months are required. The entire experiments have been effected with No. 2, which has a surface of two square mètres. This apparatus, if charged to saturation, gives 62 ampère hours as its total capacity, and, as in the Planté, this capacity constantly increases wish use. The normal rule for the charge is 10 ampères per square mètre, and for the discharge double this quantity. This apparatus has always given me on discharging 40 ampères at the E.M.F. of 1·85 volts during 60 or 65 minutes. The charge is effected in two hours up to 20 ampères, without any appreciable loss of electricity. The points to be aimed at in an accumulator are longevity and energy, or, rather, rapid yield per kilo. From both points of view accumulators of the Planté type (and consequently those of Montaud) are far superior to those of the Faure type. My opinion, therefore, is that the Montaud accumulator is very practical, that it is a great improvement on the Planté type, and that it can compete successfully with the other systems in use."—*Revue Internationale de l' Electricité.*

Cracking Glass Tubes.—Small glass tubes, less than ⅜in. in diameter, give no trouble at all in breaking to any desired length, provided there are two or three inches to be broken off. Make a deep scratch—it need not go far round—on the tube, and then, with both thumbs close together, pull strongly and bend from the scratch. Tubes from ⅜in. to 1in. in diameter may be cracked by making a scratch as before, and heating circumferentially in a blow-pipe flame. The flame should be very small, and the tube turned rapidly to prevent irregular cracking. Heat as small an area as possible on each side of the crack. If the glass is not very thick, about half a dozen turns will be enough to heat it sufficiently. As soon as this is done, take it out and blow sharply with the breath just on the scratch, and a beautiful clean crack will spring partly round. The parts may then be pulled asunder. This is a very successful method with English glass, but that of German manufacture is apt to fly unless carefully done. Perhaps the easiest way for tubes that cannot be pulled asunder cold is to make the scratch and then dab on a piece of white-hot glass. The way to do this is to fuse up in the blow-pipe a bead on the end of a fibre. The smaller and hotter it is the better chance of a square crack. This is the method to use when only a ragged corner or a short end has to come off. If there is an electric current handy the largest tubes may be cut with certainty. Just where the scratch has been made wind one turn of wire—platinum is the best—of such length and diameter as to get white hot when the current passes through it. The ends where the wire leaves the glass should be as close as possible; but must not touch so as to short-circuit. The part round the glass keeps much cooler than the other; but the current may be switched on and off so as to have it red-hot without overheating the free part. Another method for large tubes, but one not generally so successful, is this: About ½in. on each side of the scratch wrap strips of wet blotting or filter paper, and then turn the bare part in front of a sharp-pointed flame. If the crack starts well, it may be led round by the flame. One of the most important factors of success in all these methods is the scratch, which can best be done with a rectangular piece of good steel hardened in salt water and sharpened.

Photographic Lenses, &c.—Messrs. Taylor, of Leicester, have issued new price-lists of their "soliscript" and other lenses, and descriptive circulars of their photo-actinometer and exposing flap and shade.

SCIENTIFIC SOCIETIES.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE seventh general meeting of the session was held on Tuesday, April 12th, Mr. James Gill, vice-president, in the chair. Ten members were elected and 11 candidates proposed, and Lord Crawford and Dr. Dunér were elected honorary associates of the Society. A large number of communications in support of Mr. Elger's resolution, "That the next annual meeting be held in London," were read, and upon the question being put to the vote, it was carried unanimously.

In a paper on "The Proper Motion of ζ Ursæ Majoris and its Naked-eye Companion" (Mizar and Alcor, the *eques stellula* of old), Mr. Herbert Sadler said it had long been known that these two components were moving together through space with the same velocity and in the same direction. It was, therefore, a matter of interest to ascertain whether the small star which forms a triangle with them partook of their common movement. Of this star, Smyth relates that in 1723 a German astronomer thought he had discovered a new wandering star near ζ, and, not remarking that it was a strange location for a planet, immediately dubbed it *Sidus Ludovicianum* in honour of his sovereign, Louis V. of Hesse Darmstadt. This was probably the 8th magnitude star to the southward of Alcor, and its location would perhaps not have appeared so "strange" if it could have been known that the position of *Euphrosyne* on January 17, 1867, would be R. A. VIIIh. 42m. 20s. + 61° 81·7m., and, consequently, not far from Alcor. From a presumed identity of proper motion, a physical connection had been suspected, and Smyth even assigned a period of 190,000 of our years, though this was probably an error. The brightness of Sidus Ludovicianum had been variously estimated from the 6th to 8½ mag., so that it might almost certainly be classed as variable.

The Rev. S. J. Johnson remarked upon the interesting occultation of the Hyades which took place on March 29th. Although the moon had on this occasion set before reaching Aldebaran, there was some compensation from the fact of that wide pair, θ^1 and θ^2 Tauri, being occulted; not only because they were such a noble pair in the telescope, but also remarkable from the suspicion—or, according to W. Struve, more than suspicion—of a physical connection, notwithstanding their wide distance apart. θ^1 disappeared at 9h. 18m. 87s., and θ^2 at 9h. 27m. 50s., both instantaneous, and both easily visible in a small single-lens opera-glass.

In the conclusion of his essay on the "Temperature of Stars," Mr. W. H. S. Monck contended that if their heat and size varied as they had reason to believe, it was clear that they must not look exclusively amongst the brightest stars for their nearest neighbours. Few of the bright stars were, for example, as near as 61 Cygni, and yet this was near the limit of naked-eye vision. The companion of Sirius, which could only be seen with a very powerful telescope, was as near to us as its primary. The very faint 40^2 Eridani had also a sensible parallax, and there was little doubt that we might hereafter discover a tenth, or even twelfth magnitude star with a greater parallax than α Centauri. Until recently, chance only could lead astronomers to hit upon such a star, but photographs might now be taken of regions which might hereafter show displacement, and though this would not indicate parallax, its evidence of large proper motion would form one of our best guides to the nearness of them.

On the supposition that astronomical causes underlie and determine physical agencies, Mr. M. ergus reviewed the different theories which account for glacial epochs. The mean annual amount of solar heat might remain fixed, but, with an eccentricity of 0·0747, and winter in aphelion, the earth would be eight million miles further from the sun, and the temperature of the British Isles 6° Fahr. below zero. Further, there was the increased length of aphelion winter, which, taken at its maximum, varied from 33 to 36 days longer than the summer. With the southern winter at aphelion, the south of Patagonia and the Falkland Isles—lat. from 50° to 55° S.—were covered with snow and ice to the edge of the sea. Geology revealed repeated interglacial periods, though it did not explain them; but astronomy and meteorology together afforded strong evidence that a glacial climate would prevail on that hemisphere which had its winter at aphelion during an epoch of extreme eccentricity of the earth's orbit.

Mr. George Higgs did not think the present low eccentricity of the earth's orbit would account for these differences of climate in aphelion winter, but attributed the relatively high temperature of northern latitudes to the warm-air currents and to the action of the Gulf stream.

Mr. James Gill thought it was not safe to rely too much on the Gulf stream as a modifier of climate, since Dr. Carpenter had proved during the expedition of the *Challenger* that it was dissipated before getting halfway across the Atlantic. The present mild winters were rather due to the returning warm ocean currents from tropical regions, which flowed in a direction from S. W. to N. E. as a consequence of the earth's rotation. Both the initial direction of these currents and the trend of the land favoured their projection on to the British Isles.

In dealing with town definition, Mr. W. F. Denning enjoined observers residing in populous districts not to despair of doing really useful work. The vapours hanging over a large city were by no means so objectionable as was commonly supposed, unless they were moving rapidly across the field of view. In a comparatively tranquil state of the air, definition was excellent, and he had frequently found planetary markings very sharp and steady through the smoke and fog of Bristol; the interposing vapours, indeed, moderated the brightness of the image with excellent effect. Vapour from neighbouring chimneys was, of course, ruinous, as a bright star was transformed into a seething cometary mass, and the planets underwent contortions of the most astonishing character.

The work of the Meteoric Section, under the direction of Mr. Denning, included the simultaneous observation of a meteor, which was first seen by Mr. Monck at Dublin when 56 miles high, over a point S. by W. from Holyhead. Mr. Backhouse had noticed it directly afterwards when it was 49 miles high, and from thence it descended to an elevation of 28 miles between Carnarvon and Dublin. The whole of the visible path was 33 miles, and its velocity slightly more than 22 miles per second, the radiant being near λ Draconis.

Papers were received from Mr. George. Higgs on "The Presence of Potassium in the Sun," and on "Star Colours" by Mr. W. H. St. Q. Gage. The meeting adjourned at 9.30 p.m.

A Time-Checking Clock.—Mr. N. C. Firth, of Chester, draws our attention to an invention for checking the arrival and departure of workmen, which seems perfect in its construction, accurate in its operations, and should be equally appreciated by employers and employed. Fraud on the part of the employés is entirely prevented. The device consists of a clock which drives a slotted disc or drum. Below the clock and inclosed within a casing is a tube, which may be of any convenient length, but is ordinarily about 15in. long. Each person whose time has to be recorded is provided with a numbered check, which is dropped into a narrow slit below the clock, whence it falls into the tube where the successive checks accumulate in a pile in the precise order of their introduction into the apparatus. Workmen will sometimes help each other in undesirable as well as in commendable fashion, and it is by no means rare for one man to drop in a comrade's check as well as his own. Now if it should be found, for example, that 287 is not in evidence at his work, but that his check has been delivered, it is only necessary to refer to the position of the check to detect the culprit. If check 287 is preceded by 186 and followed by 435, it is evident that the owner of one of these two checks is responsible for the temporary lapse in morality, and it will not generally be difficult to fix the blame on the right shoulders. It is further necessary in such an apparatus to obtain an indication of the time at which each check was delivered. This is done by the agency of the slotted disc before referred to. The number of slots in this disc may be 12, and it may be driven so as to rotate once in an hour, or any other number of slots or period of rotation may be taken. We will assume the number given. Below the disc is a slit communicating with the check tube, so that a check dropped by the disc will descend into the tube and take its place among the employés' checks. Into each of the slots in the disc there is inserted a copper "clock check," these checks being numbered successively 0, 5, 10, 15—55, indicating the number of minutes after the hour. As the disc rotates one of the checks falls at the end of every fifth minute, and thus marks by its position among the numbered checks the times at which the latter have been deposited.

Demagnetising Watches.—A correspondent sends to the *Electrical Review* the following account of a very simple method of demagnetising watches:—"My watch was very strongly magnetised, so that I could not depend on it at all for the correct time, as sometimes it gained and sometimes lost considerably. The watch was placed in a coil of wire completely surrounding it, this coil was circuited in series with a small alternating machine and an adjustable resistance, and when the current was first switched on all the resistance was taken out; it was then gradually all put in, and immediately the current was switched off, when no trace of magnetism was found about the watch. I may add that although this was about six weeks ago, the watch has since then kept excellent time."

SCIENTIFIC NEWS.

THE death is announced of Mr. James Wyld, the well-known geographer, at the age of 74 years. Mr. Wyld was educated at Woolwich for the Army, but subsequently devoted his attention to scientific and educational works, and became a leading member of many of the scientific and learned societies then in existence. As a Fellow of the Royal Geographical Society he was especially active, and of late years, as a member of the Clothworkers' Company, he took the lead in devoting the attention of that guild to the advancement of technical education, and it is mainly due to his exertions that the cities of Bristol, Leeds, and Manchester owe the erection of their fine technical schools. He was one of the governors of the City and Guilds Institute. His knowledge of languages, attained by almost continuous travel, and his wide and intimate acquaintance, caused him to be much sought after. No fewer than 17 European orders were conferred upon him, and from the German Emperor, when King of Prussia, he received the gold medal for scientific merit.

Mr. William Husband, of Hayle, died rather suddenly last week at the age of 68 years. He was President of the Mining Institute of Cornwell, an amateur astronomer, and a well known inventor of mining appliances, notably his patent pump-valve and his pneumatic stamps, which are in extensive use abroad. In 1848, Mr. Husband went with Capt. West to erect the 144in. cylinder-engines for draining the Haarlem Mere; and his last great work was superintending the erection of the pumping engines at the Severn Tunnel.

The death is also announced of Dr. John Hymers, F.R.S., the author of several mathematical textbooks.

Minor planets 263 and 265 have been named Dresda and Anna respectively.

The conference to consider the means to be adopted for the construction of a photographic chart of the heavens, met in Paris on Saturday last.

The Rev. S. J. Perry and Dr. Copeland will observe the total solar eclipse of August 19 next at Dr. Bredichin's residence near Moscow.

Dr. Lewis Swift, director of the Warner Observatory, Rochester, New York, informs us that Mr. Warner has renewed his offer of 100dols. for each and every discovery of a new comet made between April 1, 1887, and April 1, 1888, subject to the usual conditions, the principal of which are that the comet must be unexpected, except as to that of 1815, and that immediate information must be sent to Dr. Swift by telegram in North America, or by mail in other countries. The intelligence must not be communicated to others until publicly announced by Dr. Swift. The prizes are awarded four months after discovery and verification of the claim.

The lectures founded by Sir Thomas Gresham will be read to the public gratuitously Gresham College, Basinghall-street, on the following days, commencing at 6 p.m.—viz.: Rhetoric (Mr. J. E. Nixon), April 26, 27, 28, and 29; Law (Judge Abdy), May 3, 4, 5, and 6; Geometry (the Dean of Exeter), May 10, 11, 12, and 13; Astronomy (Rev. E. Ledger), May 16, 17, 18, and 20; Divinity (the Dean of Chichester), May 24, 25, 26, and 27; and Music (Dr. Henry Wylde), June 7, 8, 9, and 10.

The discourse on Thomas Young, the last delivered by Prof. Tyndall at the Royal Institution, has been issued in full in a wrapper, as one of the papers of the Institution. The discourse was delivered on Jan. 22, 1886.

The Council of the Iron and Steel Institute have arranged to hold the spring meetings of the society on the 26th, 27th, and 28th of May. Mr. Daniel Adamson will be installed in the presidency in the place of Dr. Percy, and a number of interesting papers bearing upon the progress of the metallurgical industries will be submitted for consideration.

Mr. Eric S. Bruce will deliver a lecture on "Science and the Jubilee" at Prince's Hall, Piccadilly, on Thursday, April 28. The lecture will be descriptive of the great discoveries and inventions during her Majesty's reign, and will be illustrated by many brilliant experiments and dissolving views.

Referring to the article on p. 139 as regards the use of liquid fuel for steam generating on board ships, we note that a vessel, the *Charles Howard*, left the Tyne last week for the Black Sea, which is fitted with Tarbutt's apparatus for burning petroleum refuse instead of coal. The vessel has been specially arranged for carrying refined oil in bulk, is 249ft. long, 30ft. beam, and 23ft. deep, and has not only the cargo space, but the water ballast tanks fitted for carrying the oil, the tanks being used for the petroleum refuse used as fuel. The objection that the use of steam to inject the refuse into the furnace is a waste of fresh water which can ill be spared, is met in the Tarbutt system by the use of compressed air. The boiler is of the ordinary marine type, with three flues of 3ft. 6in. diameter. These flues are fitted with a brick combustion chamber and superheater, as in the case of other vessels fitted on the Tarbutt system. The point of departure in the present instance consists in the substitution of highly heated and expanded compressed air for the steam ordinarily used in liquid-fuel fires. The steam used for compressing the air is exhausted into the condenser the water from which is of course available for feeding the boiler along with that condensed from the main engines. The *Charles Howard* left the Tyne Dock last Saturday for the Black Sea, and as she steamed down the river at full speed not a particle of smoke was visible from the funnel, the fires working admirably from the start. It is stated that the owners purpose to fit the remainder of their fleet with similar apparatus. The storage of the oil in the water ballast tanks has, we believe, never before been introduced in practice. It is an important feature, as it saves the shipowner the heavy expenditure incidental to the fitting of tanks in the bunker spaces, and, combined with the substitution of air for steam, marks a decided departure in liquid-fuel practice.

The annual Sportsman's Exhibition is this year being held at Olympia, from the 20th to the 30th inst.; and from the 26th to the 29th there will be a show of sporting dogs, which will no doubt prove a great attraction.

The name of the *Renown* has been altered to *Victoria* in honour of the Jubilee. She is 340ft. long, 70ft. broad, and has a mean draught of 26ft. 9in., displacement 10,500 tons, and horsepower 12,000. She was launched the other day on the Tyne.

High speeds are being gradually attained in steam vessels by the use of enormously high horse-power compared with the size of the ships. The other day a torpedo boat for the Italian Government made the almost phenomenal mean speed of nearly twenty-nine miles an hour in the river below Gravesend; and the Italian cruiser *Dogali*, in experimental trips at sea, made a mean of twenty-two and a half miles an hour. The latter is probably the fastest cruiser afloat, and the high speed has been obtained by the use of triple expansion engines and high-pressure steam. It will be noticed that both vessels are for the Italian Government.

An American medical journal makes the startling announcement that in a number of tonics and bitters sold as non-alcoholic or as soothing inducements to temperance, the quantity of alcohol is from 6·1 to 47·5 per cent. From half to a full wine-glass three times per day, or even more frequently, is the common daily dose recommended.

Prof. Oscar Lenz, who has crossed Africa practically on foot, attributes his excellent health to having attended to hygienic rules. He never ate raw fruit, or drank unboiled water. He lived mostly on rice, chicken, and tea. Wine and spirits he never touched. He was also careful to avoid bathing in the rivers and pools of clear, cool water, so tempting to travellers, but which so often give deadly chills. He dressed in flannels, and exposed himself as little as possible to night air. In this way he passed unscathed through regions infected with marsh fevers, ague, and smallpox.

The Commissioner of the department of Agriculture in the United States has issued a circular about the so-called Australian rabbit, in which he points out that this animal—the common rabbit of Europe—has been very mischievous in Australia, and expresses his belief that its introduction into America would be an unnecessary and hazardous experiment. Mr. Colman is of opinion that Congress should pass a law conferring upon the Commissioner of Agriculture the power to prevent the landing of any animal, bird, or other pest that might, in his opinion, be injurious to agriculture; and he cites the case of the English sparrow as an example of the harm that may be done by species taken without due consideration from the Old World to the New.

The owners of the patents for the Edison-Gilliland-Smith and the Phelps induction systems for telegraphing to and from moving railway trains have combined their interests, and will be known as the Consolidated Railway Telegraph Company.

With reference to the question of using electricity for lighthouse illumination, Lieut. John Millis, U.S.N., says, in his report to the United States Department, "It is evident that, with the present known means of generating electricity, it can never compete with oil as an illuminant in the matter of expense, if the comparison be made with the present annual cost of maintaining a first-order light, without regard to the greatly superior intensity of the electric light, and that, as stated in the report of the committee of the Trinity House, electric illumination, as at present developed, is only to be recommended for the more important coast lights, in which cases it is by far the best available agent for producing such a light as the situation demands.

On the Boston and Albany line there is an express train lighted by electricity and heated by steam taken from the dome of the locomotive. The managers are so satisfied with the result of their experiment that they intend to fit all the rolling stock as fast as possible,

We mentioned some time since that a few trains on a Glasgow local line had been fitted up with an automatic system of electric lighting, by Mr. T. P. Carswell, C.E., of the North British Railway Company's engineering staff. It has, we understand, now been arranged to have the whole of the carriages illuminated in this manner throughout the entire length of the tunnels, from the College to the Finnieston stations, at an initial cost of something like £5,000. At first, 100 volt 16c.p. lamps were used, only one being in action in each compartment at a time; the more recently-fitted trains have two 25 volt 10c.p. lamps in the first-class compartments, both being used. The third classes remain as before.

M. Tommasi is supposed to be the originator of the idea of heating railway coaches by electricity; but it appears that Mr. W. Leigh Barton, of Richmond, Virginia, so long ago as 1869 obtained a patent in the United States for an improvement in electric heating, attached to which is a drawing showing how the device might be applied "for the warming of railway cars." A model of Mr. Barton's electric heater was taken to Paris in 1870 or 1871; but as the inventor says, no electric heater was practicable at that time, because the dynamo had not been brought to its present degree of perfection. Mr. Barton exhibited his electric heater at the Philadelphia Electrical Exhibition in 1884, and he says that, having obtained a patent for an important improvement in his electric heater, he has good grounds for hoping that the near future will witness the utilisation of electric heat for warming railway carriages.

It is said that Dr. H. D. Cogswell, a millionaire, is about to establish in San Francisco a magnificent technical or trade school, at a cost of 200,000 dollars, which he will endow with real estate worth a million dollars. The school is expected to open next January. Senator Stanford also proposes to establish technical schools at his new university at Paolo Alto.

At the meeting of the San Francisco Microscopical Society on March 9, the subject for discussion was "Bacillus Tuberculosis in Fowls." Dr. Stallard said he had found the liver and spleen, the mesenteric glands, the lungs, and other parts of a chicken infested with true tubercle bacilli. He expressed the belief that about five per cent. of all the fowls offered for sale in San Francisco were similarly affected. Danger to the human race is reduced by the fact that a temperature of 150° Fahr. destroys the bacilli, but a much higher temperature is needed to kill the spores. As an instance of the brilliance with which many animal integuments are displayed by the use of polarised light, the secretary exhibited a carbolic-acid mount of the human flea, and also a slide of a rare marine crustacean from the Channel Islands. At the meeting held on March 23, Mr. Howard showed specimens of *Noctiluca miliaris*, the interesting little organisms to which is mainly due the well-known "phosphorescence" of the ocean. The gathering (which was a very plentiful one) also contained numerous specimens of the rare *Leptodiscus medusoides* (Hertwig), an organism allied to *Noctiluca*, but distinguished from the latter principally by the entire absence of any transversely-striated tentacle, and by the very regular reticulate appearance of the contained protoplasm. A slide of arborescent silver crystal was handed in by Dr. E. S. Clark. A slide of native gold crystals from quartz, also mounted by him, was of unusual beauty. Reference was made to the newly-discovered deposit of fossil diatoms at Oamaru, New Zealand, which is attracting much attention at present in Microscopical Societies by reason of its great richness and the large number of forms entirely new to science found therein. A slide of this beautiful deposit was examined with great interest.

USEFUL AND SCIENTIFIC NOTES.

Locomotive Boiler Explosions in the United States.—Locomotive boilers explode pretty frequently in the United States, even on railroads that are esteemed as first class. Even new engines frequently blow up, showing that either the design or the material, or the workmanship, or all three, must be bad. There is little excuse for an old boiler blowing up, as hydraulic testing and proper examination will reveal its dangerous condition; but there is absolutely no excuse for the explosion of a new boiler. Yet cases such as that quoted below are of frequent occurrence:—"A large new passenger engine, the William H. Sayre, on the Lehigh Valley Road, jumped the track near Hazelton on the afternoon of Feb. 26, and was overturned, and immediately afterwards the boiler exploded, completely demolishing the engine. The engineer and fireman of the locomotive were badly injured, and the life of the latter is despaired of. The engine had been completed at the Hazelton shops here only three days before." A new Wootten engine built by the Baldwin Locomotive Works blew up while running an express train on the Baltimore and Ohio on Sept. 26th, 1886. A few days afterwards a new boiler blew up on another road paying a good dividend and carrying a large number of passengers. Even the incomplete newspaper returns show fully thirty locomotive boiler explosions per annum, which are therefore about ten times as numerous in the United States as here, taking the relative number of locomotives into account; and still Americans maintain they are the best railway engineers in the world. With marine engines which break down, bridges that tumble into fragments, and locomotive boilers that burst on all sides, it seems difficult to prove the statement.—*The Engineer.*

A Codfish with a Pocket-Knife.—In a Bulletin of the U.S. Fish Commission recently issued, Mr. J. W. Collins describes the finding of a knife of curious workmanship in the thick flesh of a large cod. The "find" was made at Gloucester, Mass., on September 15, 1886, by Capt. Q. Getchell, when discharging a fare of codfish from his schooner. He had lifted several fish from a tub, and, running his hand over the thicker portion of one of them to call the attention of the by-standers to its fatness, he felt something hard beneath his fingers. Further examination produced a knife. The handle of the knife is of brass, curved and tapering posteriorly, with a longitudinal incision on the concave side, to receive the edge of the blade. The form is remarkable, and suggests "the handiwork of some savage tribe, or the scrimshaw work of a sailor." The blade, which is of a lanceolate shape, has been corroded a good deal, and the extreme point is very thin. The total length of handle and blade together is 6¼in. "As to where the fish got the knife," says Mr. Collins, "we can only conjecture, unless some ethnologist can point out [illegible] origin. In any case, the finding of such a remar[illegible] able implement in such a stran[illegible] matter of interest to the ethnol[illegible] alike."

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of ur correspondents. The editor respectfully requests that all ommunications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of* e ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to . PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when peaking of any letter previously inserted, will oblige by entioning the number of the Letter, as well as the page on hich it appears.*

"I would have everyone write what he knows, and as uch as he knows, but no more; and that not in this only, ut in all other subjects: For such a person may have me particular knowledge and experience of the nature f such a person or such a fountain, that as to other things nows no more than what everybody does, and yet, to keep clutter with this little pittance of his, will undertake o write the whole body of physicks, a vice from whence reat inconveniences derive their original."—*Montaigne's ssays.*

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HE CELESTIAL "MRS. HARRIS" —A "CATASTROPHE" HAPPILY AVERTED—THE ECLIPSE OF THE SUN OF AUGUST 19th—METEORIC ACTION ON THE MOON—BINOCULAR TELESCOPES—PARABOLIC REFLECTORS—NITRATE OF SILVER STAINS —THE "JOURNAL" OF THE ROYAL MICROSCOPICAL SOCIETY—OBSERVING DOUBLE STARS BY DAYLIGHT —THE SUPERNATURAL DARKNESS ON THE FIRST GOOD FRIDAY.

[27115.]—THERE is no Vulcan but Vulcan, and Backhouse is his prophet; and according to custom astronomers were this year bidden to watch the disc of the sun for Lescarbault's supposititious planet on and about the 18th ult., with a view of detecting this celestial "Mrs. Harris," which was to be either in its ascending or descending node at that date (I really do not remember which, but it is absolutely immaterial). Under the exceptionally favourable conditions for such a search which the spotless face of the sun has recently presented, of course, not a trace of the planet was seen by any single observer. Is not the Vulcan farce pretty nearly played out by this time?

The absolutely unwarrantable assumptions in letter 27052, p. 125, that gravels have been deposited by floods only, and that their existence in different parts of the world—in solitary patches—indicates contemporaneity of deposition, scarcely need——I had written so far, Sir, when I read the concluding sentence of your "Answers to Correspondents" on p. 133, and my respect and esteem for you are too great and sincere to permit me to add another word beyond the assurance that out of deference to you I will *not* answer any statements about the "catastrophe of fifty centuries ago."

In reply to query 62170, p. 136, the central line of eclipse crosses Europe through Vitebsk (where totality will last for 2m. 23s.), a little to the north of Moscow; through Jaroslav on the Volga (where the duration of totality is 2m. 38s.), to the north of Vialka (where totality lasts 2m. 50s.), all in European Russia; and so across the Ural Mountains, to the north-east of Perm (duration of totality 2m. 59s.), into Russia in Asia. Here it continues to the north of Tobolsk, considerably to the north of Tomsk; across the southern half of Lake Baikal; over the Khirghan Mountains in Mongolia, and so over Mantchooria and the sea of Japan to Japan itself, whence it travels out into the Pacific somewhat to the north of Yedo. If "J. L. O." wishes to observe the eclipse himself, he might get to Riga or Memel pretty easily, and either stay there or go on to Vitebsk up the Duna; or he might proceed to Moscow by the usual route. A good view of the eclipse may, moreover, be obtained from numerous places in Russia which are easier of access still.

I do not quite understand what "Tau" means (in query 62181, p. 137) by "any known observation of the effect of the impact of meteoric bodies on the surface of the moon," because certainly no change in the configuration of the lunar surface has been observed since the invention of the telescope which can legitimately be referred to this cause. Proctor, in his work on "The Moon" (second edition), pp. 260-264, does suggest that the small craterlets visible on our satellite may have been produced by the plash of meteoric rain; but I quite fail to see how those extraordinary formations the clefts can in any way be explained upon this hypothesis.

"Tourist" (query 62192, p. 137) may buy binocular telescopes giving powers of 15, 18, or 20. The two latter instruments are, of course, superior in power to a 1¼in. telescope magnifying only 16 times; in fact, the binocular magnifying 15 times is much superior to it in light and for effective vision as both eyes are used. Mind, I am speaking of binocular telescopes. The highest power on a "marine glass" is 10, and that on a large proportion of them does not exceed 5 or 6.

"Z." (query 62193, p. 137) will find a full description of the manner in which parabolic reflectors are made on pp. 9 to 12 of the work on "Optical Instruments," by the late J. F. Heather, which forms No. 169 of "Weale's series."

In the days when I used to photograph, I may tell "Londiniensis" (query 62197, p. 137) that I used always to get nitrate of silver stains off my fingers by the use of cyanide of potassium, without the slightest difficulty. This dangerous material must, though, on no account whatever be employed if a scratch or cut exists on the hands.

I spoke in letter 26868, Vol. XLIV. p. 560, of the failure of my attempt to learn, at the rooms of the Royal Microscopical Society itself, the reason why the index to the volume of the *Journal* for 1886 had not appeared at the date of my visit. This was in February, and here we are more than half through April with no sign of the index yet! Verily, if there be any foundation for the quasi-explanation vouchsafed to me at King's College, Mr. Crisp must have been oppressed with an amount of business almost appalling to contemplate.

In connection with the concluding paragraph of letter 27086, p. 150, I may say that the reason of the ease with which certain double stars are divided in daylight is not far to seek; having its origin in the fact that the diffraction rings surrounding a bright star disc in a dark sky are practically obliterated by the illuminated atmosphere. I have no particular difficulty in dividing δ Cygni, for example, in bright twilight, but have invariably failed to do so at night.

In reply to the question addressed to me by Mr. Gardner in letter 27112 (page 156), I can only say that I have been, so far, wholly in ignorance of the existence of the "Egyptian astronomer" referred to in the sermon from which he quotes. Perhaps the preacher was referring to what Phlegon the Lydian says (as rendered in Jerome's Latin version of the "Chronicles" of Eusebius): "In the fourth year of the two hundred and second Olympiad there was a great and extraordinary eclipse of the sun, distinguished among all that had happened before. At the sixth hour the day was turned into dark night, so that the stars in the heaven were seen, and there was an earthquake in Bithynia, which overthrew many houses in the city of Nice." If, however, this is the authority of the Darlington clergyman, one or two very simple considerations will show that it can have had no reference to the darkness alleged to have overspread the land at the Crucifixion. Imprimis, no solar eclipse can by any possibility have lasted from the sixth to the ninth hour; and in the next place, at the time of the Passover the moon was full, so that no such eclipse can have happened at all; while, finally, the date assigned to the phenomenon disposes of the question. I, of course, note that the preacher stated that the darkness was "not due to any eclipse"; but this may only have arisen from some mental confusion, or an inability to appreciate the meaning of what Phlegon really said. The whole quoted passage, however, only serves as a fresh illustration of the woful trash which, in the shape of pseudo-science, is inflicted on long-suffering congregations from the pulpit. The alumnus of the school board who (intending in his essay to enunciate the fact that there were monkeys in the Zoological Gardens) unwittingly wrote that "there are donkeys in the theological gardens," only gave unconscious utterance to a bald matter of fact. It is most remarkable that neither the elder Pliny nor Seneca, in whose lifetime the Crucifixion occurred, says one syllable about the supernatural darkness which attended it: albeit the minute descriptions of the former of every abnormal phenomenon are familiar to everybody, and he *does* mention the preternatural gloom which followed Cæsar's death.

A Fellow of the Royal Astronomical Society.

CAN STARS BE SEEN IN THE DAYTIME FROM THE BOTTOM OF A WELL?

[27116.]—THE "E. M.," in the several letters on this subject which have lately appeared in its columns, will have wrought great good if thereby it has convinced its legion of readers that this belief, though well-nigh universal, has no foundation in fact. That the fallacy is widespread argues nothing in its favour, as, were this true, we should be justified in giving credence to a thousand other absurd things, such as, e.g., the germination of wheat, beans, &c., from the mummy pits of Egypt, the embedment of live frogs in solid granite, the dropping from the clouds of living reptiles (uninjured by a fall of a half-mile or more), the ejection from the human stomach of snakes, lizards, frogs, &c., alive; the localisation of water in the ground, for the digging of wells, by the use of a forked-stick of witch hazel—the "divining-rod"; the extinguishment of fire by sunshine; the burning of air by passing over a very hot stove; the close connection of weather changes, as well as the germination of seeds and future growth of plants therefrom, with the changing phases of the moon, and other vagaries too numerous and humiliating to be stated here.

During the progress of the construction of the Hoosac Tunnel in this country, in order to hasten its completion by simultaneously working four faces instead of two, a shaft was sunk in the mountain to the depth of nearly half a mile. On ascertaining this, I bethought me that this was the opportunity to test the matter so decisively as to settle beyond controversy the question whether stars can or cannot be thus seen. I therefore wrote to the engineer in charge of the enterprise, asking him if, when the sky was cloudless, he could from the bottom of the shaft see stars in the daytime. His answer was, as I expected, an emphatic No. It is owing to the luminosity of the air that stars cannot be seen by day, and this luminousness is not diminished by descending into a well.

Soon after my public announcement of having found, during the total eclipse of 1878, two suspicious objects near the sun which were supposed to be inter-Mercurial planets, I received several letters asking "Inasmuch as stars may be seen from the bottom of a well in the daytime, how long ought a tube to be which, attached to the object-end of a telescope, would allow the objects to be seen without an eclipse?" My reply was: "If it were possible to construct a tube of some opaque material thirty or forty miles in length, air-tight, its upper end covered by a glass cap—assuming that the cap would not interfere with definition—and the tube exhausted of air, the objects could probably be seen," if on or near the meridian.

I have often been lowered into a well forty feet deep, but the stars have never revealed themselves to my eyes in return for the labour of my experiment.

It is very surprising that such an absurdity should have found its way into a work written by Sir John Herschel, though perhaps not more so than that he should have endorsed the assertion that "the moon scatters away the clouds."

Lewis Swift.

Warner Observatory, Rochester, N.Y., April 4.

α LEONIS—SATURN.

[27117.]—LAST NIGHT, in company with Mr. Herbert Sadler, I was observing *α* Leonis when we detected a closer companion than the well-known 8th mag. It was exceedingly faint (certainly not over 14 mag.), and is nearly on a line between the great star and the 8th mag., about 50′ or 60′ from the latter. It was only seen by shutting the bright star out of the field of 320 power. I also suspected a very small star a short distance S. of the faint one; but Mr. Sadler was not so sure. It is curious if this star should not have been noticed before; but the presence of Regulus in the field would, I think, prevent its being seen even in very large telescopes.

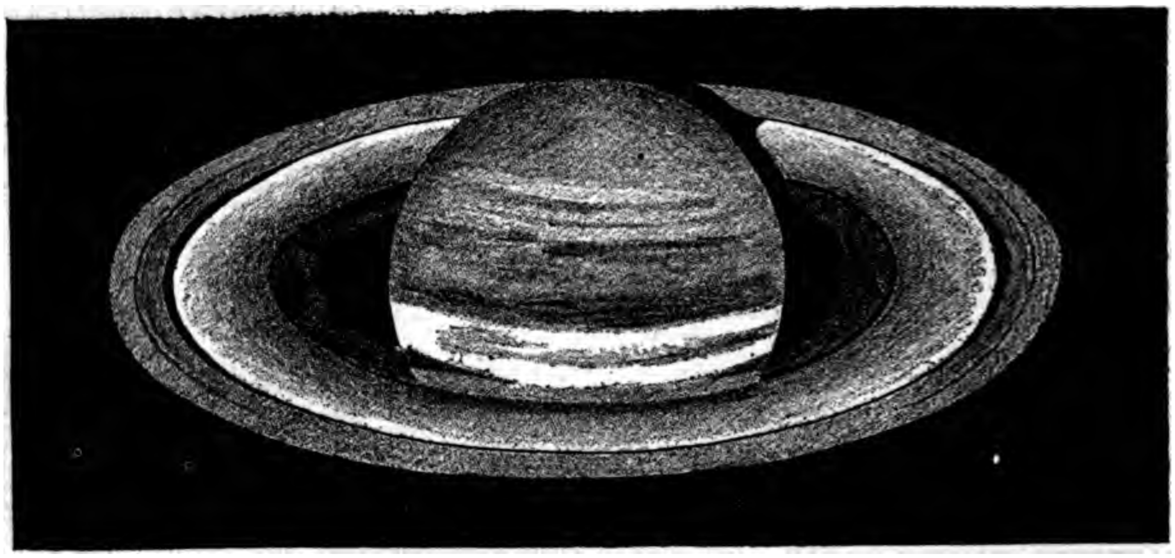
I may just, perhaps, mention, in reference to the shadow of Saturn in the ring, that I have on several occasions lately seen the "tooth" or notch on the (perhaps) slightly convex following edge of the shadow, where it crosses Cassini's division, and it was seen here by Mr. Sadler on 10th inst.

Herbert Ingall.

Champion Hill, S.E., April 13.

SATURN'S OUTER RING AND SHADOW, AND REQUEST.

[27118.]—IN compliance with Mr. Kempthorne's request, "E.M.," p. 149 (letter 27081), I inclose a few observations of the bright zone in ring A. In 1884, MM. Henry detected a bright zone in ring A contiguous to Cassini's division, which they considered gave rise to appearance of Encke's division by contrast. In December, 1885, Mr. Denning, 10in., describes narrow bright zone near middle of the ring. A correspondent in "E.M." doubted Mr. Denning having seen this. Mr. Denning, in his reply, "E.M.," May 28th, 1886, asserts it a very reliable feature, and certain to be seen again. Mr. Green, 18in., *Monthly Notices* R.A.S., May, 1885, says: "Lightest portion is certainly on side next Cassini's division, but does not come close to it; and on exterior is faint line of light, causing an appearance of shade, but no indication of Encke's division could be detected." Mr. S. Williams, *Observatory*, February, 1887, "saw white zone last December." Mr. Perkins, 8½in., L.A.S. *Journal*, March, 1885, saw central zone ring A brighter than outer or inner edges. Rev. J. Bone, 8in., inner edge of ring A more luminous than other. Mr. Offord, 5¼in. Grubb, "light zone sometimes in centre, but more usually nearest Cassini's division." Mr. G. Davis, 5½in., "bright zone in centre." Mr. Gemmill, 3¼in., "variation in light on outer ring." Mr. Ellis, 6in., "inner edge most luminous." Mr. Tarrant, 10¼in., "bright zone nearer Cassini's division, but variable in position and brightness." A great brightness of inner edge of ring was noticed by Coolidge, Dawes, Lassell ("Celestial Objects," p. 177). Bond, in his "Observations of Saturn," says, Jan. 30th, 1857: "Dusky seam in ring A, shading off rapidly, leaving bright inner



edge to ring A." Again, on Feb. 12th, 1857: "I thought ring A was brighter on inside of this dusky seam." March 4th: "Ring A—decrease of light from both edges to interior." The white zone is said to be on a photo. of the Bros. Henry. I did not wish to accuse Mr. Kempthorne of inconsistency, I only desired to obtain from him the epoch when he saw the notch, and when it became "*invisible* in his mirror," because time is an important factor in these observations: to ascertain if the peculiar form of shadow is an optical illusion only seen by a few observers at uncertain times, or whether it is an actual and permanent feature of the Saturnian system. Bond, in his "Observations of Saturn," 1847-56, lays great stress on the form of Saturn's shadow (gives 39 plates of the same). Most of these forms, "the notch" and "concavity outwards," and the "double notch" and "*the roof*," have been seen, but some I do not think have been recorded by any observers during the late apparitions. The double notch is hard to explain. Bond says when *two* notches are seen near opposition, one is usually much fainter than the other—*like a mirage*. Trouvelot gives a very peculiar form of shadow when Saturn's rings were less open than at present. Proctor attributed this narrowing of the shadow opposite outer part of ring B to irradiation. I am sure we should all be greatly obliged to Dr. Royston Piggott if he would kindly inform us if irradiation or other optical illusion, and how caused, could account for Saturn's peculiar shadow. The shadow varies slightly week by week, as close observers can testify. I notice Dr. Terby describes the division of Struve *between* rings B and C; Proctor and Dawes give this in middle of ring C. Bond, with 15in. Merz, with which he discovered Hyperion, asserts positively no space or division exists between rings B and C, as this was often most carefully looked for by him under the finest definition, and that they are quite contiguous.

April 18. **H. Watson.**

THE DARK RING OF SATURN.

[27119.]—I INCLOSE a drawing of the planet made on 12th March, 8h. 30m. to 9h. 30m., with a power of 384 on my 8½in. Calver reflector, showing the anomalous appearance of the *p.* ansa of the dark ring, the inner edge of which, both on this and on other nights, has of late either exhibited an irregular outline, or what Dr. Terby terms "*des masses sombres*" on its surface.

Thos. Gwyn Elger.

SELENOGRAPHICAL — MERCATOR — CLEFT NEAR HIPPALUS—AGATHARCIDES—ASTRONOMICAL—SATURN.

[27120.]—I THANK Mr. Sadler for answering my query about Mercator (letter 27009). Evidently the crater was one of the two shown by Neison. I observed both on March 5, 1887, and they appeared plain and easy objects. The wonder is that Schmidt missed them when, on May 18 1858, he observed Mercator with the 14ft. Berlin refractor, and found two small craters in the same. This would almost lead one to believe that they did not exist then. The small crater Neison shows on the N. of the above, and just outside Mercator, is a hillock.

Observing the fine system of clefts near Hippalus on April 8, 1887, the whole of those shown by Schmidt were seen without difficulty. As this region has often been critically surveyed, I was *not a little surprised* to discover another cleft not *recorded heretofore. It is situated* at the N. extremity of the cleft which crosses Hippalus, and lies at right angles with it, extending about the same distance on each side. It was not more difficult than the two crossing each other, which Schmidt shows W. of A., Hippalus.

During the same observation I found 11 craters on the floor of Agatharcides, and 8 hillocks on the two large mountains which partially block up the entrance of this formation on the N. So far as I know, these objects have never been recorded.

I have five observations, recently made, of B. 599, the mean of which gives 119° for the actual position by estimation of its *comes*. B. 808 gives 310°.

I have several other observations of double stars; but, as they are simple estimations, I do not feel justified in occupying space in the "E.M."

I think there is no mistake about the notch shown by the shadow of Saturn on ring just before it reaches Ball's division where it ends, as shown by Dr. Terby. Like him, on several occasions I have noticed dark spots on the dark ring; but always treated them as illusions. A few evenings after I thought I could just perceive now and then the faintest traces of the rim of the ball on the N. side of the ring. Is it an illusion?

C. M. Gaudibert.

THE GREAT SOUTHERN COMET.

[27121.]—THE comet which has just left us, after a brief and most tantalising visit, notwithstanding the disappointment to which it has subjected Australian observers, is, I think, an object of very special interest. It seems to have baffled all observers, even with the most powerful means at command, to discover any sign of a nucleus or of special condensation. It appears to have been, as I have previously described it, "all tail and no head." In this respect, so far as I am aware, it is unique, and is so far specially interesting. The only instances that I am aware of, or can discover, that will at all compare with it in this respect are —1st, Tuttle's comet of 1790, which is described as "a confused nebulosity, without indications of a nucleus"; and, 2nd, the comet of 1880. These instances are, however, not really parallel with the present, as Tuttle's was presumably an object within moderate limits, whose position was measurable, whilst that of 1880 furnished somewhat uncertain indications of a head, from which approximate positions were obtained. What adds greatly to the interest which attaches to the late visitor, is a still further resemblance in certain particulars to that of 1880. The general appearance was very similar. In apparent length they correspond very closely; also as to position in the sky, direction of tail, and time of year. The last comet appears to have been first seen on the 19th ult. My last view of it was on the 29th ult. The comet of 1880 was first seen on 2nd February. My last view of it, and I believe the last to anybody, was as a very small, dim, nebulous speck in the telescope on 17th February, 1880.

I have referred to their comparative position in the sky, and this is a point of special interest. As a matter of fact, they did not occupy the same positions, but such positions approximately, as it appears to me, either would have occupied on corresponding dates. If I could exhibit to your readers such a chart as I have drawn up, what I am trying to explain would be seen at a glance. In this chart of that part of the sky, I have laid down, from my own notes of both comets, all their several positions as approximately obtained. From this it would appear that, if the late comet could have been watched longer, it would, from its apparent
course, have passed over successively ver
the position of the former comet at the corr
ing dates. In considering this question it
borne in mind that the projection of the
a comet's orbit upon the background of
will depend upon the position of the earth
time, and the direction of its (the earth's)
But, as it was at the same season of the
course both the earth's position and dire
motion would be the same on both occasion

The question then naturally suggests its
the paths of those two comets identica
Tebbutt, who is a far higher authority than
rather doubts it. In a letter just receiv
him, he says: "It is remarkable that the
obtained by Mr. Todd, and published
Government astronomer for January 24
lies almost exactly in the projection of t
of the great comet of 1880; but the rough p
obtained by me on 28th and 30th are far to
from the projections for those dates to wa
in saying that the comet is moving in t
just referred to." Mr. Tebbutt, however,
not to have been more fortunate than mys
obtaining any definite and workable positi

There seems to be something very rem
about comets in this particular region o
The great comet of 1882 was, from a com
of orbits, supposed to be identical with
1880, 1843, and 1668. If now we may add t
we have either several successive appear
the same comet, or a succession of long,
tailed comets, very similar and apparently
in the same path, or nearly so. If not i
they suggest a strong family relationship.

The headless character of this last com
gests to me some curious thoughts. The
a comet is ponderable matter, however
substance. It, and it alone, as pertainin
comet, obeys the laws of gravitation and p
motion, and from its position the orbit is co
The nature of the tail is still an unsolved
Matter, as we understand it, it cannot b
sets at defiance all the laws of gravitat
motion. The tail is always projected in a d
from the sun. Imagine, then, a particle of
however small or light (suppose a feather
tail of the comet of '43 or '82, and at a
from the head equal to that of Venus f
sun. (This distance would be well wit
limits of those comets' tails.) As those
whisked round the sun at perihelion in th
of a few hours, such a particle must ha
three-fourths of a circle round the sun in l
a day, while, as matter, it should take mo
five months to do it at that distance from
The question stands, if this last comet wa
tail without a head, by what law is its
governed?

It strikes me, however, as being quit
the bounds of possibility, if not probabil
the object under discussion may be of a
nature from that of a comet, or comet's
think it quite conceivable that it may con
meteoric stream. In that case, however,
the stream would have been coincident
actual path or orbit. I cannot say [illegible]
it was not so; but so far as I could [illegible]
rough observations, I think the st[illegible]
siderably more inclined from the ec[illegible]
right angle) than the direction of [illegible]
than the orbits of the other come[illegible]
As, however, it was impossible to [illegible]
positions of the object, considerabl[illegible]
be allowed for the position of the c[illegible]

[illegible]

Launceston, Tasmania, Feb. 14.

TABLE I.

Name.	Mag.	R.A.		Dec.		r	φ	
		Hrs.	Min.	°	′	″	°	
μ Capricorni......	5·2	XXI.	45·4	− 14	4	26·3	87·0	
ι Pegasi............	4·0	XXII.	0·3	+ 24	38	28·7	86·5	
θ Pegasi............	3·8		2·9	+ 5	29	26·5	81·5	
33 Pegasi. (1)...	6·0		16·7	+ 20	7	31·9	93·0	Σ 2900. Common proper motion and binary.
34 Pegasi. (2)...	5·7		19·2	+ 3	39	26·1	81·0	β 290. Common proper motion.
Ll 44276. (3)...	8·5		31·8	+ 13	22	31·0	116·1	Σ 2928. Common proper motion. Binary?
Ll 44975............	8·3		53·1	− 15	2	26·9	94·7	
Ll 45199............	6·5		59·3	+ 19	8	31·9	84·3	
ψ Aquarii. (4)	4·5	XXIII.	8·3	− 9	53	35·1	89·0	Σ 12. App. II. Common proper motion.
94 Aquarii. (5)	5·2		11·5	− 14	5	28·4	109·5	Σ 2998. Common proper motion.
Bradley 3107. (6)	6·5		15·6	+ 19	46	31·2	86·5	Σ 3007. Common proper motion.

TABLE II.

Name.	Mag.	R.A.		Dec.		r	φ	
		Hrs.	Min.	°	′	″	°	
σ Pegasi............	5·8	XXII.	45·1	+ 9	4	41·4	84·5	
Ll 45455. (7)	7·0	XXIII.	6·1	− 9	41	54·2	92·8	Σ 2993. Common proper motion.
P. xxiii. 43. (8)	8·0		11·5	+ 4	37	55·8	101·5	β 80. Common proper motion. Binary.

STAR-DRIFT IN PEGASUS AND AQUARIUS.

[27122.]—DURING the last few years several astronomers have paid attention to that community of proper motion among groups of widely-separated stars to which Mr. Proctor has given the very appropriate name of *star-drift*. For example, Professor Safford has investigated the proper motions common to certain groups of Circumpolar stars in the *Monthly Notices* of the R.A.S. for March, 1878, and Mr. Stone has a very interesting note on "The Evidence of a Past Connection between four Widely-Separated Southern Stars" in the number of the same publication for November, 1879. M. Flammarion has also given, in Vol. LXXXV. of the *Comptes Rendus*, a few instances of what he has termed "Nouveaux Systèmes Stellaires"; though, as Dr. Hind has remarked, several of his cases can by no means be called *new* ones, as their common proper motions have long been remarked; while I must confess that nearly all M. Flammarion's remaining instances seem to me to have but little actual foundation in fact. One of the most striking examples in the heavens of this curious phenomenon is that of ι Ursæ Majoris and 10 Ursæ Majoris (κ Lyncis of some maps), two bright stars more than 6° apart. The secular proper motions are, according to Mädler (Cf. ENGLISH MECHANIC, April 8th, 1887, letter 27048, p. 124)—

	r	φ
ι Ursæ Majoris	52·5″	238·9°
10 Ursæ Majoris	52·6″	238·5°

while Auwers's proper motions yield nearly the same results—viz., 50·0″ in 240·5° for Iota, and 51·3″ in 240° for 10 Ursæ. Iota Ursæ is, moreover, a double star, having a minute *comes* at about 9½″ distance, which shares in the proper motion of its brilliant neighbour, and is at the same time in slow orbital movement round it.

While investigating the proper motions of some stars in Pegasus and Aquarius, I came lately on some rather remarkable cases of this star-drift, which may not be without interest to some of the readers of the ENGLISH MECHANIC. So far as I am aware, they have not been noticed before. In the two little tables above I give the designations of the stars in question, their magnitudes, approximate places for 1855, secular proper motions (expressed in Mädler's form, as in letter 27048), &c. It would appear that, while the whole of the 17 stars in Table I. seem almost to form one general system, traces of subordinate ones can be detected—i.e., μ Capricorni, θ Pegasi, 34 Pegasi (double), and Ll 44975 seem to be combined in one sub-system (if I may so express myself); ι Pegasi, 33 Pegasi (double), Ll 45199 Pegasi, Bradley 3107 Pegasi (double), and ψ Aquarii (double) in a second; and Ll 44276 Aquarii (double), and 94 Aquarii (double) in a third. I have more than a suspicion that some small stars besides those mentioned in Table I. share in the common proper motion of the group; but I have not had time yet to determine their proper motions with the requisite exactness. The proper motions used in determining r and φ are Auwers's, except in the cases of Ll 44276, 44975, 45199, 45455, and P. xxiii. 43, where Argelander's were employed, these stars not having been observed by Bradley. The stars in Table II. seem to form another group, though the community of direction is not quite so striking. Flammarion (*Comptes Rendus*, LXXXV. p. 902) gives the pairs ψ Aquarii and Ll 45455 (Σ 2993) as one of his "Nouveaux Systèmes Stellaires," reckoning the annual proper motiod of ψ Aquarii at + 0·028s., 0·00″, and that of Σ 2993 at + 0·033s., + 0·037″, the latter being Struve's values; but Auwers gives the annual proper motion of ψ Aquarii as + 0·0287s., − 0·005″, and Argelander that of Σ 2993 as + 0·0366s., − 0·027″. The direction is thus nearly the same in both cases, but the rate of motion differs considerably.

(1) A distant 7·9 mag. is not connected. The *comes* is 9·2 mag., and the angle and distance have probably decreased a little.

(2) *Comes* 12·0 mag. (Struve's scale). Hall 223·8° : 2·61″ : 1875·8 ; β 226·3° : 2·64″ ; 1880·6.

(3) Σ 327·7° : 4·69 : 1830·8 ; Cincinnati Observatory, 315·8° : 4·27″ : 1879·8. Both stars equal.

(4) Σ 312·2° : 49·6″ : 1836·7 ; β 312·6° : 49·7″ : 1880·9. *Comes* 8·5 mag. Unchanged.

(5) Unchanged ; *comes* 7·2 mag. Σ 345·2° : 13·37″ : 1830·9.

(6) Probably unchanged ; *comes* 9·5 mag. Σ 79·2° : 5·68″ : 1829·8.

(7) Unchanged. Σ 177·9° : 25·63″ : 1830·9. *Comes* 7·8 mag.

(8) De 300·4° : 1·07″ : 1875·8 ; β 312·2° : 0·91″ : 1881·6. Magnitudes 8·0, 8·8.

April 18th. **H. Sadler.**

IS MIND MATERIAL?

[27123.]—"F.R.A.S." (letter 27045) reminds me of an opponent of Darwin's theory of evolution: he really could not believe that a horse could have been evolved from a butterfly! If "F.R.A.S." had only once glanced through Buchner's "Force and Matter," he would have found on page 184 as follows: "We are not able, after the maturest consideration, to find any analogy between the secretion of bile and urine and the process by which thought is produced in the brain. Urine and bile are visible, tangible, and ponderable substances; they are, moreover, excretions of used-up materials, but thought, spirit, soul are not material, not a substance, but the effect of the conjoined action of many materials endowed with forces or qualities," etc. "F.R.A.S." complains of my stating a "merest truism." The truth is ever simple: the most complex mathematical verities are founded on such "mere truisms" as 2 + 2 = 4. The simile of the pianoforte and the player, as to soul and body, appears to me worse than the comparison between "soul" and a "secretion" of a bodily organ. Soul and body are "interwoven," closely depending on one another, not known to us as separately existing entities. The piano and the player are distinct and separate known entities. The player does not become more perfect because his instrument is improved, neither does he "play" worse because his instrument is "inferior." Put a Beethoven before a common instrument and a duffer before the most modern and excellent one, what will be the result? The excellence of tone does not compensate for bad performance, but excellence of play will compensate amply for want of melodious sound. But the most recent researches of physicians prove almost to demonstration the most remarkable correspondence between "mind" and the development of brain matter in formation, size, weight, and quality. To put it shortly, a Newton with an injured brain should show, according to this simile, better "performance" than a fool with a sound brain. However, I beg to assure "F.R.A.S." that I am painfully aware how difficult is this subject and how little I know of it; but no progress has ever been made by insisting on the correctness of preconceived ideas, however venerable and ancient they may be. To withhold them from the only tests of truth we possess—viz., reason and experience, cannot strengthen my belief in them.

"F. A." (letter 27059) calls heat a vibration. I call it a mode of motion. Is there any difference in this? Neither can I see a difference between force and energy, except in name. No doubt there are an infinite variety of forces in nature, of which "mind" is one. Nothing is ever lost, but the change of phenomena is constant. **F. W. H.**

ON PRIMARY BATTERIES.

[27124.]—"NUN. DOR." should find all the information he requires in my letters on this matter (so far as regards my battery, for, of course, "Kalon's" has no connection with this), if they have not been too technical for him. If they have, if he cares to write to me, he can obtain any particulars he may require.

Those who are not electricians, amongst whom I hope "Nun. Dor." will not be offended if I class him, will, I am sure, accept my apology for not expressing myself sufficiently clearly. The fact of the matter is, that electrical nomenclature is so familiar to me that I have difficulty in avoiding its use, and also in explaining myself without employing technical language. For the benefit of such amateurs, I hope to write a few elementary papers descriptive of the reactions of primary batteries, since I, being a professional electrical engineer, have naturally been able to devote more time to this absorbingly interesting study than those who, however clever as amateurs, cannot, owing to other business, learn all that is necessary to master this subject.

The Upward Battery referred to is doubtless very good. I have not tested it, and fear that those who have had as much experience with chlorine gas as I have would think twice, and more than twice, before introducing such a subtle and irritant poison into their premises, even were it less costly. I have no doubt, however, that this battery when perfected will be as efficient as any.

I should like to hear from one who has tried it what the local action in this cell amounts to which has been pointed out by Mr. Pearce in the *Electrical Review* for April 15th, page 364.

It is, of course, possible to recover the zinc in a commercial form from nearly any of its solutions, but this requires to be done in quantity to pay. I think one recent discovery of importance recently made is that zinc sulphide has a high commercial value as a white paint of great body; and if primary batteries would only become more generally used it would pay a company to start a chemical works to recover the zinc as sulphide from the spent solutions of different batteries. Until this is done, primary battery lighting will remain a luxury. I do not see that the account I have given is at all open to the criticism that I "could explain a lot if I liked," since I have explained all that is necessary to understand the battery, and have also stated it to be the best I have met. I have not merely stated what can or cannot be done, but what has been done. However, with some people mere theories have more weight than practice. I do not know of any circular giving the same amount of information as to the behaviour of primary batteries, and I further beg to point out that I have not advocated their use, but merely endeavoured to obtain fair play. **Electrician.**

[27125.]—I HAVE read, with great pleasure, "Electrician's" letter (27018) on the above subject, and am convinced that if his battery will perform what he claims for it, it is the best in the market.

Although a battery manufacturer, I never recommend their use when an output of more than 80 watts is required (this is my limit), as above this number either the quantity of cells, or their large size, renders manipulation difficult to an ordinary individual.

I am strongly of opinion that accumulators in an amateur's hand, in conjunction with primary batteries, only cause trouble and disappointment, at the same time costing as much, if not more, than the source of power.

As regards the question of dynamo and batteries I always argue on the basis of coal v. zinc, which seems to me to be one of the simplest ways of putting the matter.

Now, 30lb. of coal, burnt in a steam-engine driving a dynamo, will do as much work as 270lb. of zinc consumed in a battery. But the 30lb. of coal only costs 1-270th of what the zinc costs. And allowing that the residue of battery sells for 50 per cent., there is still an overwhelming balance in favour of the dynamo. Of course, as the installation increases, this balance will also increase, and the converse is equally true. But taking one consideration with another, I think "Electrician" will agree with me that for an installation requiring an output of more than 80 watts, the proverbial game is not worth the candle-power in respect to domestic lighting by battery power.

H. B. Edwards.

PLATES FOR WIMSHURST'S MACHINE.

[27126.]—MY method of piercing these machines is as follows. A disc of iron, 8in. diam., and ¼in. thick, with a hole in the centre, of the size required in the plates, is cemented to the centre of a circular glass plate by softened glass pitch (ordinary pitch with a little turpentine added whilst warm), the glass and the iron disc being previously warmed. When quite cold, the plate, with the disc attached, is immersed in water to prevent vibration, while the centre is broken through, first by driving the tang end of a file through in several places, and afterwards by nibbling the glass away with a small hammer until the hole is of the right size. This hole can then be smoothed by a file or a piece of grindstone. The iron disc is now to be detached by a gentle heat to soften the pitch, and the glass cleaned with a little turpentine on a piece of rag. I can do five plates in one hour by this process, and recommend amateurs to try it.

C. A. Lowe.

Crankhall-lane, Wednesbury.

A SIMPLE HYGROMETER.

[27127.]—IN answer to "Antares" (letter 27043), I may state that in the hygrometer described the veneer was fixed to the strip at right angles to the grain of the piece of pine, or, according to his sketch on the plane, *y o x*. With reference to the advisability of glueing the veneer on the plane *y o x* in preference to *z o x*, I could not say from experience which would be best, and should advise him to try both ways.

If we look upon the strip of pine-wood as a framework of minute capillary tubes, I should imagine that closing up one of the extremities of these tubes by means of the glue and veneer would give better results than by allowing the moisture free access to both ends. In the case of capillary tubes sealed up at one end, the moisture is prevented from creeping up very far, owing to the cushion of air within the cell.

Now, in the case of our pine lath, this would be a distinct advantage, as should the pores become thoroughly charged with moisture, the time required to expel it would be great, and would prove a detriment to its sensibility and usefulness.

Owing to a printer's error, the sentence, "A good well-built hygrometer, &c.," should have read, "A good wet-bulb hygrometer of the ordinary type."

Hygrometry is a subject which I have given but very little attention to, and I must therefore thank "Antares" for his information with reference to the articles on this subject to be found in Rees' *Cyclopædia*. I hope that some day I may have the pleasure of perusing them.

In taking accurate measurements of the hygrometrical state of the atmosphere, I should prefer to use either a wet-and-dry bulb arrangement of thermometers, or else Regnault's modification of Daniel's dew-point hygrometer. **J. T. N.**

MEDICAL ELECTRICITY.

[27128.]—I CANNOT have made my meaning clear with regard to the use of wrong currents. I intended to express that the voltaic current, either continuous or interrupted, and the induced current, are often employed indifferently and harmfully.

It is because I wish for a more exact knowledge that I have asked for a discussion to elicit the opinions of others who are more experienced than myself. My own estimate is very rough; I am only approximately sure that the induced current and the interrupted voltaic are exciting, and subsequently exhausting, to sensory and motor nerves, and, therefore, applicable where we wish to evoke contractions of muscles or overcome anæsthesia; but, as I said, the amount of contraction or of pain produced do not seem to be reliable indications of the curative action. And also, I believe that the continuous voltaic current is sedative, and applicable in cases of spasmodic and neuralgic diseases. Such a vague indication is very insufficient. The induced current may, as "Ohm" suggests, act like rubbing or other mechanical nerve vibration; general faradisation certainly refreshes a weary patient, and influences nutrition much as does "massage."

I quite agree with "Ohm" that we must "have an idea of the action of a current passing through the body." This is the idea we have not obtained, for beyond our knowledge of the action of a current upon nerve irritability, we are almost ignorant. I believe, however, that electricity acts upon and modifies the nutrition of the tissues by its effect upon the blood and lymph vessels, due either to actual stimulation of the contractile vessels themselves, or to a secondary effect through the vaso-motor nerves, or through a reflex action upon both vessels and sympathetic nerves—this through its action upon sensory nerves. I believe that electrolytic action is at work in the tissues during the action of a current. The sores produced under one pole are to me evidences of a transference of chemical substances through the tissues and their vessels. But do these effects account for its curative action, or if they exist, have we formulated the practical details arising from their existence?

We shall await the experiment, as to the increased current on reversal, which "Ohm" intends to make with interest.

The forty years' experience of "Eos" has, indeed, brought him more encouragement than I could hope for; perhaps he will give us some exact accounts of individual cases, with details of currents used—I mean the direction in which they have been applied, and the parts of the body which in each case have presumably been acted upon?

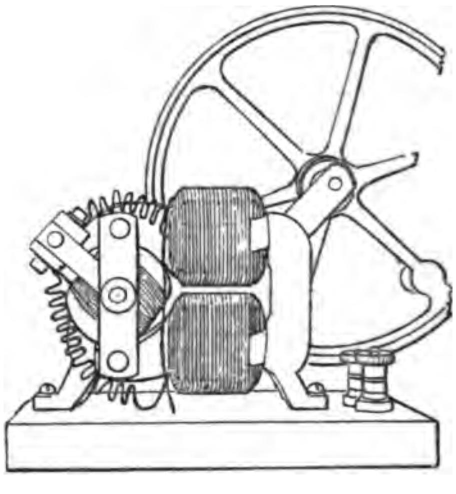
I have never used a battery of minute cells with opposite poles united, and the elements of each cell short-circuited by the moist skin; for such a short-circuited battery I suppose a "chain band" to be, because I can see no other effect likely to be produced by them but a local counter-irritation of the skin by the many superficial currents, and I can hardly think that counter-irritation alone would work "magical effects" as stated by "Eos."

The same correspondent speaks of the "normal functions being vitalised by the permeating stimulus"; this does not, I suppose, refer to the action of a chain worn and short-circuited outside the body. Such a stimulus would be entirely superficial, not "permeating"

Gerard Smith, Clapton.

PORTABLE HAND DYNAMO.

[27129.]—THIS dynamo has been designed by me to meet a want for a small hand dynamo capable of doing a variety of work. It is shunt-wound, and is specially adapted for medical purposes and for exploding fuses. It is superior to magneto exploders, as there are no permanent magnets, which often require remagnetising. It will also give a current of considerable strength. The Siemens shuttle armature has a special commutator. One or both of the slits are of variable width, being wide in one part and narrow in the other. If the brushes are on that part of the commutator having wide slits, the machine gives strong shocks by means of the extra currents from the field magnet coils. It is then adapted for medical purposes. If the brushes touch the narrow slits, the machine can be used for exploding fuses, ringing bells, or any other purpose where a weak current is required. When strong currents are required, as for incandescent lamps, the position of the brushes is immaterial. A machine weighing 5½lb. will give twelve watts, and packs in a 7in. cubical case. A very curious effect has been noticed in working the above machine. As a rule, shunt dynamos excite best on open circuit; but with this machine, when the brushes are on the wide slits, the magnets do not excite unless the external resistance is below a certain value. The probable explanation is that, unless the extra currents from the field-magnet coils attain a certain value, the tendency to fluctuation in the strength of the field-magnets is so great that the magnets do not excite. When the extra currents are strong the fluctuations are greatly reduced, and the magnets excite. I shall be pleased to show the machine at work to readers.



97, Crawford-street, W. **G. Bowron.**

AQUEOUS VAPOUR.

[27130.]—I AM sorry my last letter was not sufficiently clear to explain to "Kensingtonian" the impossibility of producing hydrogen by the action of heated metallic iron on water vapour in the presence of a large excess of free oxygen. Perhaps the following considerations will be of service to him: Assuming, for the sake of argument, that what he suggests as possible—namely, the reduction of a molecule of H_2O by the iron—should take place; at the moment of being liberated, the atom of hydrogen is in what is termed the nascent state, and in such state has a great affinity for and power of combining with oxygen. From the nature of the case, each molecule of H_2O is surrounded by at least 100 molecules of free oxygen, so that the atom of hydrogen would have no chance whatever of escaping in the free state. A familiar illustration may help to explain the difference between the two cases of hot iron acting on pure H_2O gas, and on H_2O mixed with a large amount of air. The former may be compared to firing a steam boiler so as to blow off steam through a safety valve weighted to 50lb., and the latter one to firing a boiler with *one* safety-valve at 50lb., and *one hundred* at, say, 10lb. pressure. In the former, the only chance the iron has of getting oxygen is at the expense of the H_2O, just as the steam has no means of escaping except by raising the 50lb. valve; in the latter, the free oxygen satisfies the requirements of the iron at a *low tension*, just as the steam will escape through the 10lb. valves without remotest possibility of its raising the one weighted to 50lb. **F. C. S.**

VARNISHING INCANDESCENT LAMPS.

[27131.]—IT is somewhat astonishing that electricians should go to an immense amount of trouble and expense in order to colour the bulbs of incandescent lamps for decorative lighting when lamps of any desired tint and colour can be obtained at about 3s. per dozen extra. Furthermore, any chemical process, however good, is bad for this purpose, and detrimental to the life of the lamp, and at its best the varnishing process can only produce a dirty and unsightly lamp, which greatly obscures the light, and which was apparent to all practical men who witnessed those installed in the grounds of the late Exhibition at South Kensington. It would be interesting to know how many times the lamps used at the Exhibition were redipped, and how many men were kept continually employed to carry out this process, to say nothing of the amount of strong language used by the victims who were compelled to bend over the vessels containing the nauseous-smelling compound used for the purpose, which could have easily been avoided by the payment of a small sum to our firm for permission to use coloured and fancy glass for the bulbs of their lamps, the entire patents of which we are proprietors.

Shippey Brothers.

ARE PRESSURES DYNAMIC EFFECTS?

[27132.]—YOUR correspondent's letter (27060), which argues that pressures are dynamic effects, has certainly caused a recurrence in our mind of an inquiry which several months ago obstinately provoked our curiosity. Whatever the drift may be of your correspondent's remarks, or however the word "dynamic" is understood by him, we take offence at the expression which says that the pressure of either wind or steam is a dynamic effect. Not until the tree snaps in twain, or the boiler bursts, do we see how the pressure on either can have a dynamical result. Let the wind blow as fiercely as possible against a tree, as long as the strength or adhesiveness of its fibrous structure exceeds the opposing force, so long will the motion of the wind be destroyed, or strictly reconverted into heat: but where is the dynamic effect? Not until motion produces motion can that occur to our mind. The pressure within a steam boiler may be intense without being accompanied by the movement of a single particle of matter. Is that pressure a dynamical effect? In a sealed iron box filled with air and held before the fire, there is an operating force developed as pressure, and which will display itself upon liberation by an exact equivalent of motion in matter; but for the dynamical evidence in such a plight it might as well be non-existent. A table on which rests a 56-pounder is influenced by pressure, but not until the energy which gave it that superincumbent position is resolved into motion, by the yielding of the table legs, can a dynamical motion be entertained. But with living matter supporting such a weight, as a boy or a man, there is a distinctive difference. Here the erect posture and elevation of the material is not maintained by the force of cohesion, but is absolutely at the mercy of nervous matter acting through a muscular system. Here, in overcoming the tendency of the weight to expend its energy, the person in preserving the position of his body is doing internal work, as denoted by an increased pulsation. In this case pressure necessitates a continual expenditure of force to counteract it; but not so with a boiler, or a tree, or a table.

W. K. Pulleylove.

LATHE MATTERS.

[27133.]—A FRIEND in America has done me the great service of sending me full-size drawings of the Ballon "universal engine lathe," to which I have already called attention: it has the permanent vertical slide I have so often advocated. The Americans seem to appreciate the immense convenience of this arrangement; but I suppose few English mechanics will perceive it for several years to come.

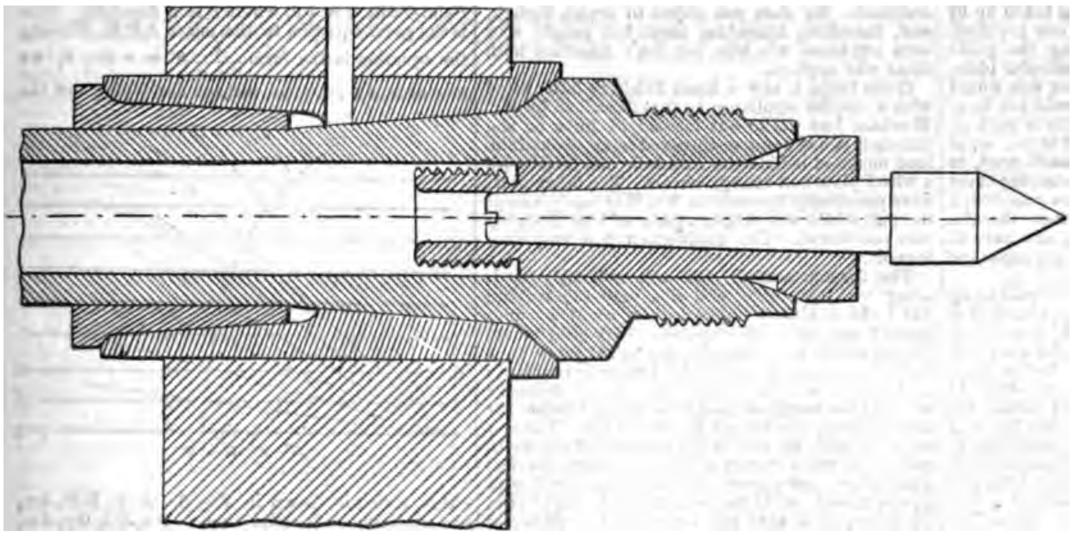


FIG 1

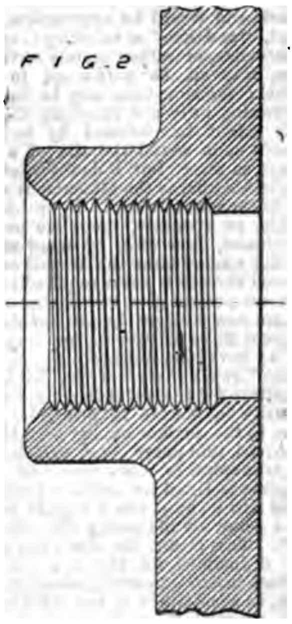


FIG. 2

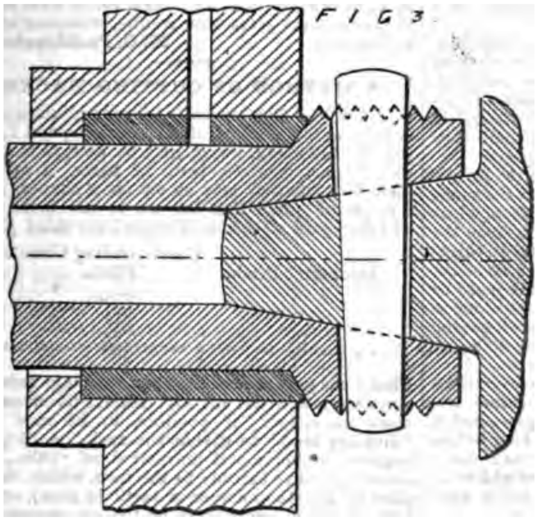


FIG 3.

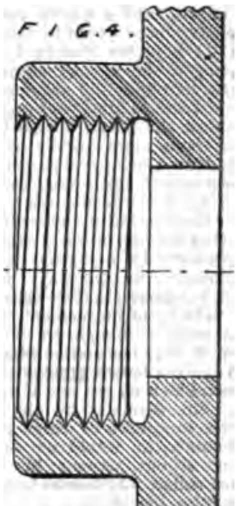


FIG. 4.

Referring to Dr. Edmunds's proposal to use the resistance thread for the mandrel nose, if the inner surface of the thread were vertical, the centring of the chuck would be determined *entirely* by the plain surfaces, the screw having nothing to do with it, but only holding the parts together. This would do away with the necessity for that extreme accuracy of the screw-thread which he intended to obtain by rotary grinders.

I think it will interest Dr. E. and others to see the full-size section I send of the nose and collar (Fig. 1) of the 4in. centre Ballon lathe. The long collar will give double friction, but increase the durability; the lathe, however, is not intended for wood. Thread 16 to the inch—terribly fine. Chucks (one shown, Fig. 2) have a blunt cone and cylinder fitting, which looks very satisfactory, though I don't know why it should be better than Dr. E.'s plan. Inside the mandrel there is a hole nearly ⅝in. in diameter, which ends in a short cone of about 60°; this is the cone which closes the split chucks for wire when they are drawn in by the tube from the back. I believe these split chucks give a more accurate centring than any other device.

I send Figs. 3 and 4 to show the kind of nose I think of adopting for the "E.M." lathe. It has, I believe, "Vulcan's" approval. It is a kind of compromise or combination of several suggestions. First we have, for the interchangeable chucks, the simple internal cone in a nose *projecting only* ⅝in. from the headstock, the truth depending on but one plain conical surface, easy to true, even if hard, with a small wheel. Chucks very easy to fit by plain turning, hole for cottar can be marked with scriber upon the male cones when placed in position in the mandrel and then drilled, by slot-drilling preferably. Chucks and lathe centre will be obliged by the cottar to take up the same angular position. Arbors for carrying milling cutters will be firmly held, and will drive either way without danger of unscrewing. The cottar plan was formerly given up because it blocked the thoroughfare hole, and because the internal cone did not seem suitable to carry large chucks such as the face-plate. This difficulty it is now proposed to avoid by screwing the outside of the mandrel-nose and making the bosses of the face-plate and wire holding chucks (which do not require to interchange) as at Fig. 4.

I was much pleased to see Mr. Wenham's capital screwing apparatus, which appears to me very perfect for the fine brass screws for which it is intended. It must have been of great service to its owners.

The inclosed photograph represents a nice little cutting-frame which will act vertically and horizontally, and which can also be inclined to a considerable degree. It has a ¾in. square stem, slot for cutters $\frac{3}{16}$ by $\frac{1}{32}$, neck $\frac{7}{16}$in., and it was made by Mr. Webb, who advertised it in the Sixpenny Sale Column.

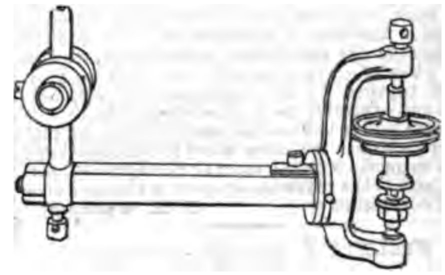
F. A. M.

[27134.]—I THOUGHT Mr. Newall's suggestions very good, having always had a weakness for the cone fitting. Why not resolve Dr. Edmunds's face and cylinder fitting into a shoulder cone? I hope Mr. Newall will give us a full-size drawing of his proposed mandrel. I find this form was proposed by "O. J. L." at the beginning of the discussion (see page 300, Vol. XXXIX., Fig. 4). On page 377 of that volume are given the proportions of the buttress screw.

Now, do forward, please, Mr. "N. D. F. P.," the details of the traversing mandrel of which you write.

I was quite surprised to find Mr. Carre accusing us of scoffing and picking holes in him; all those to whom I have spoken thought that was his forte. No one that I remember found fault with his plan of grinding twist drills. I remember I wished I could understand it, and afterwards noticed that he said his drawing was defective, and that he expected the engraver to improve upon it! I think many of our correspondents give us credit for too much quickness of perception, and many good ideas pass unappreciated for want of a clearer explanation or a more careful drawing.

As regards screwing apparatus, there is a "first," "next," "then," to be done in all screwing devices that I know of; but Mr. Wenham's is, for manufacturing purposes, most admirably contrived, and,



once set, will produce a quantity of fine screws with a minimum of trouble. Niblett's is of more general application, and, therefore, better suited for general work. The German traversing mandrel, and the one contrived by myself in imitation of it, requires only one movement of a handle to throw it in or out.

F. A. M.

[27135.]—I THANK "F. A. M." much for the small appliance he uses for *brass boring* rods and cylinders: it is on the same principle as a chuck I use for holding metal in boring *endwise*; but I have to point out two existing defects, easily removed. 1st. All drills are liable to have their points fractured when run through at speed, by impinging on the opposite metal. 2nd. I shall chamber out the neck of this centre, into which a drill can safely enter, and I shall construct it of soft brass to match a female centre with conical hole, of same metal I made two years ago, so scored and notched by drill points that I have just bored it anew.

I find the 1½in. bell chuck screwed on the nose of back centre spindle very useful, as it holds cylindrical pieces of any material truly and tightly in the case of revolving tools. I have lately added another appliance to said spindle, a heavy wrought-iron female centre, screwing thereon, with hole tapering gradually from ⅛in. to ⅜in.: this I am about to case-harden. *Use.*—My D, or engineer's bits of 1in. to ⅛in. cutting gauge have square ends to their shanks of 2 or 3in. long, the angles of which are sufficiently small to enter the hollow cone; when set to cut revolving work, a carrier having been previously attached to lean on the T-rest, thus you have only to advance your spindle end till the drill shank is fixed. I much prefer this arrangement to giving back feed by the pointed centre—in doing heavy boring—though I am quite aware that boring and grinding, from their constant chips and dust, are undesirable operations in a turning lathe. For flat bars and sheet metal my side centring arrangement is required.

Eos.

WENHAM'S SCREWING APPARATUS.

[27136.]—TO the remarks of "O. J. L." I offer some reply. Of my screw-chasing arrangement he says, "What a lot to do a little." Transpose the remark, and it will be appropriate. The "first," "next," "and then," as referring to apparent tedious adjustments, or rather merely setting the arms in place, may all be performed in less than one minute; the most time may be being taken up by unscrewing a die and attaching the one required. This might be obviated by having the guide threads sunk round the rim of a circular plate, always in place, but I doubt whether this would be worth while, as the attachment would not be as firm as the separate dies. In optical tube work up to 1½in. in diameter, there are only three, or, at the utmost, four sizes of screw-threads used, so that for a small lathe the ferrule containing these selected threads is never required to be removed. I cannot at present give the number of these threads, as I am now resident in the country, and have to postpone these matters till my traps are unpacked and my workroom finished.

The "swash-plate" of Mr. Niblett would be no substitute for these standard fixed threads, as it is radically inaccurate in principle. If a curve is given to the surface exactly suitable for *one* pitch of thread, that curve must evidently be the same as a true spiral or screw-thread on a cylinder. If the plate is tilted for another pitch of thread, the spiral will no longer be a regular incline, but will cut a screw of increasing distortion according to pitch. This is not the case when a straight-lined edge is inclined, for this is a most beautiful and accurate means of cutting screw threads of a few turns, as exemplified in the old "fusee engine," or more particularly in the modern machines for rifling firearms wherein the adjustable inclined straight-edge set outside the barrel is transferred as an accurate twist within it; but this applied to a lathe for screw-cutting, though perfectly practicable, is cumbrous and much in the way, and for every cut or traverse of the chaser, the incline has to be run back again to the starting point. Again, the swash-plate must go its full course before it goes back again, involving much loss of time. In my arrangement the tool need only just clear off the work, even if only one thread were required to be cut. And there is more work and time required in making the swash-plate notion alone, than in the whole of my arrangement which has no gear. That required for the swash-plate is a most difficult and expensive piece of workmanship, as it is no easy matter to form the internal teeth, or, may be, pins within the outer wheel to correspond and gear correctly with the inner or rolling wheel, particularly if the reduction of speed is required to be very considerable.

F. H. Wenham.

NIBLETT'S SCREW-CUTTING APPARATUS.

[27137.]—"F. A. M." is correct in thinking my remarks founded on a misapprehension. If he will refer to "O. J. L.'s" article in your issue of March 11th, he will find the following, on which my remarks were based:—

"If a bar is in contact with a swash-plate, the latter will not give uniform motion to it; it becomes necessary, therefore, to substitute for the *flat* surface of the disc a certain definite curve to equalise the traverse. This has been effected by the maker, who ascertained the curve by experiment; but it is one that a mathematician could easily decide and plot for the purpose. It is, I am told, a spiral."

Now, my reading of this was, and I think most will agree with me, that the swash-plate was not flat, but shaped like a very short portion of a screw. This, I now conclude, is not the case at all; but the plate is flat, and the traverse is equalised by making the bar or roller approach to or recede from the centre, about which the plate revolves, which is effected by forming a ridge on the plate of the necessary shape. If the bar were moved in and out on a perfectly flat level plate, the result would be the same, no matter what means were employed to move it.

"O. J. L." says "F. A. M." has well answered my question. I cannot see how; for the last line of his letter asks just the same question as I do, though not in the same way. At present I have great doubts of its being possible to equalise the rate for *every* pitch, although, as I before remarked, the variation may be so slight as not to matter. Will "O. J. L." cut a screw, then shift the tool along so as to continue the thread, and see what sort of a job that makes? I mean, to set the tool so that he commences the second screw in the middle of the first, using a single point only.

I think "O. J. L." might have devoted a little more of his letter to answering the question, and less to praising the invention and grumbling because it was not noticed more. He must remember that most readers are only acquainted with the good points of the contrivance through his description, which, though a very good one, did not it seems convey to me, at any rate, a correct idea of the most ingenious part of the appliance, and it seems to have taken "F. A. M." some time to appreciate it. Some time ago some articles of "O. J. L.'s" were noticed, and he did not seem pleased at that either.

"O. J. L.," to judge by his concluding paragraph, seems to think anything on which he puts his imprimatur should immediately be accepted without criticism. He does not object to praise, though, and, therefore, resembles theatrical people who turn out those who hiss, but don't interfere with those who applaud.

Quite lately I saw a brass finisher's lathe fitted with a similar appliance to that described by Mr. Wenham last week; but instead of hubs on the mandrel, it had a square-threaded screw about 12in. long mounted behind the mandrel, and fitted with a wheel plate and change wheels. The other parts were practically the same as Mr. Wenham's, except the nut, which was simply a piece of iron dropping into one thread. The guide-screw had very deep threads.

The arrangement I saw was evidently made along with the lathe, and was very substantial; but I think almost any amateur could fit up a similar one at small expense. Very good square thread screws can often be got at the scrap yard for a few pence, as only a short piece is required; part of a broken one would do. A set of change wheels (the smallest would be strong enough for this purpose) can be got for 12s. or 14s. The rest should readily be within the capacity of anyone to make, and when done it would be a really serviceable affair, and screws of some length and with square threads could be cut with it. It might even be arranged so that the screw of the slide-rest could be removed, and the slide clamped to the traversing bar; then the tools would be held in the slide-rest, and a pretty near approach to a screw-cutting lathe would be the result.

Sir, I do hope the Standard Mandrel question is not going to be opened again, and carried on with such hair-splitting arguments and uncalled-for personalities as filled your pages before. I certainly think the points noted by "O. J. L." in your last issue more worthy of discussion: they certainly have a more everyday application.

My own experience is that increasing the length of a bearing while the diameter remains the same, increases the durability, but not the friction, while by reducing the pressure per square inch upon the oil, it prevents its being forced out, and is, therefore, economical in that way. I gather from Dr. Edmunds's remarks that he considers the speed or angular velocity of no moment, and that as long as there is surface enough to allow the oil to stop between, it does not matter whether the diameter is small and the length great or the reverse.

I am sure he is wrong, and if he takes an extreme case, say, 4in. diameter by ½in. long against 1in. dia. by 2in. long, each of which has 6 square inches approximately, he would not treadle long before he found it out. Anent his suggestion for a shortened collar, why does he leave the troublesome boss on the headstock?—his collar being even shorter than the main part of the headstock.

While not wishing to discuss the proposed standard mandrel (if I had time I lack ability to do so), I would like to give my view of one point, that is the necessity or use of the enlarged cylinder case. It is intended to prevent eccentric variation. Now, suppose this cylinder base is perfectly true, and that the screw is sensibly out. Will not running the chuck on and off cause it to press on one particular side of the mandrel and on one particular part of the chuck every time. I don't see how this can be denied. Does it not, therefore, follow that if the screw is out, that the chucks and mandrel will eventually become out of truth also? The point I want to make is this—unless the screw is true, the cylinder base will not insure the permanent truth of the chucks; while if the screw is true the cylinder base is unnecessary, and may be left out, with a material reduction in the cost of the mandrel and chucks. Of course the mandrel would be hard, and therefore would be some time wearing; but the chucks are cast-iron or gun-metal. It has not, I believe, been proposed yet to harden them.

J. McG.

[27138.]—I THINK the following will relieve the doubt of "J. M. G." as to the theoretical accuracy of the above (letter 27039, page 105). Fig. 1 represents the swash-ring as seen in front view, and Fig. 2 the same edgeways. O X is the axis of the lathe mandrel.

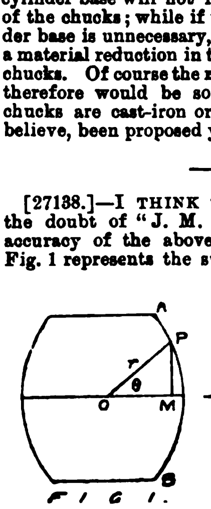


FIG. 1.

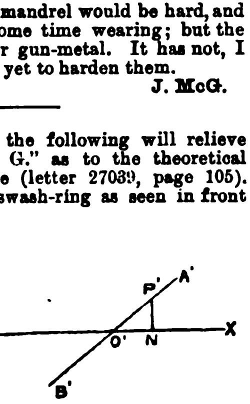


FIG. 2.

Let P O = r, P O M = θ, P' O' X = α = inclination of the swash-ring to the axis. Corresponding points are distinguished by dashes.

O' N = O' P' $\cos. \alpha$ = P N $\cos. \alpha = r \sin. \theta \cos. \alpha$

Now, O' N is to be proportional to θ; therefore $r \sin. \theta \cos. \alpha = k\theta$, where k is a constant. This is the polar equation to the curve A P B. Writing the equation in the form $\frac{k}{\cos. \alpha}\theta = r \sin. \theta$, we may deduce a practical method for laying out the curve, which is shown in Fig. 3. A A', B B', &c., are equidistant parallel lines; O a, O b, O c, &c., make equal angles with each other. The curve is drawn to pass through the intersections of O a and A A', of O b and B B', &c. As k varies with $\cos. \alpha$, the same curve gives true results, whatever be the inclination.

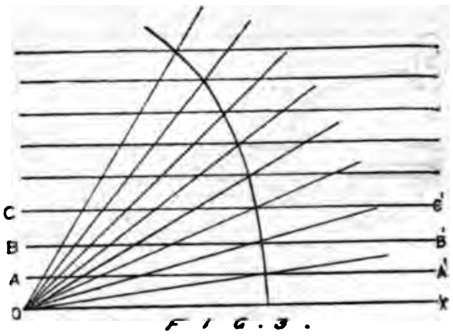


FIG. 3.

H. O. Pocklington.

A METHOD OF CUTTING RACKS.

[27139.]—I SAW recently in your columns some inquiry as to a method of cutting racks, and I send you the following, which may be new, as a quick way of spacing off the teeth of racks. I will explain how any rack may be cut on a shaper, with a screw of pitch five threads to one inch. We will disregard all decimals beyond the third place.

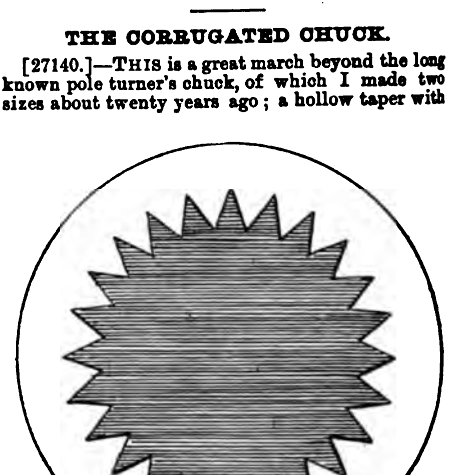
Diametral Pitch.	Corresponding Circular Pitch.
8	·393in.
10	·314
12	·262
16	·196

Find a cut gear around the shop (a change gear not much worn will do) of, say, 100ft.; fit it to the screw on shaper, if possible, to be used as a "dividing head" to divide the rack. A 16 pitch requires a horizontal movement of ·196in., the screw being five threads to the inch, which, multiplied by 100 (the number of teeth in gear), equals 500; therefore, every tooth on the gear represents ·002in. Hence to divide a 16 pitch = ·196in. ÷ ·002 = 98, that is, the gear of 100 teeth must pass through a space of 98 teeth from a given point. All the other pitches are divided the same. The 10 pitch = ·314in. ÷ ·002 = ·157, which would be one revolution, and $\frac{57}{100}$ or 57 teeth. All false motion should be taken up when beginning to divide. Even at the best the method will have its error, much, however, depending on the accuracy of the workman.

T. J. M.

THE CORRUGATED CHUCK.

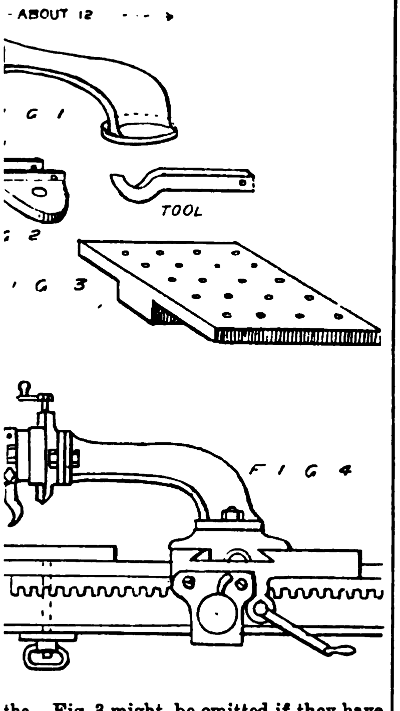
[27140.]—THIS is a great march beyond the long known pole turner's chuck, of which I made two sizes about twenty years ago; a hollow taper with



three knife edges equidistant to the bottom, th[illegible] enabling the workman to insert several sizes [illegible] wood. I got a large corrugated one about twel[illegible] months ago: it is the very thing for legs of di[illegible] les, poles, cylinders, rollers, and such like gripping them tightly with concentric teeth. s about 2½in. at the mouth. I subjoin for the benefit of any reader who may not en one. **Eos.**

LATHE PLANER FOR FIVE SHILLINGS.

1.]—CORRESPONDENTS who want such ke above three castings, Figs. 1, 2, 3, to suit



the. Fig. 3 might be omitted if they have face-plate. Fig. 2 is tool-holder, the tool rilled at end for bolt to form hinge. Fig. 1 ting bolted in place of top-rest, which is o head of casting, as shown in Fig. 4.

T. C., Bristol.

E SHRINKAGE OF CASTINGS.

2.]—THE shrinkage of castings is an im- subject for study, both in the drawing d in the foundry, and methods of prevent- e often of value. Probably some of your may find a few notes useful. The pour- etal through a small gate or sprew, and ng the number, but not their diameter, as icular casting might require, is a very good to get clean castings, and if on top, and between runner and casting short, will erially to feed up the shrink of castings, as, ner and casting being large bodies of metal, t connection is kept hot sufficiently long the casting to feed from runner. But there rge number of castings that could not be that manner without danger of scabbing, hey escaped that unsightly defect I doubt k would be provided for. Take, for in- athe beds, planer beds, engine girder beds, ic pressure cylinders, housings for rolling- ls, sugar rolls, gear wheels, flywheels, with large hubs and deep rims, driving- for locomotives, blanks for cut gears with centre, and large hubs, &c. There is a r apparent shrinkage in large and thick castings that is not due to natural shrink- he metal in green sand castings (and it is a ed fact that dry sand castings shrink but that green do). This difference is largely ar as depressions or holes are concerned, to ding of the walls of the mould in chunky and this can be easily demonstrated by heavy chunks, one with very hot and h very dull iron, and both churned by an ced hand; it will be found, when both , that the one poured hottest is the for it follows that as the water is driven he heat the hot iron keeps swelling the The above test, of course, must have both made out of same kind of sand as to temper. imes castings are accused of shrink- n it is not shrink, but setting of the ue to poor cores. If made of soft hay d casting deep, the rope will char and then I have in view now a trouble with some s, 8 to 10ft. long, 1in. thick, cast on end ll gates on top. When bored and finished e porous, with holes in the top. It was d that the inner diameter of pipe was at the end cast down. The trouble was remedied by using a riser, and an energetic man with a good feeding rod, &c., supplied at intervals with good hot iron, and this cured the shrinkage difficulty. There are irons that will shrink. I used certain grades of iron, on medium heavy work, for some three years, and to churn a piece of casting was an unusual thing to do; those that needed churning got to be known to every moulder and core maker. But on this point every moulder and foreman foundryman must use his own judgment based on experience. **Kirkstall.**

VARNISHING CREMONA VIOLINS.

[27143.]—I HAVE not yet seen any notice in the "E. M." of the interesting correspondence on the varnish of the Cremona violins, that began in the *Standard* daily paper on Feb. 28, 1887. I thought I would just jot down a few of the tit-bits that rub against us amateurs therein. We are told that the "Italian violin," known as the Cremona, has "hitherto defied all attempts to reproduce it." Now, the distinguishing character of the Cremona is "exquisite sweetness and extreme sonority." The illustrious Savart years ago gave us the clue to the secret of construction, and there is doubtless at this present moment many careful artists who are no great distance behind the master himself in carefulness of build, honesty, and suitability of wood. The air mass is a known factor which, of course, can never be overlooked by the scientific artist. There was in Mr. Lake's first letter to the *Standard* a something that told us plain enough that the Cremona varnish could now be produced, and those who could read between the lines of that letter felt, on reading it, that the writer could have scarcely given the peculiar action of the varnish on the sound plate of a fiddle or piano without being able to verify the truth of what he was writing about. The rub in the leader of the same date (Feb. 28), that "all our industry and science has so far failed to reproduce" a fiddle of the Cremona stamp will have to be taken *cum grano salis*. The world will know better directly. It is perfectly well known that it needs all the "loving care" of a great artist to make a fiddle as dear old Strad. did; but it can be done, and is done now. There must be, as I have said before in this letter, a union of all the needful qualities which go to make perfection. Given this "loving care," this "infinite capacity for taking trouble," instruments can be produced direct from the bench now as good as a new instrument by Stradivarius himself. **T. Wood.**

A CORRECTION.

[27144.]—AS the proprietors of the book "Beginners' Guide to Photography," we venture to trespass on your space to correct a slight error of the printers, which has just been brought under our notice by a friend. In the tables of weights, measures, &c., on page 63, 20 minims are given as being equivalent to one fluid drachm; this, of course, should read 60 minims = 1 fluid drachm. May we ask you to give publicity to this correction, as, no doubt, this book is already in possession of many of your readers?

Perken, Son, and Rayment.

RAILWAY BRAKES.

[27145.]—I AGREE with both Mr. Stretton and Mr. Kiernan in regard to railway brakes. A sound brake ought to be simple in construction and efficient in action. Whether vacuum or air pressure, it should have as few parts as possible in the shape of valves, &c., to get out of order. The Westinghouse brake, in my opinion, would be better if it had less parts, if it could possibly be arranged so. The shut-off tap at the end of vehicles is one part that I think could be dispensed with. It is quite as bad a trap as anything connected with the automatic vacuum; in fact, more so. For instance, supposing we have a train of eight vehicles, with one guard's van in the rear. Another vehicle is put in front of the van at a roadside station. At time of disconnecting the pipes, the gauge shows 80lb. pressure. The tap is put up at end of break van, and the pressure is held the same; but the air is let out of the coaches. When connecting up again, the coupler overlooks the handle being up at end of van. The guard sees his pressure recorded right, and they leave on the journey, no reserve power being in the train. Can Mr. Stretton inform us how the train would get on in case of a break loose? I am afraid it would not stand much chance of stopping by means of the automatic brake. Some of your readers were asking what brake the L.N.W. Railway were going to have now.

They have adopted the automatic vacuum that they put on some of their vehicles when they adopted the simple vacuum. The same fittings are utilised, with the addition of a reservoir and triple valve. By means of a handle on the side of the vehicle, either the simple or automatic vacuum can be put in gear, or both can be shut off entirely. It can be used on single vehicles for shunting purposes by putting the lever to either "Simple or Cut-off," before uncoupling. By what I have seen of it at work, it is a very good brake. But I do not hold with some of your correspondents who have condemned it beforehand. They seem to think that whatever the L.N.W. adopt in the shape of brakes is sure to be no good. It is a good thing for the Westinghouse Brake Co. that the North-Western have not adopted their brake, or the fine reputation it has would suffer. But he is a clever man who can please all. In conclusion, any of your correspondents can see the coaches fitted with the automatic vacuum, as they run daily from Euston to Liverpool and Manchester; but the automatic is not used yet. **Brake Attendant.**

[27146.]—I SEE, in letter 27106, Mr. C. E. Stretton accuses me of attempting "to throw discredit upon the results obtained at the Lancashire and Yorkshire trials in 1880." I can assure him I have no desire to do any such thing. On the contrary, my object in writing was simply to point out what I considered, and do still consider, was a wrong use, and, consequently, a misleading use of that report.

The question at issue is in reference to the vacuum automatic brake, as described by Mr. Marshall in his able paper. Now, Mr. Stretton knows perfectly well that the brake tried in 1880 was another one altogether, and yet he quotes the doings of it as though it were the same, and then asks us to accept his figures as a refutation of the paper referred to. Would he be prepared to accept the results of a pressure brake other than that of the Westinghouse, as proof of what the latter could do? If not, how can he suppose that the trials of 1880 are proof of the doings of a brake which did not take part in the trials?

As regards the question of "efficiency" *versus* "simplicity," I do not think we differ very much on this point, for though I strongly advocate the latter, I am *not* prepared to sacrifice the former.

The reference to the Penistone accident is beside the mark; we are discussing automatic and *not* non-automatic brakes. I must, however, take exception to the statement that the brake was responsible for the lives lost upon that occasion. The advocates of this theory had their opportunity of proving it in a court of law before a jury of their own countrymen, and yet failed to obtain a verdict. Further comment on this point is useless.

Geo. Kiernan.

166, Duke-street, Brooks-bar, Manchester, April 16.

[27147.]—YOUR correspondent, Geo. Kiernan (27075) seems to have very strong opinions on the brake question, but appears to be lost between automatic vacuum, and vacuum automatic, which he contrives to make one and the same system. He finds fault with Mr. Stretton's criticism (27015) because he was plain enough to speak what is known to be a fact about the Westinghouse brake, and objected to Mr. Marshall's one-sided statements. Mr. Kapteyn stated at the Society of Arts that Mr. Marshall had applied to him for certain particulars regarding the action of the triple valve, which were duly furnished along with every information regarding the brake; but these were ignored by Mr. Marshall, who preferred his *opinion* to the information supplied; so, instead of getting the facts as they are, the paper was founded on opinion, written on opinion, discussed by the society as an opinion, and ended in opinion, so that we are no more enlightened than we were before the paper was read. Your correspondent quotes James Watt as an authority. Whilst I don't want to in any way take from the greatness of his name, perhaps I may be pardoned if I say he spent his days a little before brakes began to be discussed, so can have no authority on that subject. But brakes—what is a brake for? To stop a train or to be simple? Is the block system simple? Is a locomotive simple? Is interlocking simple? No; but they are simple in their manipulation, and that is what is required in a brake. As Mr. Stretten says (27106), the height of simplicity seems to have been attained on the M.S. and L., where the couplings are tied with string. Surely, Mr. Kiernan could desire nothing simpler than the universal adoption of a ball of twine to tie up his coupling? We shall swallow the Lancashire and Yorkshire pill very hard I am afraid. How, when, and where were the experiments carried out that led to the adoption of the brake so admirably (?) described by Mr. Marshall?

Mr. Marshall's great complaint against the Westinghouse-brake was that it could not be regulated; but this is all nonsense, as he would find did he take the trouble to ride a couple of hundred miles on a passenger-train fitted with it.

At Brighton, in October last year, the delegates to the Railway Servants' Congress tested a train at the L.B. and S.C. Company's paint shops, and the regulation was perfect, as tested by watching the movement of the piston-rod under the carriages. This the men saw for themselves, and surely seeing is believing. **Rover.**

LOOSE JOINTS OF RAILS ON RAILWAYS.

[27148.]—It is of some importance to the general public that they should travel by railway with as little jolting and vibration as possible; but it seems to me that this desideratum will never be arrived at as long as the present system of loose jointed rails is kept up.

I notice that when a train is first in motion, as each wheel passes over the end of the rail, there is a very audible bumping sound; inside the carriage a perceptible jolt is felt, and the same cause sets up a very unpleasant vibration as the speed increases.

It seems a curious thing that the weakest joint in the rails where the two rails meet should have no support under it, I fail to perceive the reason why.

To any one of a mechanical turn of mind, it is evident that this cantilever construction is unsuitable for the work it has to do, although, theoretically perhaps, it comes out nearly right.

A wood sleeper without a chair might cure this defect in addition to the two plates usually bolted at the sides of the rails; but this is only an idea of mine, and I would rather leave the remedy to the ingenuity of the railway experts. I notice that, as if to add to the weakness of this weak joint, the surface drains are often allowed to run under the ends of the rails. Again I ask, Why?

Hy. J. Lanchester.

RAILWAY-SIGNAL LIGHTS.

[27149.]—Your correspondent, "P." (27074), seems to think no other companies but the N.E. and Midland are concerned in the signal-light alterations at Carlisle; but that is not the fact. All the companies, of which there are seven, use these signals, and the N.B. or Cal. men are just as liable to make a mistake with white, which is very bad as an all-right signal, as the N.E. men with green. If this argument is to hold good, all the string of signals into Citadel station must be changed from green to white to suit the North-Eastern system of signalling. Ridiculous!

Your correspondent asks to what test were the N.E. men put who were tested for colour-blindness? They were tested by the dot and card and dot and wool tests, and a large number disqualified on the "dot" test, which is about the most unpractical thing that could be invented as a test for railwaymen. What have they to see—dots, wool, or signals? They ought to be tested by the signals they are required to obey, both by day and by night, and not by naming wool, which may very well be left to the girls in the wool-shops, who won't fail to learn the colours as one of the details of their duty; but don't mix up engine-driving with wool-selling. If you want to test a driver, take him on the line, and do it by signals and flats, and at night by lights. **Rover.**

COLOUR-BLINDNESS.

[27150.]—At the Healtheries in Mr. Galton's laboratory, unless my memory fails me, one was not asked to match the skeins, but was told to select four shades of green from the heap: hence my protest. But surely *grey* and *dirty* are not synonymous terms? I cannot translate what I understand by them into scientific language, but I could easily put together a set of tints which I should call grey, but not dirty. I wish some physicist would be at the pains to master colour names as used by artists—for instance, by Wm. Morris in his lectures—for at present the two vocabularies do not abound in commensurable terms.

Against "G. C. K.'s" explanation of the Homeric colour question, I would set the statement in Liddle and Scott, that the murex dye was unknown to Homer. Anyway, it does not account for *οινοψ wine coloured*, also an epithet of the sea, and I prefer to think with Morris, himself at once master singer and master dyer, that the words commonly translated as names of *tints*, really denote *tones*. The sea, whether at Southend or Sunium, may, I take it, be of any tint from white through green or blue to black, but not red; so that in classing the sea with red things, "Homer" can scarcely have been referring to colour, and I quoted him to illustrate the possibility of intelligent people being habitually unobservant of colour. And, though colour words are frequent in our modern speech, I more than suspect that a larger section of the nation attach but a vague meaning to them, and scarcely heed the phenomena they denote except in the broadest aspects. More's the pity! And as the skeins are used not only to test engine-drivers, but educationally in the kindergarten, it is desirable that they should be true in tint as well as tone; and, therefore, we had best not import them from Germany.

W. A. S. B.

THE APERTURE AND MAGNIFYING POWER OF TELESCOPES.

[27151.]—I regret to have to ask space to correct a couple of typographical errors which occur in my letter, published in the last number of the "E.M.," and one of which makes nonsense of the sentence in which it occurs. On p. 149, third column, line 27 from the bottom, the word "prevents" should be "permits;" and on p. 150, first column, line 39 from the top, "8in." should be "8th." **M.**

THE SUPERNATURAL DARKNESS ON THE FIRST GOOD FRIDAY.

[27152.]—I find in Ainsworth's Eng. and Lat. Dictionary that Dionysius Areopagita, one of the judges that sat in the court of Mar's Hill, at Athens, when in Egypt saw an eclipse of the sun contrary to nature, at the time of the Passion of our Saviour, and said, "Aut Deus naturæ patitur, aut mundi machina dissolvetur." From what source this information is derived I have never been able to find out; perhaps some reader could enlighten us upon the subject. Smith mentions this Dionysius in his Classical Dictionary; but not the incident related above. **Amateur.**

SPIRIT BLOWPIPES.

[27153.]—I have much pleasure in giving Mr. F. Carre particulars of Costa's patent B.P. It is very simple, and gives a powerful flame. Morris Cohen, the watchmaker's tool and material supply shop, Kirkgate, Leeds, keeps the smaller sizes; mine cost 3s. A large one, on the same principle, called the automatic blowpipe, is to be got from Melhuish, tool shop, Fetter-lane, London; this is mounted on a stand, and seems a powerful instrument, price 7s. 6d. The Russian blowpipe, used by mineralogists to test ores, is a handy form, with an ascending flame; it looks like a copper saucepan, and has a handle to carry it about. I have melted hard silver solder with this; Griffin used to keep it years ago. A very powerful and pretty blowpipe lamp was attached to Soyer's portable stove (this is not made now): I used it in travelling, and could cook a good breakfast for four persons; many a dainty luncheon, too, of made dishes did I turn out thereon. The jet of fire used to boil a kettle in three minutes; the little copper stove on which it stood soon becoming red hot. Just the appliance for a laboratory table. **Eos.**

QUARTZ CRYSTALS.

[27154.]—I was informed by a travelling ornithologist, in the employ of some British scientific society, that the most wonderful specimens of crystal for size and beauty he had ever seen were common in Madagascar. As he had only two porters to carry his baggage, he was unable to take away any of these; but on this, his second tour of bird collecting in the great island, he intended to execute a commission given him by an optician to secure a small supply of the best quality.

Eos.

PETROLEUM.

[27155.]—The frontier of Upper Assam, bordering on Burmah, is very rich in this mineral oil. When travelling over this large tract, I noticed how well adapted the soil seemed to tea plantations, when I was informed by the inhabitants that, whenever a well was sunk to get water, only oil came up, hence, nobody could settle there. Since my departure from that interesting corner of British India, I am told that the oil pits are worked by a company; that it is so healthy an occupation, that any disease among the coolies is totally unknown. Petroleum has always held a high reputation for the cure of the many skin diseases prevalent among the stale-fish consuming population of the country. I have seen a man afflicted with Elephantiasis, buried in an oil hole up to his chin (the talking head on the level ground rather curious to behold) very hopeful of his cure. This dread disease has been lately proved to arise from any puncture or incised wound being neglected, and daily immersed in the putrid water and fermenting mud, during the amphibious wanderings of those savage hunters and fishers. Paraffin oil is one of the best applications to sores in cattle, very healing, and no fly will settle on it. I found out that my supply was frequently stolen for this purpose.

There can be little doubt that petroleum springs exist in many parts of the Indian Empire, notably in the hilly portion of the Punjaub. At a place called Jwabla Mookhi (literally, making himself visible in fire) there are caves where flames oozing out of the rock have been exhibited by the priests of the temple for centuries, each pilgrim giving a piece of gold, or silver coin, according to his position. As the surrounding land belongs to those holy men, the Indian Government cannot turn their lucrative possession into diggings. **Eos.**

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61002.]—**Battery.—Erratum.**—"Formation of accumulators from plain lead pipes." This is a printer's error for "plain lead plates."—Edward Conry.

[61498.]—**Induction Coil.**—Having constructed a small induction coil some time ago, and (as an amateur) being very successful, a few hints to "Ignoramus" will not be out of place. My coil consists of ½lb. No. 16 silk-covered wire for primary circuit, and same quantity No. 36 silk-covered for secondary, which has no connection whatever with primary, but is well insulated from it. The battery is connected with primary wire of coil only, and handles with secondary. I commenced at battery, or breaker end of coil, with primary wire, and finished at same; two layers, as I thought, being sufficient. I then commenced at opposite, or handles end, with secondary, and finished at same, using pure paraffin as insulation. I also made a one-quart Daniell cell, which I found to work it admirably; I afterwards made a bichromate cell, about one pint, which worked it pretty well, but not so constant. You can make a coil with all, say, No. 16 or 18 silk or cotton-covered wire; but it will not be so powerful.—R. E., Belfast.

[61780.]—**Mainspring Gauge.**—Thanks for "D. G.'s" kind attention. They are positively watch mainspring gauges, made of brass. On the flat sides of the oldest there are 16 circular marks, with hole in centre of each, graduating, No. 1 about ¼in. to No. 16 ⅜in. On the new one circles are same size, but sunk. Name on new gauge, Echelle.—Tinker.

[61832.]—**Violin Strings (U.Q.)**—I have been looking for a reply to this, and regret to find it has reached the "Unanswered" column. General Peronet Thompson says: "In strings of the same length, but of different thicknesses or materials, to make the same number of vibrations in a given time the stretching force must be as the weights of the strings to be moved, which in strings of the same material but of different diameters is as the squares of the diameters, and in strings of the same diameter but of different materials is as the specific gravities, and in strings differing both in material and diameter is as the specific gravities multiplied by the squares of the diameters." Whence, as the stretching forces are as the squares of the diameters (all other conditions equal), it follows that the diameters must be as the square roots of the stretching forces. He further says: "That in the same string of constant length, but stretched by different weights, the number of vibrations will be as the square roots of the stretching forces." And it has already been shown that the diameters are as the square roots of the stretching forces, whence it follows that the diameters will be as the number of vibrations, which, being as 2 to 3 (perfect fifth) between each pair of adjacent strings in this case, the diameters will also be in the same ratio. And as the stretching forces are as the squares of the diameters when the number of vibrations and all other conditions are the same, the tension necessary to make each pair of adjacent strings give the same note will be as 2^2 is to 3^2, or as 4 to 9. Are these correct deductions?—S. E. Hunt.

[61839.]—**Twist-drill Apparatus.**—Twist drills are not simple things to make in any case, and they cannot be cut with a screw-cutting lathe. Lathe attachments for cutting twist-drills are made in Germany; but though they make fairly good drills from ⅜in. upwards, they are useless for smaller sizes. The drills produced by these attachments are not equal to the bought ones, but do very well for rough work. The hardening and tempering is very vexatious, as after one has taken great pains in cutting a drill it often breaks in the process. Up to the present there has been no really efficient lathe attachments made. What objection has "A Country Parson" to fluted drills, for they cut as well as the twist, are less liable to break, and can be made in a lathe.—A. F. Shakespear, Lüttichaustr. 14, Dresden.

[61839.]—**Screw-cutting Lathe.**—This can be so constructed as to cut spiral drills; but it must have extra gear-wheels, and a milling head would have to be fixed on the slide-rest. To design and make one would cost a considerable amount, but if six could be made it would very much reduce the extra cost. Designing and pattern-making are expensive items.—Britannia.

[61865.]—**Kaleidoscope.**—How are the mirrors platinised—can any reader describe the process?—O. P. Q.

[61890.]—**Violin.**—The report that the Cremona varnish had been "discovered" has not been subtantiated, nor is it likely to be, in my opinion. Our makers can and do "exactly copy" any of the old shapes of violin, and those made nowadays are quite as good as the instruments turned out by the famous makers—that is, when the Strads., &c., were new. It is the continual vibration—the playing—combined with age, which has made the Cremona violins so excellent. It must be remembered that all violins are not alike—not even those of the famous makers: some are better than others.—N. E. CHILD.

[61891.]—**Superheated Steam.**—I do not think "Shiny Boots" can expect an answer to his query. It must be very difficult to "explain exactly the chemical and physical action of superheated steam," though it is known well enough that it does corrode parts of the boiler, and also the cylinder surfaces, which, moreover, cannot be efficiently lubricated. Probably the iron being raised to a high temperature is acted upon by the superheated steam, though it is not easy to accept the idea that part of the steam is actually split up into hydrogen and oxygen. Nystrom, however, says positively enough that "When steam is superheated above the temperature and pressure due to saturated steam, and the volume is increased, the hydrogen is not capable of holding all the oxygen in its own volume; but part of the vapour is converted into gas until the volume is increased 50 per cent., when all the vapour is converted into gas. For instance, if four cubic feet of steam is superheated under constant pressure until its volume becomes six or more cubic feet, that volume will then not be vapour but a gas, which may be exploded by ignition (?) In the ordinary use of steam it is never so superheated, but is always in contact with water which prevents its conversion into gas, and it requires above ignition about 600° to ignite it to explosion." I have quoted the passage from Nystrom's "Steam Engineering," pp. 147-8, and have inserted the (?) which is Nystrom's own. Accepting this view, we get no nearer to an "exact explanation"; but I would suggest that as it is a demonstrated fact that steel tubes at a red heat are porous to hydrogen, it is not improbable that in the case of superheated steam at high temperature, the iron of the boiler, if not of the cylinder, may not only occlude hydrogen, but also seize on the oxygen, as it naturally would. The question is, At what temperature and in what conditions can iron dissociate the components of steam? The behaviour of iron when heated is very different to what it is when cool, or comparatively cool, and it may be that at some quite moderate temperature it is able to effect alterations in steam which from known facts might not be suspected. Anyhow, it is certain that superheated steam does corrode iron; whether it does so by physical or chemical action seems to be unknown. Perhaps this note may bring out useful information on the subject, as it is not unlikely that in the buried *Transactions* of some of the Societies there are records of experiments which would throw light on the subject. Those who are willing to argue that boiler explosions are caused by the disruptive force of oxygen and hydrogen in the act of embracing one another will, I hope, keep clear. The question has nothing to do with their hypothesis.—SAML. RAY.

[61894.]—**Corrosion in Hot-Water Cisterns.**—I have tried washing over with two coats of Portland cement, as suggested by your correspondent, "O. R." I find the corrosion strikes through the cement before the water is put in the cisterns. Again, the cement washes off the first time the cisterns are used. If any other of your readers can suggest any other remedy I shall be glad to give it a trial. Many thanks to "O. R." for his attempt to solve the problem.—JOSEPH DERBYSHIRE.

[61899.]—**Air-Compressor.**—Mr. H. S. Garrett seems to imagine that there is such a thing as an air-compressor which can be used instead of ice for cooling a safe for perishables that has the enormous dimensions of 6ft. by 6ft. by 4ft. Such a thing can be made; but what's the good, and who's going to work it? Compressed air which has been cooled, when it is allowed to expand, will extract heat from anything in its vicinity: but it is not easy to compress air in sufficient quantity with a simple air-pump, and if a steam-engine is employed the safe might as well be a little larger. In No. 914 your querist will find an illustrated description of Lightfoot's simple air refrigerator, which I gather from the text was published because the Editor had received many queries asking for a means of obtaining a supply of cold air.—NUN. DOR.

[61901.]—**Sewing Machine.**—The defects of this machine are set forth so fully and clearly that it is not difficult to give the querist advice. It is evident, from the full description he gives, that he must take the machine to those who understand it.—T. J. M.

[61906.]—**Hackworth's Gear for Locomotives.**—Will "Semaphore" say where he found any mention of Hackworth's gear for locomotives, that he asks for a description of it? If Hackworth invented any special form of gear, no doubt he patented it, and the records of the Patent Office would contain full particulars.—NUN. DOR.

[61909.]—**Jenny or Spinner.**—Although this query is not of much interest, it may be as well to point out to the querist that he would learn a good deal by inspecting the machines in a tinsmith's shop.—NUN. DOR.

[61910.]—**Refrigeration.**—This tube of water can be frozen by immersing it in a mixture of ice and salt, or any of the numerous frigorific mixtures mentioned in the text-books and in back volumes. The question, "What degree of cold does it produce?" is incomprehensible while "it" remains undefined.—NUN. DOR.

[61924.]—**Annealing Boxes.**—There is no "usual" thickness: they are made of anything almost, from thin sheet-iron to pieces of old pipe. —T. P.

[61926.]—**Enamel or Polish for Indiarubber Goods.**—Perhaps they are covered with rubber varnish; but more likely they have the natural glaze. It is not clear what the querist means, as soft goods rarely have a polished surface.—E. H.

[61927.]—**Curved Mouldings.**—This query should be supplemented by some explanation. Mouldings, when not worked by machine, are done by hand with the usual moulding planes. As to wax-polishing oak, body in as usual, and rub over well with block of beeswax; then polish with brushes. The experts at the wax-polishing floors business fit the brushes on to their feet, and skate about.—T. C. L.

[61928.]—**Lens.**—Merely a trade name for a lens which should be useful for the purposes mentioned. The "Optimus" is a good lens for all-round work. It is made by Perken, Son, and Rayment, of Hatton-garden. Probable cost for a lens to cover 7 by 5, about 70s.—E. M.

[61936.]—**Working Man's Bicycle.**—If this querist had given more details he might have had a more definite answer. I would suggest that the receptacle for the tools might be held in a cradle clipped firmly to the back-bone, or to the top of the hind fork.—ESSAR.

[61938.]—**Cylinder Flute.**—What is the "extra D key," &c.; also "B lever key." If such a flute is in existence one would like to see it.—R. C.

[61941.]—**Dipsomania.**—Even if this querist does find out what "rack-root" is, it will be no benefit. The only cure for dipsomania is total abstention from intoxicating drinks.—P. G. M.

[61951.]—**Legal: Dental.**—Just one word to "Dens, of Peckham." There exists a law, an Act of Parliament, which states distinctly that he and those in a similar position are not dentists. A solicitor's apprentice (however long he may have served) is not a solicitor till his name has been entered on the rolls, nor is a surgeon's apprentice a surgeon till he has been registered as such. These laws are passed and enacted for the protection of the public, and not for the benefit of any profession; and if "Dens, of Peckham" has only served an apprenticeship to a dentist, he cannot have obtained the qualification which the law requires. "D. of P." asks me what he is, after stating that he is an operating and mechanical assistant: he has thus answered his own question. Let him buy a copy of the Dental Act (a few pence) and read it. My railway allusion was a little beside the mark. The Act of Parliament admitted those dentists who were bonâ fide in practice at the time, and their pupils and apprentices, in the same manner that apothecaries in practice were admitted at the passing of their Act, and the chemists and druggists later on, also veterinary surgeons. Our Legislature has decided, and wisely too, that anyone who is or may be called upon to practise in any department of medicine, surgery, or pharmacy, ought to have some better qualification than his own *ipse dixit*.—OS.

[61951.]—**Legal: Dentists Act.**—The case of "Dens, of Peckham," is a sad one, and a typical one also; but he must not take the advice of "Dens," of whom it would be flattery indeed to say that he is but imperfectly acquainted with the subject, and his remark as to "Dens, of Peckham," taking his stand on the common law of the country is really nonsense. It is well known that many sharp men took advantage of a carelessly drawn clause and succeeded in getting themselves registered "*bonâ fide* in practice at the passing of the Act"; but the register has been closed to such for several years, and only those who comply with the rules now in force are entitled to registration, and at present the following regulations are imperative: 1st. The passing the preliminary examination in arts. 2nd. Attendance at certain lectures and at dental and general hospitals about 2½ years. 3rd. An apprenticeship of four years to a registered dentist for the purpose of acquiring a knowledge of mechanical dentistry. 4th. The passing an examination in anatomy, physiology surgery, &c., before a joint Medical and Dental Board at the termination of the curriculum. To return to "Dens, of Peckham." Of course, he might carry on a hole and corner practice, but as soon as it became known that he was an unregistered dentist, it is certain that some one or other would set the law in motion and prosecute him for the penalties; for under the Medical Act Amendment Bill any one who chooses can now initiate proceedings in such a case, and the production of the register is in itself sufficient to convict, if the name of the defendant is absent, no matter from what cause, and if "Dens" who so cheerily advises "Dens, of Peckham." to practise unregistered, is not himself a registered dentist, and will boldly give his name, I will undertake at once to satisfy him as to the "common law of the country." I should very much like to impress upon intending students of dentistry who are also readers of the "E. M." one fact, easily remembered and of the utmost importance; it is this—that no lectures or hospital attendance, or even time passed in the workroom, counts for the curriculum until after the preliminary examination is passed, and any man apprenticed to dentistry must either go through the whole of the course of studies up to and including the pass examination and subsequent registration, or remain a dentist's assistant all his life. Scores of youths have been entrapped into apprenticeships by the same unscrupulous men who so cleverly obtained admission into this profession through a loosely drawn clause in the "Dentists Act," and perhaps the fact that they happen to be readers of this paper may save many young men from being eventually in the same predicament.—L.D.S.Eng.

[61951.]—**Legal: Dentists Act.**—I was more than surprised to see a writer of the calibre of "Dens" take up the position he did in his reply to "Os" on the above question. I had always considered "Dens" a sound logical and common-sense writer; but his reply in the present case is neither logical nor has it the tone of sense; and I feel sure that if he had taken the trouble to refer to the Dentists Act of 1878 before writing, he would not have attempted to vindicate himself on such a false basis. "Dens" must know, if he is a practitioner of any standing, that what "Os" said was right—viz., "that 'Dens, of Peckham,' ought to know that the Dentists Act will trouble him." And, with "Os," I say assuredly it will if "Dens, of Peckham," takes upon himself the responsibility of using the name or title of "dentist" without being first registered under the Act. In clause 3 of the Act it distinctly says that, "after the first day of August, one thousand eight hundred and seventy-nine, a person shall not be entitled to take or use the name or title of 'dentist' (either alone or in combination with any other word or words) or of 'dental practitioner,'" &c., which clearly means to say that any unregistered person using any of the above titles puts himself directly antagonistic to the law, which is criminal, and at the risk of being fined the penalty of £20. "Os" also spoke the truth when he said that "Dens, of Peckham," cannot possibly be a regular dentist, however many apprenticeships he may have served, neither can he call himself a regular (or any other) dentist until his name appears on the dentists' register" under the present Act. The fact of having served an apprenticeship under a stamped indenture gives no extra privilege unless the articles took effect before the passing of the Act. Under these circumstances, the person may get registered by sending the articles to the General Council for their inspection and approval. "Dens" speaks of a "regular dentist" exercising all his rights under the common law. I would like to know his definition of the words "regular dentist." I was of the opinion that the law recognised only one grade of dentists now, and protected no other—viz., those whose names appear on the register, and therefore entitling them to practise and call themselves dentists. "Dens" surely labours under a mistake in thinking that there are a great many "regular dentists" (unregistered persons using the title of dentist, I presume) who have gone into business and have not been prosecuted. The British Dental Association was established to carry out the spirit of the Act, and judging from the work it has already done, of which I could give two striking instances, I would venture to say it is keeping a keen and searching eye open, and will certainly bring all offenders of the law to the front. If "Dens" is a qualified practitioner he ought to know better than to urge anyone to commence the practice of dentistry without first securing the necessary qualification, or other means of getting his name put on the register, as it is a thing calculated rather to lower the tone of the profession than otherwise.—M. D.

[61967.]—**Pressure Gauge.**—I have made a small gauge something similar to that described by "H. H. D. B.," and it works well. It has a metal diaphragm, and is fixed direct on to top of boiler; no siphon is required. The external diameter of the case is ⅝in., and the depth from front to back is a ¾in. The pointer describes a half circle, and indicates from 0 to 40lb. I tested it with water-pressure against a large gauge, and found it quite satisfactory. The diaphragm is flat, not corrugated, and the end of plunger rests on it. The needle-point is not wanted, and there is not nearly so much space above and below diaphragm.—FRANCIS PUTLEY, Dover.

[61967.]—**Pressure Gauge.**—The movement of the piston in the gauge, of which I sent a sketch, was not more than ¼in., and you should be able to get that by the diaphragm, but keep it as large as possible. The thickness is matter for experiment, as it depends on the corrugation and the hardness. You may have to try several or get final adjustment by means of a light spring. You might invert your segment and let it hang downwards, and connect direct to it; then I think you may omit the bell-crank figured E in your sketch, especially if teeth of segment were internal, so as to get a little extra length.—T. C., Bristol.

[61968.]—**Woodward's Spongy Lead Accumulators.**—Having been away from London for the past week, I have only just noticed "Electrician's" request, and hasten to point out that the use of the wood "polarised litharge" is a misprint: it should read "pulverised litharge," which I have no hesitation in saying was first introduced by Dr. Woodward. I find "Electrician's" memory serves him rightly—Camille Faure did use the word "polarise," but this refers only to his red-lead patent; but "Electrician," with his extensive knowledge and technical experience, must well know that any kind of oxidisable salt of lead would become peroxide if polarised. I am sorry I cannot comply with our worthy contributor's request to further describe the "Woodward" process, as part of same and the manufacture of lithanode is only known to a few experimenters. However, we are sending a set of plates to "Electrician" for testing, which he has promised to report upon in due course for the benefit of "ours."—ARTHUR SHIPPEY.

[62067.]—**Astronomy and Mathematics.**—Absence from home has prevented me from seeing, and more promptly acknowledging, the notice kindly taken of my query by "F.R.A.S." and "Tria." The former is good enough to promise a more definite reply upon knowing the particular branch I wish to follow up: it was gravitational astronomy I had in my mind. Spherical trigonometry must first be mastered—what works, in order, should follow? Should "F.R.A.S." think fit to name French authors, I am sufficiently acquainted with the language to make use of their works, if in print.—T. S. S.

[62068.]—**G. and S.W. Engines.**—Diameter of cylinders, 18¼in.; length of stroke, 2ft. 2in.; diameter of wheels, 6ft. 9½in.; heating surface of firebox, 101sq.ft.; heating surface of tubes, 1,105sq.ft.; diameter of tubes outside, 1⅝in.; number of tubes, 240; total length of tube, 10ft. 11in.; grate area, 16sq.ft.; total heating surface, 1,206sq.ft.; pressure of steam per square inch, 150lb.; weight on driving-wheels, 15 tons 12 cwt.; weight on trail wheels, 13 tons 10 cwt.; weight on bogie centre, 14 tons 9 cwt.; total weight of engine in trim, 43 tons 11 cwt.; total weight of tender, 27 tons 12 cwt.; total of both, 71 tons 3 cwt. "G. H. F." makes a mistake in supposing we use other than Stephenson's link motion. As far as I am aware we have never tried any other, and I can vouch that there never has been an engine running with the motion he mentions in his query.—G. AND S.W. RAILWAY FITTER.

[62123.]—**Mounting Emery Wheels.**—Thanks to A. F. Shakespear and "Eos." I wanted to know what was the professional way of mounting small wheels. The holes in none of them are true, so that even if tightly fitted on spindle they do not run true, and when loose, and pressed against a true shoulder by washer and nut, they are not true either. The hole in my wheels is ½in., and their diameter 3in. Now, is this hole made intentionally so small, to allow of its being trued by enlarging it while the wheel is mounted in a chuck? If so, what is the best method of doing this, and will "Eos" say what thickness he finds sufficient for his spindle on which he mounts his three wheels? Would it not be better to screw both ends, say, for 2in., leaving the centre unscrewed? This would not weaken the spindle so much, and the mounting could be done equally well; and would not a piece of brass tubing with ends plugged, and then bored to fit the spindle, be better than the wood? The brass plugs might be made with flanges, which would insure the wheels running more truly at the outset, and if water was to be used, it would save the spindle from rust. Perhaps "Eos" would kindly say what distance he finds most convenient between his three wheels, and what the thickness of his spindle for 3in. wheels is?—F. C.

[62127.]—**Finishing Repousse Work.**—"F. C." should buff his repoussé work with leather buff and lime in lathe, finishing with cotton dolly and rouge. It requires a fast motion. It is better to buff the brass before working on it; but, if carefully done, the buffing will not injure the matting. If "F. C." cares to publish his address, I shall be pleased to give any information I can.—S. L. P.

[62127.]—**Finishing Repousse Work.**—It has always been a puzzle to me to know where to acknowledge information received—through the query columns?—for I think it is only fair to acknowledge a kindness. I now thank "Fal." for his reply. It may be very well to say a polisher would do the work for a trifle; but he is not always within reach, and I have sometimes found "a trifle" subject to a good deal of variation. Almost all the information "Fal." gives I had in a little book by Haslope; but there, as also by "Fal.," the final polishing is directed to be done after the tracing and beating, and it was because I feared this would erase all the fine tooling I hesitated to carry it out. I accordingly was satisfied with only polishing the plain parts, and then dipping the whole. The scratchbrush did not seem to me to have the slightest effect; but then I had only the iron motion on my lathe, and used porter, as I could not get ale or beer. Next time I will use higher speed and cream of tartar lubrication. My scratchbrush is 5in. in diameter, and the wires as fine as stout horsehair, say, $\frac{1}{100}$in. Would "Fal." say if he knows any reason for the brass not being brought to a high polish before any tracing or beating is done on it? It is so much easier to do it while it is in the flat. The brass I have worked on was got prepared from Gawthorp, and had the appearance of having been rubbed with circular strokes with sand or glass paper. What is the cause of a reddish tinge after dipping?—F. C.

[62133.]—**Screw-cutting Apparatus.**—To "O. J. L."—I was thinking that Niblett's apparatus might, if fitted to a traversing mandrel, be used in its present form, as well as for traversing. I am not likely, however, to have an opportunity of trying my suggestions, as my work is too coarse, and too long, for the apparatus.—A. F. SHAKESPEAR, Lüttichaustr., 14, Dresden.

[62155.]—**Acoustic Telephones.**—I saw an arrangement for a central station exhibited somewhere—at the Inventions Exhibition, I think. It was as follows:—The telephones, a separate instrument for each line, were fixed up in the building—near the top, if I remember aright, and speaking-tubes from the instruments were led down into one room. When one subscriber wished to speak to another, the clerk at the central exchange connected the two speaking-tubes by another short piece of tube. Thus the conversation between the two would be unheard by anyone in the exchange, or by any of the other subscribers.—G. RALPH, Newcastle-on-Tyne.

[62157.]—**Petroleum for Steam Boilers.**—Anderson gives evaporative power of Welsh steam coal as 14·6lb. of water per lb. of coal, and of petroleum as 21lb. of water per lb. of oil—i.e., about 50 per cent. more. The temperature of the furnace in the latter case would be about 6,300° absolute, according to a curve given by Mr. Anderson in a lecture before the Inst. of Civil Engineers, or (4,900 + 461 + 60° =) about 5,421° absolute, according to his book on "Heat," if using 15lb. of air per pound of oil. The usual temperature of a coke-burning locomotive furnace would be about 3,700° absolute with 18lb. of air per lb. of coke. The disadvantages of petroleum appear to be risk from fire and explosion, and increased wear and tear of furnace plates owing to the high temperature, which is considerably greater than melting steel. Anderson describes—not very fully—some ways of burning the oil in his book on "Heat." Several burners were illustrated in the engineering journals two or three years ago.—GLATTON.

[62159.]—**Evaporating without Heat.**—Pump air through a tank full of dry quicklime, and let it bubble through the liquid until too thick. Then let liquid flow as a thin, broad stream slowly down a long sloping surface, while the air, dried as above, is made to blow upon this surface, by a fan, in an upward direction. Common salt would do instead of this quicklime, and could be dried and used over again. It should be remembered that air does not "dry" a wet surface, it only hinders the evaporation. The vapour forces its way among the particles of the air, and if the interstices are not already filled by moisture—that is, if the air be dry—it does not hinder evaporation so much. Your best plan will be to make provision for pumping all the air away from the surface of your liquid, when you will get the highest rate of evaporation without heat which you can expect. GLATTON.

[62160.]—**Coach-Builders' Lift.**—I am afraid the reason why "Hereward" did not get an answer to his query this week was because it would really take up more space than could be given to one querist—that is, to give anything like a detailed account of a really good lift, or "trap," as we call it. I will give a description of the simplest arrangement I have seen; and then, if "
ward" wishes anything more elaborate he
better advertise his address, and apprise m
doing so, and I will do my best to help
Procure two 6in. deal planks about 15in. wid
16ft. long; fix strap-hooks on one end of each
bolts, and have fixed outside the loft door a l
iron bar for the hooks on planks to hang on
slide to suit the width of various vehicles he
want to work at. Next procure a crane (one
a good brake, in case of an accident) with a
chain and a heavy flat hook at its end, suffic
large enough to encompass the axle of ca
when a wash-leather and piece of carpet is
round. Of course, this is to prevent damage t
paint. In raising the carriage the chain is p
once round the front axle and hooked on hind
a cord is tied to each shaft, and a man stand
the loft above can then steer the vehicle very
I have an idea that this simple lift may be o
vice to many other readers of "Ours."—H. C.

[62160.]—**Coach-Builder's Lift.**—Sketc
closed, showing principle of a simple lift.

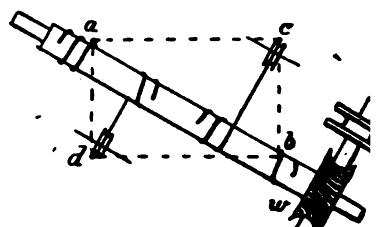
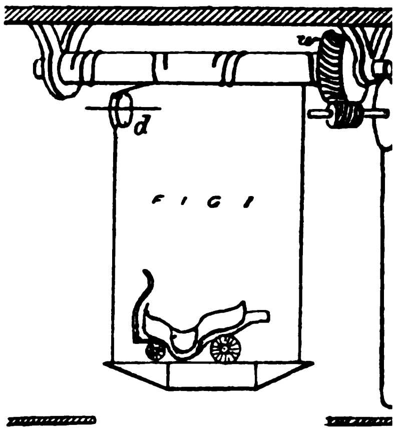


FIG 2
PLAN



large roller or drum, with four ropes coiled
one to each corner of platform on which ca
stands. Two, *a* and *b*, fall direct from drum
other two, *c* and *d*, are led off pulleys. Dr
driven by a worm and wheel and endless
Lift to be in corner of building, and well g
—GLATTON.

[62163.]—**Engine Governors.**—The ide
question asked by "H. G. B." was answe
No. 1,101, and Nos. 1,107, 1,108, and 1,110 als
tained some further information that may po
prove useful. In the first of these the meth
arranging a spring governor was described
what fully; but if there is any point that do
seem quite clear, I shall be pleased to expl
"H. G. B." will write again.—W. J. R.

[62163.]—**Engine Governors.**—Referri
"T. C.'s" remark that "W. J. R." "promi
write further on this subject, but has hit
failed to do so," permit me to say that the pr
—if such it could be called—was condition
said that when some of the readers of the "E
had stated their views on a subject that cert
had not been over-discussed, I might have an
word or two to say on the matter. But wit
exception of our friend "T. C." himself,
seems to have felt any interest in the subjec
it naturally dropped. Although quite will
continue a discussion on governors had th
sion seemed to have demanded it; yet, on th
hand, it appeared to me bad taste and of d
utility to force the matter. Furthermor
the definite questions had been answered,
method of pursuing the matter was to ope
entire question of governing the stea
which would demand a small treatise.
ject of automatic expansion alone is
which many of the pages of the "E M
filled without a superfluous word, w
the most cursory examination of the
trip gears were attempted—but no, li

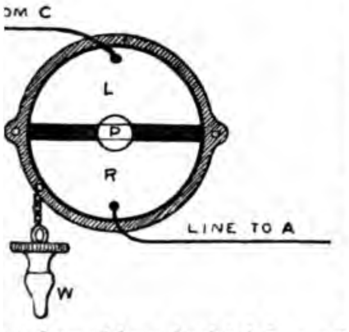
hat. Possibly now that the subject opped up, another little discussion may pon. There are so many features that rofitably dealt with. Should engines overned by the throttle-valve? If so, r plan be found that is not complicated ve? What is the most suitable governor gines? These are just a few of the ich are not by any means settled yet, e same time productive of much waste- so long as they remain unsettled. Some losophers have remarked that just at ey are about to die, men are beginning w to live. In like manner it would when the steam-engine is at the point erseded by some more efficient heat- , and then only, we shall have learnt rn it properly.—W. J. R.

-**Leclanche Type of Cells.**—First, it ly the respective quantities of carbon ese which gives the best results in The ordinary way of filling the porous urround the carbon plate with a mix- on and manganese, which makes them lar results. I have seen cells that own before the bell had got fairly ring- to make a good Leclanché cell, you procure a good, hard, and very porous st I can recommend are made by J. ns), a good, sound retort carbon plate, oken carbon and manganese, in separate ace the carbon plate in the porous pot, entre as possible; now put a layer of thin as the pieces will admit, taking ey are all in contact with each other; of manganese in the same way, and so ly, until the cell is full, and seal up, to make two or three holes for ventila- dly, fill in between porous and carbon manganese; use zinc rod amalgamated. N.

-**Model Locomotive Engine.**—The ders for 5in. driving-wheels should be ore by 1½in. stroke; but a plain boiler d 3in. diam. will not make sufficient p these cylinders going—at least 100 s of heating surface are required; this ned by adding a firebox about 4in. long , and 2½in. wide inside, and five ¾ tubes long. The pressure of steam can be o 20lb. per square inch. In models I ch better to have large boilers making eam at 10lb. or 20lb. than a small boiler much higher pressure.—E. L. P.

-**Measurement of Surface.**—It is f "Sm" to have taken the trouble to query, but I am afraid he has not quite proposition. I require to know the a body, not its volume, and "Sm" agine that surface and volume mean ing. Let me make the point clear by Take an ounce of lead in the shape and its bulk or volume can readily be by "Sm's" method of displacement, doubt its surface if it be polished, be the minimum conceivable. Now, llet and roll it out to a strip the thick- er. Its volume will be found by the t method to be identical with the ts surface will be enormously increased indicated by the proposed method. I w the different amount of surface be- ooth and a roughened body, and I men- y query the only two possible methods g that I can imagine. Perhaps "Sm" else can suggest some other plan, or a aking my plans practicable.—P.

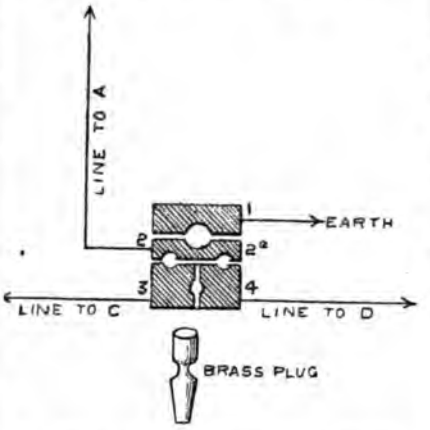
-**Telephone Switch.**—I think the etch will suit "Country's" require-



wo pieces of brass, insulated from each th ebonite; P, hole for peg W to con- two pieces of brass together; W, peg.

o switch C to A, or A to C, put brass e hole P, which connects the two lines —W. JACKSON, M.

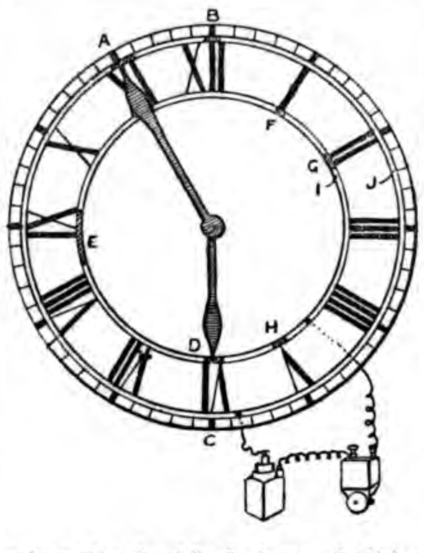
[62180.]—**Telephone.**—Failing any better suggestion, "Country" will find a plug-switch (see sketch) answer his purpose very well and easy to make.



When switch is not required, a brass plug should cement 1 to 2, and another 3 to 4. If A wants to speak C, plug between 3 and 4 should be removed, and plug between 1 and 2 placed between 2 and 3; if it is D that A wants, it should be placed between 2a and 4. Of course, he wants to fix his brass plates firmly on some good insulating material (such as ebonite).—P. O. LINEMAN.

[62178.]—**Fires in Ships at Sea.**—"Backwoodsman" is correct in his belief that carbonic acid would extinguish a fire in the hold of a ship. Several patent fire extinguishers are now in the market, and these are all based on the principle of evolving large quantities of gases which do not support combustion and are not inflammable—e.g., carbonic acid, nitrogen, &c.—when thrown into the midst of a fire, or played upon it.—M. ISADER, Lewes.

[62182.]—**Electric Clock for Factory.**—Perhaps "Manufacturing Electrician" will find sketch as under to meet his requirements:—Make

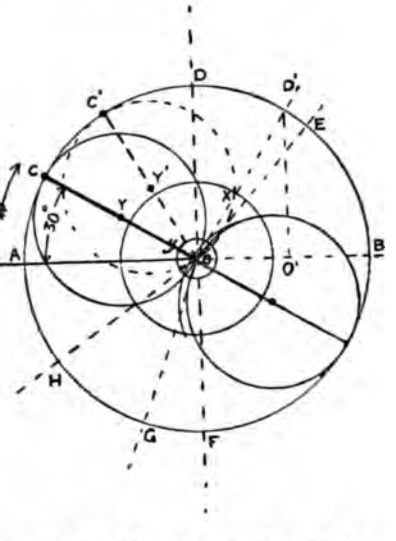


two brass rings, I and J; fix these on the dial, and solder some pieces of brass, A, B, C, that will just reach minute-hand, and some D, E, F, G, H to touch hour-hand, rounded off at beginning end, so that the hands won't stick fast. The length of time the gong will ring will depend on the length of brass projections on ring J, as will be seen. The gong will have to ring the same length of time at five minutes to six, five minutes to nine, and five minutes to two. Care must be taken not to have F and H too soon, or the gong will ring at five minutes to these hours. Of course platinum contacts will give the best results. Any further information willingly given.—H. AUSTIN.

[62183.]—**Wooden Pendulum.**—The use of wood for pendulum and of paraffin for waxing the same is no novelty. According to my experience an ordinary eight-day clock, the escapement of which was reversed to make it dead beat, governed by a well waxed wooden pendulum of 1in. by ½in. in section carrying a lead bob of 12lb. in weight by a pin driven through the centre of gravity, keeps better time than a £100 astronomical clock fitted with the ordinary mercurial compensation. There is too great a difference between the thin steel rod and the thick column of mercury. The steel rod is more rapidly affected than is the mercury by a sudden change of temperature. I have tried to compensate wooden pendulums by carrying the leaden bob on a screw, and also on a zinc tube, but have not yet found a combination that is an improvement on the method described above.—SM.

[62183.]—**Wood Pendulum.**—I failed to notice "A. W.'s" previous invitation to anyone who had tried wooden pendulum rods to express an opinion thereon, or he would certainly have been assured that one unfortunate at least (to his sorrow) had endeavoured to get a cheap compensated pendulum by the wood and lead method. 'Tis true he was not aware that the "word of the enigma" was paraffin, and he followed with happy anticipations and implicit confidence the instructions to procure a well-seasoned piece of straight-grained deal and varnish. That the wood taken was well seasoned admitted of no doubt whatever. It had served another purpose for thirty years at least, and had nearly two years' additional drying near a steam-boiler after it had been nearly trimmed to size. The ends had been carefully fitted, and at least six coats of copal were given. On the pendulum being attached to the clock a series of horological vagaries were performed that was simply exasperating. The difficulty of regulation was enough to show the inefficiency of the thing, but even when something like a rate was obtained it was never constant. As the clock was capable of a fair performance, being a well-made dead-beat unencumbered with striking train, I fancied that as the rate was increasingly losing the attachments at the ends of the wood rod were at fault. These were accordingly improved, but with the same vexatious results. After enduring this for three months, the conviction was forced upon me that wood was a totally unsuitable material for pendulum rods where accurate timekeeping is aimed at. Acting upon this conviction, the wretched bit of wood that had cost so much trouble was sternly consigned to the flames, and the long leaden bob used with a steel rod, which of course it only partly compensated. The result, however, has been an immense improvement on "cheap compensation," and will have to suffice until someone is enterprising enough to supply zinc and steel tubes suitable for pendulums of moderate weight. By the way, would there not be a fair opening for someone to take up the manufacture of zinc and steel pendulums upon a decent scale, supplying them to the trade and others? No one would think of using any other in a good clock if the price was only moderate, which assuredly could be effected by making fair numbers. But of course they will not be made; or, at least, when they are, the mark upon them will be something of the following character—"Tempus Manufacturing Co., Horaville, U.S.A."—W. J. R.

[62184.]—**Steam.**—The simplest way would be to draw a diagram of your valve. Draw a line A O = half-travel of valve; with centre O and radius A O draw circle; with centre O and radius



O I = outside lap draw circle; with centre O and radius O J = inside lap draw circle. Draw O C, making angle of 30° with A O. This is the position of eccentric when crank is at A O. On C O draw circle with C O as diameters; then O H, a line drawn from centre O through point of intersection of lap circle and circle on C O, is position of crank when steam is admitted, O D position of cut-off, O E position of release, and G O position of compression. To find position of eccentric to cut-off at three-quarter stroke:—In A B take O′ so that A O′ = ¾ A B, draw perpendiculars O′ B′, join O B′ with radius C Y = quarter travel of valve; draw circle passing through O and X = point of intersection of lap circle and line O B′; join O Y′ and produce to C′, then O C′ = position of eccentric when crank is at A O to give cut-off at three-quarter stroke. You must, therefore, advance your eccentric from C to C'.—ELAG.

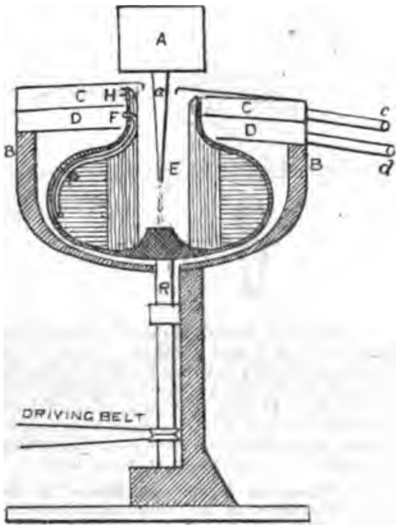
[62185.]—**Steam.**—To compress steam at 4lb. to 30lb. pressure you would need to decrease the volume 7½ times, taking $p \propto v$. Therefore 7½ × ½ = 3¾in. = distance of piston from end of cylinder when compression; this is ignoring the clearance of the ports and passages between valve and cylinder. To be correct, they should be added to the space between piston and cover at end of stroke. Compression would have to begin earlier in that case. With initial pressure 85lb. + 15lb. = 100lb., and ratio of expansions 3, the terminal pressure would be 33·3lb., and mean pressure 70lb. At commencement of stroke, when h.p. cylinder begins to exhaust into low-pressure cylinder, the back pressure is 33·3lb. in the h.p. cylinder, at the end of stroke; when the steam was expanded 9 times the pressure is 11·1lb. only. The back pressure on the h.p. piston is always the same as the pressure on the l.p. piston as long as communication is open, except such loss of pressure as is due to friction of passage.—ELAG.

[62186.]—**Siphon.**—ERRATUM.—In my reply upon this subject upon page 160, at 3rd line, "weight" is a misprint for "height."—A., Liverpool.

[62187.]—**Silica in Fluorspar.**—Very finely powder a few grammes of the substance, and weigh out 1 gramme (15 grains) very accurately. Then fuse with 5 or 6 grammes of fusion mixture (equal parts of sodium and potassium carbonates) in a platinum crucible. When cold, put the crucible into a moderately-sized beaker and boil up with water, until all that can be dissolved in water is dissolved (if possible, break the mass up). Filter, and add conc. hydrochloric acid in excess to filtrate. This will precipitate all the silica, which can be filtered off on to a Swedish filter paper with known ash. The precipitate is then dried at 100° C. When dry, as much of the silica as possible is detached from the filter paper and put into a platinum crucible; the filter paper is then cut up into small pieces (without losing any) and placed on the lid of the crucible, and heated to redness until all the carbon has been burnt away. The crucible itself is then gently heated, allowed to cool, and weighed together with the lid. By subtracting the weight of crucible and ash from the weight thus obtained, the weight of the silica is found, and this multiplied by 100 gives the percentage of silica.—M. ISADER, Lewes.

[62197.]—**Removing Nitrate of Silver Stains.**—There are two ways open to you. 1st. Take a lump of cyanide of potassium and a saucerful of clean water. Go out in the open air, dip the lump of cyanide of potassium in the water, and rub it briskly over the stained parts of your hands. Finish by washing in a running stream of water, and rubbing in a little vinegar. N.B.—Throw away the water in the saucer, and be careful not to taste the cyanide, as it is a violent poison. 2nd. Get a little tincture of iodine; paint over the stains two or three times with the tincture; wash it off. Now get a little liquor ammoniæ from the chemist's, and dilute it with its own bulk of water. Wash the stains with that, and the iodine and silver will come off together. Repeat the operation if the stains are not quite dissolved away. The former is sure and quick; the latter is also sure, but much slower, and quite safe.—S. BOTTONE.

[62199.]—**Separation of Cream from Milk.**—"Grass" refers to the centrifugal separator, of which there are several forms in the market, the principle of each being identical. The separator consists of a steel bowl, shaped like a kettle, revolving horizontally or vertically. The periphery of this bowl, whatever its size may be, being caused to travel round at the rate of three miles a minute at least, and milk being introduced into the bowl, instant separation takes place of the cream from the milk. The former being the lighter remains nearest the centre, the latter flying to the outside. Various contrivances are employed for removing the cream and milk from the bowl. In the Leval, which is the form I have in use, there are two openings in the side of the bowl so arranged as to height, that the cream, rising higher than the milk, escapes by the uppermost and the milk by the lower hole, as shown in the annexed diagram, in which A is the tank from which the milk enters the bowl by the funnel *a*. E is the interior of the bowl, represented full of milk, shaded horizontally, and cream shaded vertically. The milk enters the tube F, and is driven out with great force into a circular pan, D, which rests upon the frame of the machine B, and escapes through the funnel *d*. The cream rises up to the orifice H, which, by the way, is a mere notch in the edge of the bowl, and is driven into the pan *c*, which rests on the top of D, and thence escapes by the funnel *c*. The machine I have separates 50 gallons of milk an hour, the bowl revolving 7,000 times a minute. Now for its advantages. It is a fact well known to those who have studied dairying that the more quickly the cream is removed from the milk the better will be the butter produced, and so true is this that an expert can generally distinguish butter made of cream separated immediately after milking from that produced by setting the milk in pans. By the use of the separator a larger percentage of cream is removed from the milk, a percentage which is generally considered to add £2 to the produce of each cow in the season. The freshly-separated milk is less likely to cause gastric disturbances in calves than skim milk, which is often sour, but it requires the addition of a fat such as linseed to make up for the extra butter fat abstracted. There is no messing and slopping with milk pans, and no worry about keeping the dairy cool, &c. Centrifugal separators are now made to work by hand, and separate about 20 gallons an hour. Messrs. Carson and Son, of La Belle Sauvage-yard, London, are the agents for the Leval and Peterson separators. If, however, querist has only a small dairy, he would obtain almost equally good results at a much less cost by using the Jersey creamer, which, next to the centrifugal machine, is the best method of cream separation I have used.—DOCTOR MEDICINÆ.



[62200.]—**Vertical Boiler.**—Height of boiler, 24in.; diam. 13in.; height of furnace, 15in.; diam. at bottom, 11in.; at top, 9½in.; eight tubes 1in. inside diam., leaning at an angle of 75°—a single conical flue may be used instead, but I prefer the tubes—thickness of plate, $\frac{3}{16}$in.; working pressure, 30lb.; opening of safety valve, ⅞in.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[62201.]—**Gramme Dynamo.**—A wire ring armature does not usually give very good results when so small. You may get, perhaps, about five 10c.p. lamps of, say, 15 volts. I should put about 8lb. No. 20 on the fields, in shunt with the armature, and run it about 2,000 revs.—S. BOTTONE.

[62202.]—**Granite Turning.**—Holtzapffel, in his chapter on "Stones and Minerals," says:—"Granite is incapable of being worked in the lathe; it is therefore treated like porphyry, that is shaped with heavy picks, and finally with smaller points used with a hammer; it is afterwards ground with circular or reciprocating motion, according to the figure, by means of iron plates fed with sharp sand, next with emery, progressing finer and finer upon wooden rubbers, endways of the grain; and lastly the polish is perfected with felt rubbers and crocus. The process is tedious and difficult, from the unequal hardness of the particles; in this respect granite is inferior to porphyry." I have seen corundum used in India for cutting and polishing every known mineral excepting the diamond and ruby; it is in every way superior to emery as an abrasive substance, and very cheap in India; but I have been unable to get it in England.—EOS.

[62204.]—**Pumps.**—5in. pipes are plenty large enough—4in. should do. You should have an air vessel on suction-pipe, then you would not have to start the column of water with such a jerk, consequently the pump will work easier and with a fuller barrel. There is a little less friction by having the delivery-pipes a little larger than suction, which latter should be half-diameter of pump-barrel.—T. C., Bristol.

[62207.]—**Legal.**—A marriage settlement need not be made public in any way. (2) The trade gazettes dare not publish it. (3) The husband must be perfectly solvent, including the liability entered into by the proposed settlement; more than that, if it is to be effectual in the event of a future bankruptcy, all existing debts must be paid off. (4) There is nothing to hinder the husband being a trustee. (5) So soon as the property
"settled" stands in the name of the
trustees or in their possession.—B.SC., Pl

[62209.]—**Relative Resistances of F**
A. in Dynamos.—For series machine
ture = 1; F.M.'s = ⅓. For shunt-wound
A. = 1; F.M.'s = 400. Please note th
figures hold good in practice for rathe
machines, say from 1cwt. upwards. Small
vary somewhat. Thus, small shunt machi
better if the ratio between A. and F.M.'
to 25 or 30; and series machines work bet
ratio between the resistance of A. and F.
1 to 1.—S. BOTTONE.

[62212.]—**Pump.**—Stroke of pump e
by ⅜in. diameter. You had better make
valve seats all ¾in. diam. in bore, Corni
2ft. by 1ft. 6in., tube 9in.; 3-16in. plate, ri
no steam dome, safety-valve ⅜in. dia., ste
⅛in., work at 60lb.—T. C., Bristol.

[62213.]—**Shafting.**—You must g
through the partitions in approximate
shafting, and strain a line through at rig
and position for first hanger, and then lev
from that for each hanger; but each case
a little variation in treatment, the ma
being to get everything level and in line,
easily done when you know where ends of
must come.—T. C., Bristol.

[62214.]—**Boring.**—Have a bar 14ft.
by 1⅜in. diameter, or less on middle of len
can cut grooves in this collar for insertion
wood packing, the cutter being wedged in
front of collar. Bolt a temporary bearin
port bar and travel with saddle at each en
hole so as to support bar at intervals of 7ft
you are particular in starting the cut tru
not feed too heavily, I think you will
Two cuts would be best. Have larger
collar for larger holes.—T. C., Bristol.

[62215.]—**Speed of Millstones.**—T
these at 100 (which is rather low if 4ft. sto
lay shaft and consequently engine shaft,
size pulley, must make 100 × 37 ÷ 43 =
per minute.—T. C., Bristol.

[62217.]—**Promissory Note.**—A pr
note, in proper form and duly stamped, is
tual voucher of debt, and in the event o
death, "B." can recover the amount le
from his representatives, provided he left
surplus after payment of his funeral ex
B.SC., Plymouth.

[62218.]—**Indicating Engine.**—As f
mechanical part goes, you must have hole
in cylinder sides at each end, quite clear o
to which must be fitted suitable cocks to w
indicator is attached. You must also fi
connected to cross head by a fork at fre
which indicator cord can be attached a
position as to give a movement of the cord
5in. The cord must be led over pulley
cator. The indicator must be well blown
to get it hot before taking a card. As
reading diagram, you had better study th
in a book—a short reply would be useles
Bristol.

[62221.]—**To Affix Corner Pieces to**
Frames.—These are usually composed o
ture of whiting and glue, and being ver
do not add much to the "strength of th
The best method is to scrape off some of
ing here and there where the corner piec
fixed. Now place a damp cloth upon, a
shovel, lay one of the corner pieces upon t
it upon a fire for a minute or two, and it
be bent in any shape to suit your requi
Brush it with glue, and hold in required
for a short time until it sets.—A., Liverpo

[62222.]—**Tempering Cast Steel J**
for Rock Boring.—For boring quartz
the diggings, we used ¾ and ⅞ octagon
bars; these were faced up by means o
hammer, not touched with a file or gr
heated to a dull red, and dipped slowly
pendicularly into water, and left at that
any letting down. The cutting face ou
slightly curved, not flat.—A., Liverpool.

[62223.]—**Dynamo, 100c.p.**—TO M
TONE.—Field-magnets, circular in secti
diameter, 7in. long; yoke, 1¼in. thick, 6½
pole-pieces cast with F.M.'s having a tun
in diameter and forming a square of 6¼in.
ture, a cog ring (Pacinotti form), 5in. in d
from tip of cog to tip of cog; 16 sections
the armature with about 3½ No. 20 silk
copper. Wind the F.M.'s with 8lb.
No. 20d.c.c. Connect the F.M.'s in shunt
armature. This, if well made, will [illegible]
20c.p. lamps of 48 ohms resistance
for charging
six in seri

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wh
ab

NSWERED QUERIES.

bers and titles of queries which remain unan five weeks are inserted in this list, and if still are repeated four weeks afterwards. We trust will look over the list, and send what information the benefit of their fellow contributors.

r last, S. E. Hunt has replied to 61832.

namo. To Mr. Conry, p. 531.
ntegnius, 531.
ney's "Arcadia," 531.
ral Springs, 531.
rtable Engine, 531.
lnut Veneer, 531.
el Castings, 531.
ndulum, 531.
gan Music, 531.
-plate Creaser, 532.
ndenser, 532.
ctroplating, 532.

croscopical, p. 42.
lephonic, 42.
ass Standards, 42.
Mr. Edward Conry, 42.
ins, 42.
cro. Objectives, 42.
ter Wheel, 43.
tical Lantern Lens, 43.
gnetic Coil, 43.

QUERIES.

—Algebraic Geometry.—I would wish to ed as to whether algebra can be applied to solve in geometry by any general methods, in the same it is applied to solve problems in algebra books? oks do contain an application of algebra to but they don't seem to give any general method tion. Can any such method be applied by a th a knowledge of Euclid and algebra, but with- gular knowledge of analytical geometry, or, as wise called, co-ordinate geometry?—J. K.

—Induced Currents.—Silvanus Thompson, ectricity," says that a magnet when brought up it induces in that circuit a current, which will everse direction to the current which would tend ise the magnet with its existing polarity. Thus, that if a north pole is brought up to a circuit a a counter-clockwise direction will be induced; obvious from an energy point of view. The I find is this: Supposing a bar of soft iron is ide the coil; when the north pole is brought up a current in a counter-clockwise direction in t. Well, does not this current make the bar of gnet, the end nearer to the north pole of the magnet north—that is, a north pole by induction orth pole? Will some reader kindly say where g?—ALEM.

—Glaze in Teapot Strainer.—I have an are teapot. The holes in spout are filled with . How can I remove this? I think fluoric acid ve it, but cannot get it here. How can I make I could get at it to drill it if I knew what drill BROSCENIUS.

—Weight of Flywheel.—Will any friend n the following? I have made a model horizontal in bore, 3in. stroke. Now, what size and weight e flywheel be, and how many revolutions per ight I expect with 40lb. pressure of steam, and d casting the flywheel myself of brass, what are points to be considered to insure a good casting, ass suitable for pouring when it throws off a ne?—J. GRAHAM.

—Speed Pulley.—I want to put up a new ley on my lathe out of one piece of wood, the one diam. for quick speed, and the other 8½in. diam. As soon as I have got the mandrel put right the ts. I have tried ash and beech wood. Would l reader inform me what to try next?—YOUNG

—G.W. Locos.—Wanted, principal dimen- weight of n.g. saddle-tank goods engines, 1661 TSWOLD.

—L. and N.W. Goods Engines.—What ght of the large goods or excursion engines?— D.

—Honey.—How can artificial honey be dis- d from the genuine article?—A. F. SHAKESPEAR,

—Sulphuric Acid Bulbs.—Will some dly tell me the best method of introducing, say, ree drops of concentrated sulphuric acid into a s bulb or tube, and then of hermetically sealing ?—A. B. C.

—Soft Colours.—Could anyone give par- or preventing soft colours on linen or cambric ning when washing? Also particulars for taking stains on linen or cambric?—COLOURS.

—Feed of Planer.—How is the feed-gear so as to give the feed only at the commencement t? In my machine, in cutting from right to left, comes on at the end of the cut, and in conse- gets a tool broken sometimes.—A. F. SHAKESPEAR,

—Antimoniate of Potash.—I wish to mparise some antimoniate of potash by [illegible]'s manual is the only one I on the subject; but I find quired—something to be do not meet with process seems so at this stage ry

[62240.]—**Chloride of Calcium Solution.**—Would some chemical reader kindly explain how I can prepare a solution of chloride of calcium to boil at 270 degrees Fahr. by steam? Have tried various proportions of calcium, but failed in getting the above temperature.—C. C. S.

[62241.]—**Piston Rings.**—Will one of our readers tell me how to put piston rings on a piston? Ought the piston to fit the cylinder, so that the rings would be level with the piston, or should it be turned slightly down? Full instructions will greatly oblige—AN AMATEUR.

[62242.]—**Chloride of Silver Battery.**—Would some correspondent kindly inform me how to construct the above named battery? I can find many allusions to it in previous numbers, but none giving complete instructions for making one suitable for carrying in the pocket to light an electric scarf-pin.—MORE LIGHT.

[62243.]—**Multiplex Back for Dry Plates.**—Can any fellow-reader give a description, with diagram, of a changing (or "multiplex") back for dry plates (¼-plate)? —EL SENOR INGLES.

[62244.]—**Large Field Eyepiece.**—Will "F.R.A.S." answer the following? I am told that for a telescope having in focal length (say) 15 apertures of o.g. an eye-piece can be made giving two degrees of arc in extent. Can this be done with good results for comets, star clusters, &c.? I have had three made at different times, hoping to obtain this, but have not succeeded. They were, two of them, pancratics, and one an ordinary day e.p. Will our optical friends please consider this, and give their candid opinion on positive and negative eyepieces, having regard to field?—CORONA.

[62245.]—**Butterine.**—Would Mr. A. H. Allen or Mr. W. J. Grey be so kind as to inform me what is the nature of the altered condition that takes place in making butterine, as to its digestibility? Is it more so than ordinary fats? I understand that in making it is amalgamated with an acid (I believe nitric). If any were retained in the product, what effect would be produced upon those who eat it? I also understand that it undergoes a process of churning. What is the effect of doing so with regard to making it more digestible? Any of the possible effects that may result from living upon it I should be glad for them to state it.—P. W. R.

[62246.]—**Steam Ferry.**—Will any of "ours" kindly give me some particulars as to the construction and working of any steam ferries under the following conditions? Tidal river, ¼ mile wide; rise and fall of tide, 12ft. Barge to be worked by steam, and sufficiently large to carry a waggon and team of four horses. Shall also be glad to know where one can be see at work.—JACK.

[62247.]—**Electric Saw.**—In Vol. XII. or XIII. there was a short account of an electric saw for cutting wood. Can any of our readers say if such has been perfected?—T. WOOD.

[62248.]—**Gegenschein.**—This is the German appellation of a phenomenon described on p. 420 of Newcomb's "Popular Astronomy," as follows: "It is said that in that point of the heavens directly opposite the sun there is an elliptical patch of light, a few degrees in extent, of such extreme faintness that it can be seen only by the most sensitive eyes under the best conditions and through the clearest atmosphere." Has this appearance been noted by any reader of the "E.M."? If so, under what conditions? Can it be explained?—T. S. S.

[62249.]—**Proportional Size of Field Magnet to Armature of Motor.**—About a year ago I made a small motor, consisting of two very much flattened horseshoe magnets, and as the easiest way of balancing the resistances of the two, I made them exactly the same size and wound with the same length and size of wire. I want now, in order to increase the efficiency, to put in a larger field magnet. Must I make it so many times larger than the armature, and then calculate the size and quantity of wire required to balance the resistance, or take an equal resistance of larger wire and make the magnet just large enough to take it? If the first, how many times larger, and if the latter, what rule is there to determine what two sizes of wire would work best together? I believe the armature is wound with No. 21, but I don't know how much, and have no instruments with me here, except a galvanometer, which won't be much good in this case. I should like to know where I can get a table giving the resistances of so many feet of different sized wires. Is it in Sprague?—HARRY FRIVOLI.

[62250.]—**Small Accumulator.**—Will that kind person who gave a description of a small accumulator in the ENGLISH MECHANIC, to light an incandescent lamp of 3c.p., tell me with what sized battery he charged it? For how long the lamp remained lighted after charging, and how long it took to get the plates of the accumulator in a proper oxidised state before it would be in proper working order? As I intend making one, perhaps he will kindly give me this information.—A ROMAN.

[62251.]—**Bookbinding.**—Would any brother reader tell me how to use book cover ink on cloth covers with hand stamps, brass type, &c? How is the ink applied to the tools? Should the tools be worked in hot first without any ink, and then the ink applied to the impression with the tool cold, or how? Anyone who will give a few hints on above will confer a favour on—HAND STAMP.

[62252.]—**Defective Hydraulic Ram.**—About two years ago I put up a ram to supply water to farmyard. The fall of water is about 7½ft.; the farmyard, 500 yards distant and 60ft. higher than ram; drive pipe, 1½in. dia.; discharge or supply pipe, ⅜in. All went well till last week, when the ram stopped, and when opened the valve inside air chamber was worn out. Another was fitted, and we now find the machine does not work so well —in fact, it won't work at all unless there is a weight put on the pulse valve, without which it only makes about twelve regular strokes, then gradually increases in speed till it makes two, three, and four irregular sputtering strokes in the time of one, and eventually stops altogether with pulse valve closed. There is then a small quantity of air under the pulse valve, which gradually escapes through it; but how it got there is what I cannot find out. The drive pipe is lead, and in the work of getting in the new valve, that portion which is exposed in pit quite close to ram may have been bent down slightly [illegible] ram; but this deflection does not exceed ⅛in. [illegible] that the air confined under pulse valve is the cause of the double and treble beat; but how is it that the extra weight makes it overcome this, and how does it happen that under the same head and doing the same work it requires a weight on pulse valve now, when hitherto no such thing was required? I may say that the valve in air-chamber is a plain bit of leather, with a stiffening bit of brass screwed on upper side.—SUBSCRIBER.

[62253.]—**Pitch Pipe.**—Will anyone tell me how to make a pitch pipe that will have some variety, say three notes?—E. G. P.

[62254.]—**Creasote in Consumption.**—Can any reader give any information as to the use of a naso-oral respirator charged with creasote or carbolic acid in phthisis, as recommended by Dr. G. Hunter MacKenzie in the *Lancet* (Nov. 27, 1880, p. 871, and Braithwaite's "Retrospect," LXXXIII. 1881)? Is it liable to excite irritation or inflammation of the throat and lungs.—SPERO.

[62255.]—**Spiral Cracks in Glass Bottles.**—Can some of your readers kindly tell me how the spiral zigzag cracks are made in glass bottles? I saw some once that came from India, and was told that only a few of the natives new the art. Is this so?—R. H. H.

[62256.]—**Violoncello.**—Can any fellow-reader oblige me with instructions on the building of a violoncello?—MID SUSSEX.

[62257.]—**Keying Permanent Way.**—Could any of our railway friends give the pro and con. of inside or outside keying, as I was always under the impression that inside was much the safer and more easy to examine? On crossing a portion of the Midland system yesterday (Sunday), I observed that they had been relaying one line of rails, the new portion being keyed on the outside, differing from any of the others which are keyed on the inside, at the same time noticing that within a few yards there were two keys out and several others that I could kick in with my foot, a circumstance that appeared to me to be especially dangerous with outside keying. What is the reason of the change?—J. O. B.

[62258.]—**Legal—Nuisance.**—Will some legal correspondent kindly say if the burning of leather scraps under a boiler is a nuisance, and if the inspector can prevent a boot manufacturer from burning them, it being in a small town and very few houses round, as they take no notice of it in larger towns?—L. L.

[62259.]—**Chemical.**—Will some practical chemist kindly say what gases, &c., are evolved in the combustion of leather scraps, and if it is more injurious to health than burning coal, and are there any means of treating it to prevent smell?—L. L.

[62260.]—**Specific Gravity.**—In some calculations, based on the specific gravities of certain substances, it became necessary to know the exact weight of a cubic foot of distilled water. Several books have been consulted, but the weights given by them do not agree. The two nearest yet happened on give the weight as 62·425 and 62·5lb. avoirdupois; but even these show a difference of more than 2lb. per cubic yard. Will someone kindly say what is the correct weight of one cubic foot of distilled water in an open vessel at ordinary temperature, say 60° Fahr.?—GRAVITY.

[62261.]—**Electric Lock.**—I have an iron gate with a simple latch at present, at about 50yds. from house, and wish to put some device on it so that it can be locked from the house by simply making contact there between two wires, instead of going to the gate on dark nights. Will any of "ours" kindly help me in my difficulty?—BACHUS.

[62262.]—**Engine Query.**—In a direct-acting horizontal engine the lengths of the crank and connecting rod are 1ft. and 5ft. respectively. How far is the piston from the middle of its stroke when the crank is vertical?—A YOUNG ENGINEER.

[62263.]—**Azaleas.**—Can any of your obliging readers tell me how to treat azaleas when they go off bloom? I mean those which have been forced in hot-houses, and are sold in London in full bloom. I have referred to several books which profess to give an account of the flowering plants we have in England, but can find nothing about the treatment of azaleas. In one, a sort of dictionary work, the only reference to Azaleas is that A. procumbens is now called Loiseleuria, with not a word about the culture of these charming plants.—HORTUS.

[62264.]—**Duodecimals.**—Having heard it said that 12 is a better number than 10 as a base for counting, will someone kindly say if this is so, and why, and if our present system could be easily converted into duodecimals?—S. H.

[62265.]—**Marine Boiler.**—The degree of saltness of the water entering the boiler is read off as $\frac{1}{33}$, and that of the water in the boiler as $\frac{2}{33}$. The temperature of the feed-water is 100°, and that of the water in the boiler 280°. What percentage of the total heat given to the boiler is wasted by blowing off (the total heat of steam at 248° is 1189·4)?—PUZZLED.

[62266.]—**Steam.**—A steam-engine raised 18¾c.ft. of water through a height of 19ft. at each stroke, and made 7½ strokes per minute. The coal consumption was 32cwt. in 24 hours. Find number of units of work obtained by burning 112lb. (weight of cub. ft. of water taken as 62½lb.) —PUZZLED.

[62267.]—**Photographic Lenses.**—Lenses for photographic purposes are generally sold without being attached to cameras. Is there any means of testing them in that condition? If so, how do you proceed?—T. L. J.

[62268.]—**Guano.**—Is there any rough-and-ready test by which a farmer may ascertain whether the bulk of guano delivered to him is adulterated?—EAST ANGLIA.

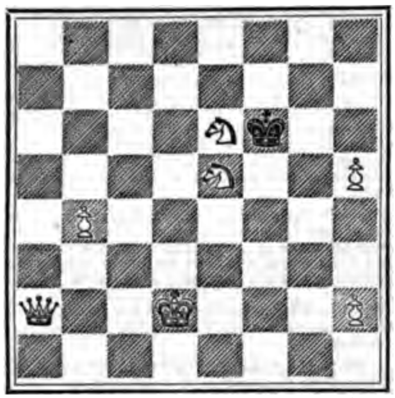
Watch and Clockmakers' Tools.—The illustrated price-list issued by Mr. Morris Cohen, of Kirkgate, Leeds, is increasing in dimensions, and now contains nearly 150 pages. It will be found useful by all watch and clock dealers jewellers, &c.

CHESS.

All Communications for this department must be addressed to J. Pierce, Langley House, Dorking.

PROBLEM MXL.—By "Black Pawn."

Black.



White. [7 + 1

White to play and mate in three moves.

Solution to 1,038.

White.	*Black.*
1. B-K 6.	1. K takes Kt.
2. B-Q 5 (ch).	2. K moves.
3. B mates.	

There should be a P at K B 5; but a second solution is still open, commencing 1. B-K 8.

NOTICES TO CORRESPONDENTS.

Correct solutions to 1.037 by Avon, Country Boy, Hensing, J. W. Hamill, J. Palmer, J. Mackenzie, T. H. Billington, H. Hosey-Davis; to 1,038 by Black Pawn (5), Link (5), A. Dean (5), F. Krasser (5), V. S. Pochin (5), J. Rayner (5), A Beginner (3), Major (2), W. Hosey-Davis (2), Harold N. Lancaster, W. Hewson-Kilbee, E. C. M. (Ipswich), J. Mackenzie.

F. W. W.—You have overlooked the fact that after Black's first move the White K is in check.

Blase, J. Quigley, and Rev. E. L. Hopkins are thanked for problems. The first is requested in future to diagram his positions.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 20, and unacknowledged elsewhere:—

H. Booth.—A. Stanley Williams.—W. A. McClintock.—Leroy and Co.—Eos.—H. Sadler.—An Humble Inquirer.—John Hampden.—S. Bottone.—Proscenius.—Inquirer.—H. Schwarz.—Scud.—H. P.—Jumbo.—Bromide.—C. R. Marten.—Fish.—G. J. Brown.—Doubtful.—R. A. Wheeler.—J. Eatock.—J. V. Blew.—Pen-y-Van.—A Country Parson.

J. Miller, Charkoff. (The query was inserted, and there is a brief reply on p. 156. You might try mixing the emery with plaster or cement, or even with indiarubber or guttapercha. Ewbank's polishing or whitening machine consists of two cylinders placed concentrically, the outer being stationary while the inner revolves. The latter is covered with sheepskin having the wool on, and that surface is placed outside, so as to rub the grains against the inner surface of the outer cylinder. We do not think there is any book on the subject; but you might find useful information in "Rice, its History, Culture, Manufacture, and Food Value," by H. B. Proctor, published by W. Dunham, 24, Mark-lane, London, E.C., price 1s.)—Moss Pearson. (A current of air beneath the floor would be useful; but if the soil is permeated with noxious matter, it should be removed, and the whole basement be covered with lime or charcoal, or preferably concreted or asphalted.)—Vibration. (At any musical instrument warehouse. Water, or water containing a little alum.)—Speaking Machine. (Full instructions for making a phonograph have been given. See No. 683, which is, however, out of print, but may possibly be obtained by advertising for it. Nos. 678, 702, also contain descriptions of phonographs, and others are to be found in books—such as Du Moncel's "Telephone, Microphone, and Phonograph.")—Frant. (How would a black crayon do? At any rate, see what you can find at the stationer's shop.)—B. C. O. (Query is not of sufficient interest to others; nor would it bring out an answer if inserted. We do not recognise the design referred to; but no doubt there are plenty of artists who would supply one as a matter of business.)—W. R. (Procure a catalogue from Mr. Batsford, 56, High Holborn, W.C. You may find a suitable work in that.)—Constant Reader, Ebbw Vale. (The best way would be to procure estimates from those who do such work; unless it is to be done by some local workman. You will find many suggestions in back volumes, and might perhaps try the Polmaise system illustrated in No. 411, and described in No. 398. No one could give any useful advice without plan and dimensions of the building.)—J. D. R. (If you mean a depilatory, try a strong solution of sulphide of barium made into a paste with powdered starch and applied directly. 2. Corrosive sublimate is soluble in boiling water, and also in cold. 3. Do not know anything about it, or what is meant.)—J. H. Henderson. (Crookes's "Handbook of Dyeing and Calico Printing," Longmans, 42s. We do not know of a work devoted exclusively to the use of the dyes named.)—G. Watkinson. (The only instructions for building an American organ that can be said to be complete appeared in Vol. XXVI., which has long been out of print.)—Nitro-Glycerine. (It is made by mixing nitro-glycerine with an infusorial earth—generally Kieselguhr. Why not obtain one of the cartridges?)—A Poor Fitter. (If you want to understand the principles of electricity you cannot do better than study Sprague's "Electricity: its Theory, Sources, and Applications," published by E. and F. N. Spon, 125, Strand, price 15s.; but if you want details of batteries, accumulators, dynamos, &c, you will not find them except in our columns and those of the technical journals.)—Constant Reader, Kidderminster. (The best book on the Gas-Engine is Dugald Clerk's, published by Longmans. We do not think there is one on rotary Engines.)—H. Dean. (What do you mean by lettergraphic printing? There is a "Grammar of Lithography," but no book that we know of on what are commonly called the "graphs." They have been described many times in back volumes.)—E. H. Y. Clevedon. (They are ebonised with logwood decoction and copperas, and polished, as described many times; but see No. 1078, p. 246. 2. The weight is the best test, as a rule.)—One Wishing to Brew. (We think not. Black's "Treatise on Brewing," Longmans, 10s. 6d., is a good book; and Gardner's "Brewer, Distiller, and Wine Manufacturer," may be useful. It is published by Spon at 6s. 6d. Possibly Booth's "Complete Art of Brewing," Simpkin, Marshall and Co., one shilling, will give all the instruction you require.)—Corona. (We do not know the price; but it can no doubt be had of David Nutt, Strand, or of Wesley and Son, 28, Essex-street, Strand, W.C. It is published by F. Hayez, Rue de Louvain 108, Brussels.)—A. Freeman. (Immerse in a hot solution of caustic soda or potash, and then brush well with powdered pumice or Bath brick. Place in clean cold water until the bath is ready. The method has been frequently described. If you prefer the acid, ask for "dipping acid" at any drysalters or large oil-shop.)—Chengstry. (Certainly. See indices. You do not say what the shades are.)—Defence. (By appealing to a magistrate, who will, if necessary, cancel the indentures. Good Friday and Christmas Day are regarded as Sundays; but they are not observed as holidays in all trades, nor in all parts of the country.)—W. Jackson, M. (Any patent agent can tell you by referring to the records. We think some time in 1892. Others expire before then.)—A Constant Reader. (Application must be made to the Comptroller of the Trade Marks Registry, Southampton-buildings, London, E.C., on prescribed forms. You should procure the Rules from the office, price 6d.)—R. Loudon. (See the textbooks and back volumes. The work referred to was published some time ago.)—A. Dumbell. (There are many recipes in back volumes; but they do not perhaps answer all your conditions. The insect powder made from the flowers of a foreign grown pyrethrum is, perhaps, the best thing.)—J. R. M. (You can do it with scales or with the squares, that is, threads laid over in squares or pencil lines ruled, say, 1in. square on the original, ¼in. square on the paper that is to have the copy.)—J. Wilkins. (The red lead is no doubt at fault. The best aquarium cement—at any rate, one which has stood the test for many years—is made by mixing three-parts each by measure of finely-powdered litharge, fine white sand, and plaster of Paris, and one part of finely-powdered rosin. Mix thoroughly, and work into a paste with boiled linseed oil free from driers; beat it up well, and use it after it has stood for about four or five hours. 2. A cement made by mixing guttapercha one part with two parts of pitch, is also good.)—Oliver Bavington Jones. (Coal is believed to exist there. See note on a paper read at the late meeting of the British Association, p. 55, No. 1,121. It seems certain that the coalfields of South Wales and Somerset are connected with those of Belgium and the North of France.)—One Anxious to Learn. (See recent back numbers and Vol. XLIII., and procure also an elementary textbook.)—Germ. (Ph.D. is a very doubtful degree; but you can obtain all particulars from the respective universities, if you cannot refer to back volumes.)—A. E. F. (No necessity to go to a special hospital. St. Bartholomew's, or any of the general hospitals, will attend to cases of that kind, and at some—notably St. Thomas's—you can enter the paying wards. You must see the house-surgeon about admission. Taking your address to be in Kent, the train would land you near the first-named hospital, and you should apply between 9 and 10.)—Enquirer, Oxon. (As you have seen nearly all the recognised authorities, we can only suggest application to the Throat Hospital, Gray's Inn-road.)—John Stroud. (Why not try Banting's system?)—Crimson Lake. (Yes; there is no copyright now in the originals.)—Stock. (Get Mathieson's "Vade Mecum for Investors," Mathieson and Co., Bartholomew House, Bank, E.C.)—Cymro. (No; 18 is not too old, but premiums and periods of service are entirely matters of private arrangement on which we cannot advise.)—Inquirer. (Look up our back vols.; it is late in the day to ask for an explanation of the brakes m
They have been described long ago, and
almost *ad nauseam*)—L. Davis. (1. We can
estimates—practically that is what you as
through the shops. 3. You must decide this
4. Yes, most certainly.)—Chas. C. Ellison. (
sonal to print. It is one thing to call objects
mental turning "gimcracks," and quite an
sneer at a man himself. Dr. Edmunds is the
Officer of Health for St. James's, Westminster;
well-known London physician, and has in his t
great good in connection with philanthrop
scientific undertakings. Like all hobbyists, h
on people's corns sometimes, and they are
justified in returning the pressure—but after t
fashion)—Memnon, Skinningrove, R. S. O. (

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kinds of sound or repairable Scientific Appliances.—C
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—125, Coltman-street, Hull.

Wanted, one to three-horse Launch Machin
Fittings, Lathe, Ratchet Brace, Safety-valve, and Ste
£60 worth Hardware offered.—Harrison, Boat-builde
Cornwall.

Wanted good Model Steamer, without en
boilers. Will give a new Musical Box, cost £12 12s. this
Bedford-street, Liverpool.

Optimus Printing Press, cost 35s. Offe

Newton's Three-wick **Lantern**, cost £4 4s, a
doz. Slides, coloured, £3 10s. for the lot, or offers in Safety
—Wright, 118, Lumb-lane, Bradford, Yorks.

Splendid **Gramme Dynamo**, 100c.p. ligh
covertable terminals; wanted 52in. Bicycle, light roadster.
Cornwell, 72, Goldstonevilla-road, West Brighton.

3½in. centre back-geared **Bench Lathe**, be
for saddle, in exchange for 52 or 54 bicycle, value £7
Beale, 35, Market Hill, Cambridge.

4¼in. **With Mirror**, in inner and outer
Browning, adjusting screws, and airtight cover, film in
condition; have purchased a 6¼in., so no need for above.
for first-class phonograph or model locomotive, or o
Southgate, 76, Spring-road, Ipswich.

Orguinette with 20 tunes, wanted small Sc
Tackle or 48in. or 50 Bicycle.—H. Hall, 1, Coton-hil
bury.

Steam Gauge, 2½in. Lathe Wheel, single s
Crank Boiler, 2ft. high, plates; pump, suit one-hors
Offers. Mutual approval.—W. Smith.

Vice and 5ft. Bench, Youth's Tricycle, Grinds
Frame, two capital Surface Plates. Offers. Stamp for
Smith, Bilston-road, Wolverhampton.

Six-stop **Chamber Organ** for Piano or Tr
Further particulars, E. Whomes, Bexley Heath, Kent.

"**Rankine's Applied Mechanics**,"
"Perry's Steam," "Newth's Natural Philosophy," "
Engineering," "Kinear Clarke's Steam Engine." Exchan
—H., 56, Grantley-street, Grantham.

Tricycle, Rudge's Convertible Sociable,
condition, part plated, balls everywhere except pedals. la
cost £29. Exchange for modern Drawing-room Furnitu
£13.—Buchanan, Greenwood and Co., 119, Fenchu
London.

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cators." Exchange for Hand Dynamo or Wimshurst
Machine. Offers.—G. Booth, 35, Beastall-street,
Torkard, Notts.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, APRIL 29, 1887.

THE MOON AND THE WEATHER.

OF all surviving pseudo-superstitions that of the influence of the Moon on the weather dies the hardest; and the belief that the (so-called) "changes" of the Moon are accompanied or followed by changes in the condition of the terrestrial atmosphere is still to be found among a very large number indeed of otherwise educated and enlightened people. Let us first see in what form this belief has been most widely current, and then glance at the grounds on which it is, or is supposed to be, founded. During the earlier years of the century scarcely an almanac appeared which did not contain the following table, prefaced by some such remarks as that it was "the result of many years' actual observation" . . . was "constructed on a due consideration of the attraction of the Sun and Moon in their several positions respecting the Earth," &c., and latterly additional weight was attempted to be conferred on it by the bold assertion that it was the production of "Dr. Herschel," and that it was "constructed on philosophical principles."

If Moon change	In Summer.	In Winter.
At 12 noon ...	Very rainy.	Snow and Rain.
If between 2 and 4 aft.	Changeable.	Fair and mild.
4 „ 6 eve.	Fair.	Fair.
6 „ 8 „ 8 „ 10 „	Fair if wind NW Rainy if S or SW	Fair and Frosty if wind N or NE. Rain if S or SW.
10 „ 12 night	Fair.	Fair and frosty.
12 „ 2 mng.	Fair.	Frost, unless wind S or SW.
2 „ 4 „	Cold: showery.	Snow; stormy.
4 „ 6 „	Rain.	Snow.
6 „ 8 „	Wind and rain.	Stormy.
8 „ 10 „	Changeable.	Rain or snow.
10 „ 12 „	Showery.	Cold; windy.

We shall have something to say about Herschel's connection with this rubbish presently: meanwhile let us examine it in the light of familiar astronomical facts. And first, as to the moon "changing." To hear the majority of people talk, one would imagine that a "change" of the moon is in some sense cognate with a conjuring trick; in which the performer, after showing that he has nothing in his hand, instantaneously produces an egg, an orange, or a ball from it. Now nothing could well be farther from the truth than this: the fact being that the moon is *always* changing—·01 second before conjunction she is waning, ·01 second after it she is waxing, and so throughout her monthly path. When her (celestial) longitude is identical with that of the sun, she is said in the almanacs to be "New": when such longitude differs 90° from the sun's towards the east she is in her "First quarter": when they are separated by 180° the moon is "Full": and when she has travelled to that point in her orbit in which she is 90° to the west of the sun she is said to be in her "Last quarter"; in each case it being assumed that she is viewed from the Earth's centre. The use of the word "change," then, in connection with her position in these four points of her orbit, is a solecism, pure and simple. If, though, we now look at the table above, and assume, temporarily and for the purpose of argument, that a "change" of some sort actually does take place, let us see where its predictions will land us. It gives, it will be observed, prognostications of the weather alleged to be incident upon the time of the Moon's changes; but, unfortunately, the Earth turns on her axis in 24 hours of sidereal time—*i.e.*, in 23h. 56m. 4·09s. of our ordinary time, which time is derived from the Sun, and as this turning takes place from west to east, when it is noon at Greenwich it must be 1h. p.m. at any station 15° east of our National Meridian, and 11h. a.m. at any point 15° west of it. Let us take a hypothetical example and see how this will operate. We will imagine that the Moon is New at 1h. 50m. in the early morning at Greenwich on any given day in summer. Well, as this is between 12h. and 2h. in the morning, we ought, according to our table, to have the weather "Fair." Now Berlin is 53m. 35s. east of Greenwich, and hence the local time of new moon at the last-named place will be 2h. 43m. 35s. a.m. But this is, obviously, between 2h. and 4h. in the morning, when a "change" brings "cold, showery" weather! We have only to trace similarly the alleged effects of the lunar phases right round the 24 hours, or 360° of longitude, to show in what an utterly hopeless mass of contradiction such a theory will land us. That the same moon should at the same moment produce diametrically opposite weather in England and in Prussia has only to be stated to show its naked absurdity. We have said above that Sir William Herschel's name was, and occasionally still is, attached to the table on which we have been commenting. Here is a denial of that most eminent astronomer's, extracted from Vol. XXXIV. p. 237, of the *Philosophical Magazine*.

"Many of the public papers, for a length of time past, have occasionally ascribed certain predictions of the state of the weather to me, and several of them have lately gone so far as actually to prefix my name to what they have called a 'Weather Table,' in which, according to certain changes of the moon, wind, rain, snow, frost, &c., are prognosticated. Such a table, by some mistake, has even been very lately inserted in a very respectable philosophical magazine. In justice to myself, therefore, I think it highly necessary that the public should be undeceived by my declaring that the table pretended to be of my construction, as well as every prognostication of the state of the weather that has appeared in the newspapers, as ascribed to me, are all gross impositions.

"WILLIAM HERSCHEL.
"Slough, near Windsor, Sept. 16, 1809."

We may add that we have also seen this table ascribed to Dr. Adam Clarke; but the late Admiral Smythe alleged that it was a mere piracy from an out-of-the-way work, "Curiosiora et Selectiora Variarum Scientarium Miscellanea," by Martin Szent-Jvany.

"But," we have heard people say, "as the moon influences the tides, why should it not affect the atmosphere too?" To which the immediately obvious reply is that the tides are a semi-diurnal phenomenon; so that, on this principle, the weather ought to change twice a day also! A conclusion too ridiculous to be entertained. Nevertheless the moon *does* influence the atmosphere by causing the production in it of tides so minute as, under ordinary cirumstances, to be masked by other fluctuations. The existence of these atmospheric tides was first definitely established by the observations of the late Professor Daniell, made on Boxhill, in Surrey. It is pretty evident that observations made merely at the sea-level would not suffice for the detection of such tides, because, of course, the moon, as it were, in piling up a higher column of air beneath her would also attract it; and opposing such attraction to that of the earth, *pro tanto* diminish its weight (and that of the heightened column of mercury in the barometer.) But if the tide exists, the upward diminution of pressure ought to be slower under the moon; and, as a matter of fact, Daniell found, from observations made when the moon was near the meridian, that his barometers at the top and at the bottom of Box Hill, read more nearly together than when she was close to the horizon. If though, we must reiterate, these minute tides influenced the weather in the slightest degree, it must change twice a day—a supposition too ridiculous to merit further notice.

A curious kind of superstition in connection with the moon and the weather prevails pretty extensively, in the shape of a belief that when the young moon is "lying on her back"—in other words, when the line joining her cusps is nearly or quite parallel to the horizon, she is "holding water," and rain will certainly follow. . . . How this idea arose, it would be idle to speculate; but the explanation of the phenomenon itself is sufficiently simple. In the outset, the moon is never much more than 5° either to the north or south of the Ecliptic, or apparent annual path of the Sun through the heavens. Now the line adjoining her cusps (the sharp points of her crescent) is always square to a great circle passing through the sun and moon. Two minutes' study of a celestial globe will show how variable is the inclination of the Ecliptic to the horizon, and consequently that of the line joining the cusps of the moon also. Early in March, after sunset, and at the end of September, before sunrise, the inclination of the Ecliptic to the horizon is some 62°. Hence, if the moon were in the Ecliptic, the line joining her cusps would be inclined about 28° to the horizon. If, though, we suppose her to be at her greatest distance north of the Ecliptic, the great circle passing through her centre and the sun's may be inclined 10° (or even more than this according to her age), with the result that if very young, the line joining her cusps may be parallel to the horizon. When this condition of things obtained at the end of last February, all meteorological observers will remember how the popular idea that it is indicative of wet weather, was falsified.

Finally, the most elaborate comparisons of meteorological records made in France and in this country (in which the Greenwich observations for forty years were carefully collated with the moon's phases during that period) have sufficed to show that no connection whatever exists between them. The solitary observable effect of the moon upon our atmosphere was believed by Sir John Herschel to be exhibited in the tendency to disappearance of cloud under the Full Moon ("Outlines of Astronomy," p. 285), and this he attributed to the heat radiated from her surface.

REVIEWS.

The Mechanics of Machinery. By ALEX. B. W. KENNEDY. London: Macmillan and Co.

THIS work has been some time in preparation, and portions even in type for several years, as it is based on the lectures delivered from time to time by Prof. Kennedy to the students in his classes at University College. That fact will account for the methods adopted in treating special subjects, which might have been modified if the work of other professors could have been utilised. The volume deals with the mechanics of constrained motion, and is a notable addition to the series of "manuals for students' issued by the publishers. The first six chapters deal with problems which are in reality geometric; but chapter seven introduces the dynamics of mechanism, and then Prof. Kennedy found himself obliged to choose between the adoption of some system of absolute units, or the use of the word "pound" as the name for a unit both of weight and of force. He has, as we think wisely, retained the pound, and thus made his work more acceptable to engineers than it

VOL. XLV.—No. 1,153.

otherwise would have been, though there are some other teachers who will fail to agree with him. As the translator and editor of Reuleaux's great work, it is natural for Prof. Kennedy to adopt the system of analysis set forth in the "Kinematics" of the Berlin professor, and his first few chapters are mainly a summary of Reuleaux; but those which follow are based on entirely different lines, and are the result of Prof. Kennedy's practical experience as a teacher. Wherever it is possible the graphic method of treating a problem is adopted, because engineers and students can as a rule use drawing instruments, while few are familiar with analytical mathematics. The notes on wheel teeth and gearing might be studied with advantage by many who now work by rule of thumb, and not a few will read with attention Prof. Kennedy's section on disc engines, in which he describes those remarkable devices—the Tower and the Fielding engine (the latter is fully illustrated in No. 1,066). In the chapter on Friction, the author commences by treating the subject in the familiar manner, but says subsequently that engineers have to deal with lubricated surfaces moving with high velocity and under varying pressures, in which conditions the "laws" of friction not only are not true, but fail to represent approximately the more complex phenomena with which they have to deal. Throughout the work Professor Kennedy has endeavoured to place the various subjects before the student in the scientific manner, and if readers cannot understand at first, they will do well to persevere until they comprehend the full meaning, for a little learning of the kind is worth more than all the rules of thumb known in the workshop. For that reason we commend Prof. Kennedy's book to the attention of machinists and all interested in the study of machinery.

The Portable Engine. By WILLIAM DYSON WANSBROUGH. London: Crosby Lockwood and Co.

THE author of this work tells us that in Trevithick's engines (*circa* 1803) we have the essentials of the portable engine, which was first seen as an engine upon wheels at the Royal Agricultural Show held at Liverpool in 1841. With that invention, a rotary disc engine, constructed by Ransomes and Sims, of Ipswich, under a patent obtained by Mr. Henry Davies, of Birmingham, the history of the modern "portable" commences. It had a vertical boiler carried upon a single pair of wheels, and could be drawn by one horse. The crank-shaft was fitted with a universal joint coupling it direct to the threshing-machine. This engine received the warm commendation of the judges; but much difficulty was experienced in overcoming the prejudices and the fears of the farmers, who naturally without experience objected to the introduction of a steam furnace to their rickyards. Makers, however, continued to persevere, and by means of successive improvements brought the portable engine to a high degree of perfection. Little improvement has, however, been made since 1872, and, indeed, the portable engine of to-day is in all essential features identical with that of twenty years ago. Mr. Wansbrough's work is an excellent textbook of this useful form of engine, for while it describes with all necessary minuteness the details of various devices, it is free from a suspicion of recommending any one maker's productions, or of pretending to select an engine from amongst the many competitors now in the market. Proceeding in a business-like way, which commends itself to the reader desirous of obtaining information, Mr. Wansbrough commences with an elementary description of the high-pressure steam-engine and the locomotive type of boiler, in which he contrives to convey an accurate idea of the working of the apparatus in a remarkably clear manner. That is followed by a chapter entitled "Units of Connection," in which various fastenings and connections are illustrated and explained. Then we have the "construction" of the engine with its accessories, and ditto of the boiler, followed by a chapter on the slide-valve and its action, in which use is made of the Zeuner diagram. This chapter, and that on the Indicator Diagram, will be useful to many who are not specially interested in portable engines, the illustration showing an indicator diagram in seven different positions; that is, in the process of being drawn, rendering the matter clear to a student possessed of only average intelligence. The chapter on "Hints to Purchasers" contains a good deal of common sense and practical wisdom, and completes a manual which may be recommended to the attention of all users of portable engines, and to buyers and owners of steam-engines generally. The book is freely illustrated with plates and illustrations.

The Steam-Engine. By GEORGE C. V. HOLMES. London: Longmans.

THIS is one of the well known series of Textbooks of Science issued by Messrs. Longman and Co., and covers the whole field expressed or understood by the title "Steam-Engine." The author is a Whitworth scholar, and secretary of the Institution of Naval Architects; he is aware of the need for an elementary textbook dealing in a manner suited to the abilities of beginners, with subjects intimately connected with the steam-engine as an economical means of obtaining motive power, and he has accordingly dealt at some length with the modern science of thermodynamics, or the fundamental principles underlying all practice in connection with heat engines; with the effects produced by the inertia of reciprocating parts on quick-running engines; with the geometrical methods of dealing with slide-valves; and with the methods for diminishing the losses of efficiency in expansive engines—e.g., superheating, steam-jacketing, and compounding. The author has availed himself freely of the information to be found in such classic works as those of Rankine and Cotterill, of Zeuner and Clerk-Maxwell, as well as in the *Transactions* of the societies which devote attention to the subject: the result is a textbook in which the student will find all the information he needs to give him a comprehensive understanding of the nature of the steam-engine in theory and practice, and to prepare him for taking up the more elaborate treatises on branches of the subject. The author has not assumed that his readers have any acquaintance with the sciences of heat and motion; but they will require a knowledge of elementary mathematics and geometry to follow him. Examples are given in the text, where it is advisable, to explain as fully as possible, and at the end of the work there is a long list, which will serve as exercise questions and a means of testing the knowledge acquired by the student. The volume contains more than 200 figures and diagrams, and is an excellent addition to the series of which it forms a part.

Arc and Glow Lamps. By JULIUS MAIER, PH.D. London: Whittaker and Co.

ALTHOUGH the title of this work would apparently limit it to a description of the various lamps used for electric lighting, it is in reality a practical handbook containing an account of the now numerous inventions employed, with the exception of dynamos, which are described only in principle, with a section devoted to their efficiency and application to electric lighting. Dr. Maier is an advocate of the new light, which he says has proved its superiority over gas in every point except that of price; but he is fain to confess that "so long as dynamos, steam or gas-engines, accumulators, primary batteries, in their present form, are employed for generating electricity, gas will maintain its monopoly, people's eyesight will suffer, their blood will be poisoned, their existence during a considerable portion of their lives will be rendered miserable by our present methods of lighting." The volume belongs to the "Specialists' Series" issued by the publishers, and contains a brief but sufficient description of nearly all the modern appliances used for electric-lighting, with much useful information for those who contemplate experimenting with the best substitute for gas; but it should be clearly understood that the electric light is more expensive than either gas or mineral oil. It has advantages which in certain circumstances compensate for its extra cost.

Practical Electricity. By W. E. AYRTON, F.R.S. London, Paris, New York, and Melbourne: Cassell and Co.

We have previously referred to this work as the best of its kind, for it is a laboratory and lecture course for first-year students of electrical engineering based on the practical definitions of the electrical units. Electricity is a science which demands a great deal of experiment or laboratory practice from a student who would grasp comprehensively its main principles, and although this volume contains over 500 pages, it comprises, with some additional matter, only the substance of a first year's course. Prof. Ayrton intends, we imagine, to follow it with other volumes, giving the second and third year's work of the complete course for students of electrical technology which he has developed; but be that as it may, the present work will be found useful by teachers as a basis of a practical course of instruction, and students who can afford to make or purchase some of the more useful apparatus—especially measuring instruments,—will be able to follow the course with advantage, even in the absence of laboratory instruction. In many cases directions are given for making the apparatus, but in every sense the work is a treatise, as its title claims, on *practical* electricity.

WE have also received *Electricity in the Treatment of Disease*, by JAMES R. TUNMER, M.R.C.S. (London: E. W. Allen), a trustworthy guide to the use of the current in therapeutics; giving an account of what electricity will accomplish, from the practical experience of the author and other well-known physicians and surgeons.——*Jarrold's Norwich Almanack and Directory* (Norwich: Jarrold and Sons) is a model of a local directory, full of information about the eastern counties.——*The ABC of Modern (Dry-plate) Photography* (London: Stereoscopic and Photographic Co.) is a new and greatly enlarged edition of a well-known manual of the popular art, containing illustrations of specimens from the Amateur Photographic Exhibitions promoted by the company.——*Complete Handbook on the Management of Accumulators*, by Sir DAVID SALOMONS, Bart. (London: Whittaker and Co.), is the second edition, revised and enlarged, of a valuable little book written by one who has had much practical experience in the actual working of accumulators. The frontispiece is a photograph of the interior of the accumulator house at Broomhill, with smaller pictures of the engine-house, boiler-house, dynamo and engine-rooms, laboratory, Broomhill, and a portrait of Sir David. The little book is invaluable to those about to commence their experience with accumulators.——*Practical Electric Lighting*, by A. BROMLEY-HOLMES (London: E. and F. N. Spon), is the third edition of the useful manual to engineers and others connected with electric lighting.——*Dynamics for Beginners*, by the Rev. J. B. LOCK (London: Macmillan), explains the ele-entary principles of dynamics in a anner easily understood by those possessed f ordinary mathematical attainments. There re a number of examples, with questions rom examination papers and the answers. —*Reports on the Colonial Sections of the xhibition*, edited by H. TRUEMAN WOOD, A. (London: W. Clowes and Sons), is a ollection of the reports made on the exhibits t the recent "Colinderies," which may be of ome use. They have been prepared under e supervision of the Council of the Society f Arts.——*An Introduction to Machine rawing and Design*, by DAVID ALLAN LOW London: Longmans), is a useful work for ose who desire to acquire the skill and know- dge necessary for making working drawings —that is, for those who are seeking to enter e drawing office.——*Chemistry for Be- inners*, by R. L. TAYLOR, F.I.C., F.C.S. London: Sampson Low and Co.), is an in- roduction to the study of the science in- nded primarily for the elementary stage of e S. and A. examinations.——*The Mystery f Gravity*, by J. FRASER, C.A. (London: yman and Sons), is a thoughtful tractate n a rather puzzling subject.——*Beginner's uide to Soldering*, by HERBERT JONES Liverpool: G. Ellams), will be found useful y those who wish to learn the details of the rt of soldering.——*A Photograph, and How Take It* (London: Horne, Thornthwaite, nd Wood), is a pamphlet and price-list, n which a great deal of information compressed into a small space.——*Manual of Practical Solid Geometry*, com- iled by W. G. ROSS, Major R.E. (Cassell nd Co.), is adapted to the requirements of ilitary students and draughtsmen by the ofessor of geometrical drawing and forti- ation at Woolwich.——*The Manual of rication*, by LOUIS SIMPSON (Manchester: Andrew and Co.), will be found a useful ide by those who have to purchase lubri- ts for machinery.——*Exercises in Wood- rking*, by W. C. UNWIN, F.R.S. (London: gmans), is a set of drawings for use in dicraft classes and in elementary and hnical schools. It will be found admirably pted for its purpose, as it covers a good al of the work of the pattern shop, as well much of that daily done by the carpenter d joiner.——*Science in a Petroleum Lamp*, W. K. FULLEYLOVE (Birmingham: J. G. mmond and Co.), is a readable brochure, owing how much of interest can be made of so simple a thing as an ordinary affin lamp.——*Elementary and Advanced riptive Geometry*, by W. S. BINNS, F.S.Sc. London: Simpkin, Marshall, and Co.) is a ful treatise by the author of a "Course Geometrical Drawing" which met with siderable favour. The chapter on Graphic ithmetic will be welcomed by many dents.

have also to acknowledge the receipt of *y to Engines and Engine Running*, by JOSHUA OSE (London: Sampson Low and Co.); *The Geology of England and Wales*, by RACE B. WOODWARD, F.G.S. (London: Philip and Son);—and *The Electric Motor its Applications*, by T. C. MARTIN and WETZLER (London: E. and F. N. Spon).

ELECTRIC LOCOMOTION.

THERE can be no doubt that if it were not for the red tape which hampers every prise in this country we might by this e have had more practical experience of the ity of electric locomotion than we can in from the successful experiments at kpool, Brighton, and at Port Rush in nd. In the United States electric tram- are at work in many of the larger cities, reparations are being made for widely ding the new method of traction; while e Continent of Europe there are at least tramway schemes which are not only ically but financially successful. So long s May, 1881, an electric tramway was opened near Berlin, and traffic has been regularly carried on during the six years, without a mishap of any importance, although the average speed is twelve miles an hour, and 100,000 passengers are carried annually. The line has always been regarded more as an experiment than as a type to be permanently adopted, and for that reason cars with different kinds of gearing have been tried, not for a few months, but in regular work for several years in order to test the durability of the mechanism adopted. It is well known that to obtain a high degree of economy an electro-motor must run with great velocity, which must be greatly reduced by the time its motion is transmitted to the driving axles of a tramway car; methods of doing that form the subjects of several patents, and it may be that the best arrangement has not yet been devised. In a highly-interesting paper on the subject read last week before the Society of Arts by Mr. Reckenzaun, a gentleman practically acquainted with all the minute details of electric locomotion, the author said it seems an easy thing to the uninitiated to reduce 800 revolutions of one shaft to 80 of another; but when it has to be done in connection with a tramcar, a vehicle on which space is limited, noise objectionable, and dirt and dust in abundance, one obstacle after another crops up to disappoint the inventor who imagines he has solved the problem. On the Berlin-Lichterfeld line one of the cars has run 76,000 miles since the opening, and has pulleys on the motor shaft and car axles with V-grooves in which run cords of spiral steel wires. The cords are made by winding a pair of wires closely on a mandrel rather less than ¼in. in diameter, so that the finished "cord" is a flexible spiral having an external diameter of barely 7-32 of an inch. This device, it seems, works without noise or vibration, though some little difficulty is experienced in adjusting the "cords" upon the pulleys; for if too tight they will break at the joints, and if too loose slip at starting—not a disadvantage, as that is the most trying moment in all gearing driven by electromotors. Other devices are employed, such as the pitch-chain, but the spiral cords seem to be the best. On Mr. Volk's line at Brighton, belts made of leather links are used; the armature shaft, with a 5in. pulley, driving a countershaft with a 24in. pulley, from which the belt is taken to the driving axle. The belts slip a little at starting, but that eases the motor; while, if necessary, the countershaft being carried in adjustable bearings, the belts can be made as tight as desired. The expense per car mile of this line, the prime mover of which is a gas-engine using gas at 3s. 3d. per 1,000 cubic feet, is only 2d.—a figure which is below that which Mr. Reckenzaun gives as possible when the most efficient machines are employed—viz., 3d. The Brighton arrangements are, however, scarcely suitable for ordinary tramcar traffic, as there is no mud to contend with, and the ordinary rails serve as conductors of the current. It should also be noted that each car last year made no fewer than 23,475 miles, and but for opposition in certain quarters the Brighton electric tramway would be a success in every sense of the term. Of lines worked by overhead-conductors the most carefully constructed, if not the most important, is that arranged on the plan of Messrs. Siemens and Halske at Mödling, near Vienna. It is nearly three miles in length, and, like most other electric tramways in Europe, does nine-tenths of its traffic between April 1 and the end of October, the average cost being 3·42d. per car mile. The average speed permitted is a little over nine miles an hour, and the conductors are slotted tubes carried on posts 18ft. high and 90ft. apart, except on sharp curves. The bore of these tubes has to be made perfectly smooth, so as to offer but little resistance to the passage of the contact carriage, which consists of a flexible piece of flat steel carrying three gunmetal pistons made in halves, with springs in the middle, so as to keep the surfaces of pistons and conductor in contact. The pistons require renewal about every two months. Overhead conductors are, however, scarcely suited for electric-tramway work, except in country districts, such as the line just referred to, or that between Frankfort-on-Main and Offenbach, which is 4·1 miles long, and has the slotted overhead tube, and a contact carriage made up of two solid iron pistons, which require renewal every three or four weeks at a cost of one shilling for each carriage. Both the Mödling and the Frankfort cars have spur gearing, and the experience gained with them is not favourable to the further utilisation of that means of connecting the motor shaft with the driving axles. For instance, in the Frankfort cars a pinion of 17 teeth on the motor shaft gears into a wheel of 56 teeth on a countershaft, and a pinion of 26 teeth on that drives a wheel of 52 teeth on the axle of the car, giving a ratio of about 6·6 to 1 between the motor and the car wheels. The motor, however, runs at the comparatively low speed of 500 revolutions per minute, and the whole arrangement is heavy, for the train of wheels weighs about 4cwt., and the total weight of the driving gear for one car is more than 26cwt. The gearing produces so much noise and vibration that the sensation experienced in the car is anything but agreeable, and the wear and tear are so great that the pinion on the motor shaft wears out in a month, although made of hard gunmetal. Mr. Reckenzaun says that one of the cars is being fitted with wheels having double helical teeth, which are expected to work more smoothly and be more durable; but it may be doubted whether any difference in the shape of the teeth will render toothed gearing tolerable, although it should be mentioned that nearly one million passengers patronised the Frankfort electric tramway last year in spite of the disagreeable noise made by the gearing. On the Port Rush line, the longest electric tramway in the world, pitch-chain gearing is used, and is stated to work satisfactorily, as it does also on the Bessbrook-Newry line. Both these lines are worked by electricity derived primarily from water power, and the cost is respectively 8d. and 4d. per car mile, in the latter case including everything. Mr. Reckenzaun referred briefly to the Blackpool line, and mentioned the systems devised by Profs. Ayrton and Perry, and by Messrs. Pollak and Binswanger, the former having the "third rail" divided into sections, the connection with the main cable being made automatically by the train as it moves along; and the latter an altogether novel system, in which a powerful magnet under the car attracts, or is supposed to attract, an iron armature in a thoroughly insulated trough beneath each rail section, which armature when attracted makes contact between the cable and the surface rail, and through the latter with the switch of the car motor. Both systems are ingenious and worth trial; but at present no opinion can be formed of their efficiency, as they exist only on paper. So far, we have referred only to lines in which the current is conveyed from a central station to the car throughout the whole length of the tramway; but batteries carried by the car itself are a much earlier device, having been adopted so long ago as 1839, when, of course, they were too expensive, the secondary or storage cell not having come into knowledge then. In order to compare the two systems, Mr. Reckenzaun estimates the efficiency of the conductor and of the secondary battery in the following manner. Taking the tramway at Mödling, the conductor has 2 ohms resistance, 20 ampères of current for each car, and 500 volts E.M.F. at the terminals of the charging dynamo. Supposing only one car running on the line, the waste of energy will be practically nothing at the commencement of its journey; but it will be $20^2 \times 2$ when it approaches the furthest end of the line; the average resistance—that due to half the length of the conductor—is 1 ohm, therefore the average loss is only $20^2 \times 1 = 400$ watts against $500 \times 20 = 10,000$ watts generated by the dynamo, or a loss of 4 per cent. With six cars on the line equally distributed, however, using 120 ampères, the loss will be 14,400 watts out of 60,000, or 25 per cent.; and so by increasing the number of cars and the current the efficiency becomes less and less. With the accumulators the loss is constant, no matter how long the line, provided the quantity of stored energy is sufficient for the time, and it matters not how many cars run at the same time on the tramway. The weight to be propelled would be increased, which would entail a corresponding augmentation of power, and therefore a greater consumption of fuel would be the result. But fuel really plays a small part in the total expenditure, and viewed from the standpoint of convenience the propulsion of tramcars by means of secondary batteries is the best system that can be adopted, especially in towns, because it leaves the permanent way in its present simple state. Whether each car should carry its own battery and motor, or an electric locomotive should be used for hauling cars, will depend on circumstances; but so far as the neighbourhood of London is concerned, it appears that the electric locomotive will be the first system tried, for trips have already been made with the Elieson locomotives on the Romford-road out of Stratford, and we presume they will soon be put into regular work. The locomotives and the secondary batteries are ready, and but for the roundabout methods of the Legislature would have been earning money and conveying passengers long ago. These locomotives weigh "road-worthy" something like seven tons; what they will do in the way of hauling cars remains to be proved, but there is not much doubt that they will be cheaper than horseflesh, and it is certain that they will leave the road as clean as they found it—a point which should not be forgotten in comparing the respective merits of horse and mechanical traction. Sufficient has already been done to show that the cost of electric tramways need not exceed 4d. per car mile, whereas horses cost from 7d. to 10d.; so taking the lowest estimate there is a saving of one-half, and probably when experience has enabled managers to rub off items which can be dispensed with, the economy may be still more. As to the gearing for transmitting the power. Mr. Volk believes in the linked leather belts, but Mr. Reckenzaun and others consider the worm arrangement the best; on this point the mechanicians may have something to say, for if electric tramcars are to be introduced it will not be either the noise or the vibration produced by the gearing that will long remain an objection. It may be that the spiral wire cords adopted and used for some time on the Berlin line will be found the best arrangement; but it is certain that spur gearing will not do, because however smoothly it may run when new, it rapidly deteriorates and makes so much noise as to be decidedly objectionable. If the electricians can, however, place electric tramcars on our roads, the gearing will not long be a source of trouble to them, for there are many methods of transmitting motion which are free from noise, which only await a favourable opportunity for asserting their superiority—in the circumstances.

ASTRONOMICAL NOTES FOR MAY, 1887.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination North.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 57 0·18 AM	2 33 24	15 3 52	2 36 23·52
6	11 56 28·82 „	2 52 35	16 31 27	2 56 6·29
11	11 56 11·46 „	3 12 0	17 52 9	3 15 49·07
16	11 56 8·77 „	3 31 41	19 5 25	3 35 31·84
21	11 56 20·58 „	3 51 35	20 10 38	3 55 14·62
26	11 56 45·93 „	4 11 43	21 7 15	4 14 57·40
31	11 57 23·08 „	4 32 3	21 54 47	4 34 40·18

The method of finding the Sidereal Time at Local Mean Noon at any other station will be found on p. 382 of Vol. XLIV.

It is hardly worth the while of the observer to continue to watch the Sun for the very rare spots that appear on his disc. After the 22nd there will be no real night in any part of the United Kingdom, as the Sun never descends 18° below the horizon even at midnight.

The Moon

Is Full at 2h. 1·3m. in the afternoon of the 7th, and Enters her Last Quarter at 8h. 17·4m. p.m. on the 14th. She will be New at 11h. 5·4m. p.m. on the 22nd, and enter her First Quarter at 5h. 19·7m. in the early morning of the 30th.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.
			h. m.		°	°	h. m.		°
4	γ¹ Virginis	2½	12 25 p.m.	Dark	114	141	1 8 a.m.	Bright	199
5	B.A.C. 4277	6	1 40 a.m.	Dark	152	186	1 46 „	Bright	165
5	ι² Virginis	5	†9 30 p.m.	S.S.W.	334	323			
8	γ Libræ	4½	†1 4 a.m.	N.N.E.	162	168			
13	π Capricorni	5	3 35 „	Bright	107	93	4 57 a.m.	Dark	274
19	29 Ceti	6½	‡2 52 „	Bright	101	63	3 50 „	Dark	299
29	45 Leonis	6	8 37 p.m.	Dark	38	69	9 34 p.m.	Bright	278
29	ρ Leonis	4	11 10 „	Dark	49	88	12 2 „	Bright	272
30	σ Leonis	4	7 46 „	Dark	139	152	8 6 „	Bright	171

† Near approaches. ‡ Moon has not risen. A description of the construction and use of table, with an illustration, appears on p. 383 of Vol. XLIV.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.
3	III	Tr I	9	30	p.m.	13	*I*	*Oc D*	2	59	a.m.	22	I	Ec R	2
3	III	Sh I	10	30	„	13	I	Tr I	12	10	p.m.	22	*I*	*Tr I*	8
3	III	Tr E	11	5	„	13	I	Sh I	12	41	„	22	I	Sh I	9
3	III	Sh E	12	29	„	14	I	Tr E	2	22	a.m.	22	I	Tr E	10
4	*II*	*Tr I*	3	32	a.m.	14	*I*	*Sh E*	2	54	„	22	I	Sh E	11
4	*II*	*Sh I*	4	7	„	14	*II*	*Sh I*	7	58	p.m.	23	*I*	*Ec R*	8
5	*I*	*Tr I*	3	59	„	14	I	Oc D	9	25	„	28	III	Oc D	9
5	II	Oc D	9	55	p.m.	14	II	Tr E	9	26	„	28	III	Oc R	11
6	II	Ec R	1	8	47 AM	14	II	Sh E	10	34	„	28	II	Tr I	11
6	I	Oc D	1	14	„	14	I	Ec R	12	7	16 „	28	III	Ec D	12
6	*I*	*Ec R*	3	44	45 „	15	I	Tr E	8	48	„	28	I	Oc D	12
6	I	Tr I	10	25	p.m.	15	I	Sh E	9	22	„	29	II	Sh I	1
6	I	Sh I	10	47	„	20	*II*	*Oc D*	2	30	a.m.	29	*II*	*Tr E*	2
6	I	Tr E	12	37	„	21	I	Tr I	1	36	„	29	*III*	*Ec R*	2
6	I	Sh E	12	59	„	21	*I*	*Sh I*	2	36	„	29	I	Tr I	10
7	*I*	*Oc D*	7	40	„	21	*III*	*Ec D*	8	46	12 PM	29	I	Sh I	11
7	*II*	*Sh E*	8	0	„	21	II	Tr I	9	9	„	29	I	Tr E	12
7	I	Ec R	10	13	14 „	21	III	Ec R	10	28	55 „	30	I	Sh E	1
10	III	Tr I	12	47	„	21	II	Sh I	10	33	„	30	II	Ec R	10
11	III	Tr E	2	27	a.m.	21	I	Oc D	11	10	„	30	I	Ec R	10
11	III	Sh I	2	29	„	21	II	Tr E	11	42	„				
12	II	Oc D	12	12	p.m.	22	II	Sh E	1	8	a.m.				

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Dis ance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in indicates that its visibility is rendered doubtful, either by the brightness of the twil by Jupiter's proximity to the horizon.

The Moon.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	8·1	6 58·8 p.m.
6	13·1	11 29·7 „
11	18·1	3 14·6 a.m.
16	23·1	7 17·7 „
21	28·1	10 51·8 „
26	3·5	3 6·2 p.m.
31	8·5	7 33·0 „

The Moon will be in conjunction with Jupiter at 8h. a.m. on the 6th; with Mars at 7 a.m. on the 22nd; with Mercury an hour later; with Venus at 8h. a.m. on the 26th; and with Saturn at 5 o'clock the same afternoon.

Mars

Is absolutely invisible.

Mercury

Is a Morning Star up to the 27th, at 2 p.m. on which day he comes into superior conjunction with the Sun, after which he passes behind the Sun and becomes an Evening Star. It is needless to add that it is only at the beginning of May that the observer will have a fair chance of seeing the planet properly, if at all. His diameter decreases from 6·4″ on May 1st to 5″ by the 23rd; so that he really only appears as a large star in the telescope.

Mercury.

Day of Month.	Right Ascension.	Declination North.	Sou
	h. m.	° ′	h. m
1	1 5·9	3 58·7	10 29
6	1 34·4	7 7·8	10 38
11	2 6·2	10 37·0	10 50
16	2 41·9	14 17·6	11 6
21	3 21·8	17 56·2	11 26
26	4 5·7	21 12·5	11 50
31	4 52·3	23 41·6	0 17

It will be seen, from the above eph that Mercury, starting from a point to t of Piscium, will travel through the ren of Pisces, cross the Northern outlying Cetus, traverse the entire width of Arie considerable part of Taurus, being som like half-way between Aldebaran and on the 31st. He will be in conjunctio Mars at 4 a.m. on the 22nd, and only 27 of that planet; and also with Uranus night on the 23rd.

Venus

Is an Evening Star throughout May. now very notably gibbous, and her di increases from 13·4″ on May 1st to 16″ last day of the month. She does not se about a quarter to 11 on the night of t and by the end of May it is somethin 11h. 20m. p.m. ere she disappears beh

. She is a most conspicuous object after ver the W. by N. and W.N.W. points of

Right Ascension.	Declination North.	Souths.
h. m.	° ′	h. m.
4 58·0	24 16·3	2 21·2 p.m.
5 23·8	24 57·8	2 27·3 „
5 49·7	25 22·1	2 33·5 „
6 15·5	25 28·9	2 39·6 „
6 41·2	25 18·3	2 45·5 „
7 6·5	24 50·7	2 51·0 „
7 31·3	24 6·8	2 56·1 „

nencing at a point approximately half- tween Aldebaran and β Tauri, Venus vel through the rest of Taurus and very across Gemini, during May. She will wever, approach any conspicuous star in constellation. She will be in conjunc- th Saturn (2° 15′ N. of him) at 5 p.m. on h.

Jupiter

e the horizon during the entire working f the ordinary amateur, rising in bright it and setting in the twilight preceding . On account, though, of his South tion, he should be observed as near to eridian as possible. His angular equa- iameter decreases from 41·4″ on May 1st by the 31st.

Right Ascension.	Declination South.	Souths.
h. m.	° ′	h. m.
13 52·5	9 58·7	11 14·3 p.m.
13 50·2	9 46·6	10 52·3 „
13 48·0	9 35·2	10 30·5 „
13 46·0	9 24·7	10 8·8 „
13 44·2	9 15·4	9 47·3 „
13 42·6	9 7·4	9 26·1 „
13 41·2	9 0·7	9 5·0 „

nat Jupiter seems to travel through a region in Virgo, in the direction of Spica s.

Saturn

approaching the West so rapidly that it be looked for the moment it is dark to be seen at all. For this reason our eris only extends to the middle of the , as it would be a mere waste of space to for the latter half of May.

Right Ascension.	Declination North.	Souths.
h. m.	° ′	h. m.
7 15·3	22 20·8	4 38·1 p.m.
7 17·0	22 18·1	4 20·1 „
7 18·8	22 15·2	4 2·3 „

ce, while Saturn continues visible, he will nd close to, but moving away from, δ orum. The Eastern Elongations of his tes are, of course, invisible.

Uranus

e looked for immediately it is dusk to be ly well observed, as at the end of the he is only on the meridian at sunset.

Right Ascension.	Declination South.	Souths.
h. m.	° ′	h. m.
12 34·9	2 59·0	9 56·9 p.m.
12 34·3	2 55·3	9 36·7 „
12 33·8	2 51·9	9 16·5 „
12 33·3	2 48·9	8 56·3 „
12 32·8	2 46·4	8 36·2 „
12 32·5	2 44·3	8 16·2 „
12 32·2	2 42·6	7 56·2 „

vill be gathered, from the above ephe- that Uranus describes a very short retro- arc to the S.W. of γ Virginis.

Neptune

Comes into conjunction with the Sun at 8 p.m. on the 18th, and is, of course, absolutely invisible.

Shooting Stars

Are decidedly rare in May. The night of the 18th is the most likely one to observe them upon.

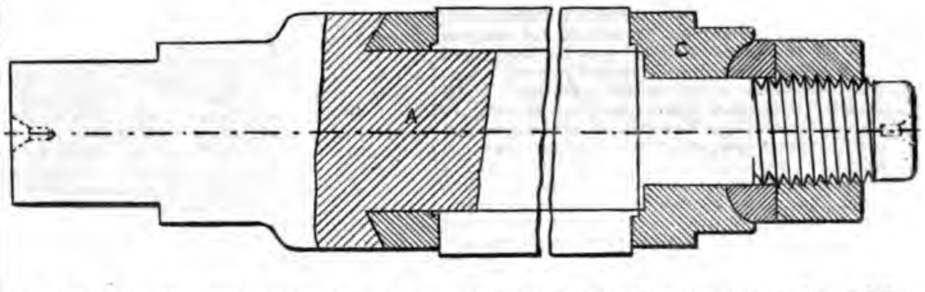
Greenwich Mean Time of Southing of Ten of the Principal Fixed Stars on the Night of May 1st, 1887.

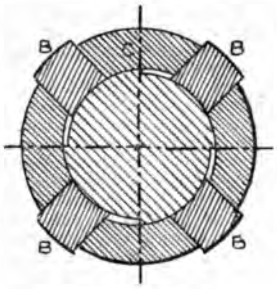
Star.	Souths. h. m. s.
α Ursæ Majoris	8 19 0·24 p.m.
δ Crateris	8 35 54·40 „
ε Corvi	9 26 23·79 „
γ¹ Virginis	9 57 55·61 „
α Canum Venaticorum ...	10 12 41·63 „
Spica Virginis...	10 41 7·13 „
η Ursæ Majoris	11 4 54·11 „
Arcturus	11 32 14·63 „
α Libræ...	12 6 16·62 „
α Coronæ	12 51 25·49 „

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above List for any other night in May, as also that of determining the Local instant of its Transit at any other Station, will be found on p. 384 of Vol. XLIV.

PHILLIPS'S IMPROVED MANDRELS.

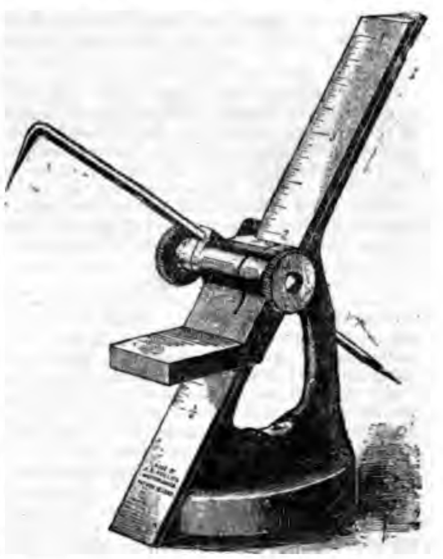
THE improved mandrel shown in the annexed engravings is intended for use in cases where it is desired to hold bored objects in order that their peripheries or faces may be turned. It has been recently patented by Mr. C. J. Phillips, of Alston-street, Birmingham, who describes his improved device as being applicable either to mandrels running between the lathe centres or flanged for bolting to face-plates. The body of the mandrel A has three or more parallel eccentric grooves cut in it parallel to its axis. In the grooves thus formed rectangular keys B B B B are fitted and held in place by a sleeve C having longitudinal slots which hold the keys. Through the sleeve passes the mandrel body A threaded at one end to receive a nut, so that by moving the sleeve diametrically on the mandrel body the keys, which at their lowest range are flush with the surface of the sleeve C, are expanded or contracted, and are kept in position by the nut on the threaded portion of the mandrel body.





NEW PLANER AND SURFACE GAUGE.

THIS little tool is one we should think every machinist, and especially those working on planers or shapers, or at die sinking and similar work, would find a valuable addition to their stock of small tools. It consists essentially of a sliding head accurately fitted to a guide standing at an angle to the base of the tool. Upon the front of this head is a shelf projecting at right angles to the base, and projecting slightly above the surface of this shelf is a steel plug hardened and ground. The guide is accurately graduated to measure vertical distances—that is, the guide rising at an angle, the graduations are enough further apart to compensate for the angularity. There is a gauge mark on the head, and bringing this to the graduations on the guide, locates the top of the steel plug at the distance indicated from the bottom of the base. Setting the base on any surface and the tool to the plug gives accurate measurement, and very quickly. In addition to this, there is at one side of the head a surface gauge attachment. This is, however, entirely independent of the tool gauge, the head being tightened by one of the thumb nuts and the scriber by the other, so that there is no interference in this respect. When desired, the base is fitted with a spirit level. The manufacturer is Arthur B. Phillips, Whitman, Mass.—*American Machinist.*



THE MEDICO-LEGAL ASPECTS OF HYPNOTISM.*

A. BINET, one of the leading French authorities on hypnotism, has written an appreciative but critical notice of the work of Campili that gives an excellent view of the French and Italian standpoints regarding this subject, that is assuming so much importance there. Dr. Campili has had the advantage of numerous memoirs in France and elsewhere. M. Legeois has shown the possibility of making the hypnotic suggestion serve a criminal purpose, but has not discussed the subject. MM. Binet and Fere set themselves to determine the conditions under which the reality of the hypnotic suggestion may be admitted by a tribunal—the judicial proof, in other words. Dr. Campili presents the problem from the point of view of the two schools of criminologists in Italy, the classical or spiritualistic school and the anthropological school, which differ not only in their theoretical conceptions, but also in their practical conclusions upon the application of punishment. Upon the question of hypnotism, however, the two schools admit the same conclusion. Dr. Campili examines what the civil and penal responsibility of the hypnotised subject is when criminal acts have been committed or obligations have been assumed under the influence of a hypnotic suggestion. According to the classical legal school, the hypnotised subject is not responsible, since he has not committed a voluntary and conscious offence. There can be no punishment where there has been no fault.

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* By WILLIAM NOYES, in *Science.*

The anthropological school, which does not assume the subjective point of view, but considers that the judicial institutions have the simple function of social preservation and defence, arrives at the same conclusion, but by a different way. In a very detailed discussion the author arrives at the conclusion that the needs of social defence only demand the repression of criminal acts when these are the expression of the personality of the agent; and since in the hypnotic subject the individual reaction is abolished, the acts that he does under the influence of a hypnotic suggestion are simply those of an automaton. These conclusions are at least debatable, says Binet, and rest on premisses that contain an error of fact. The belief is too common to-day that it is possible to characterise the psychical state of hypnotism in a single word and say it is a condition of automatism. In a vast number of cases the subject preserves his intellectual and moral identity. When he receives a suggestion to act, he may resist if the act is in contradiction with his character, and he may examine the order, and even absolutely refuse to obey. Campili seems to have seen this difficulty, for he recalls that in an ingenious article M. Bouillier has admitted a moral responsibility in dreams, but he meets this objection with an argument of little weight, that the hypnotised subject does not preserve his personality in the same way that a sleeping person does. Binet holds, on the contrary, that the closest connection exists between the effects produced by suggestion and the state of dreaming. The hypnotic suggestion is nothing else than a dream produced and directed by assistants. In fact, the somnambulist is not an automaton, he is an *individual*, and from the purely theoretical and moral point of view he may be held partially responsible for his acts. These conclusions are in direct accord with those of M. Bouillier.

But what is the practical point of view? Has or has not society the right to defend itself against the crimes of hypnotism? Will it suffice for the assassin to show that he was under the influence of a suggestion for the judges to grant him his liberty and allow him to begin his work again? Clearly a uniform toleration is out of the question. Until recently hypnotism figured only accidentally in judicial proceedings, but now all this is changed, and hypnotic suggestion may readily enter into criminal proceedings. This is exactly what has happened in Turin, where, says Lombroso (*Revue Scientifique*, June 19, 1886), there is a veritable epidemic of hypnotism. Society must protect itself against such a danger. Gorfolo, in his remarkable work on *criminologie*, argues that we must apply to the criminal who has committed a punishable act in a state of hallucination or of somnambulism the same treatment that we give to those who have committed a crime in an epileptic or hysteric attack or from the effect of impulsive mania—that is, seclusion in a criminal asylum for an indefinite period until a complete cure is established, or until the patient passes into some other condition that renders a repetition of the act an absolute improbability.

Campili thinks that it would be difficult to apply the same punishment to a hypnotic criminal, since he did not commit the crime of his own accord, but under the influence of a third person, who is the true culprit. The hypnotic subject is simply an instrument of crime in the hands of the hypnotiser, the same as a revolver or a knife, as it is he who ought to bear the responsibility of the act. This is a subtle distinction. The hypnotic subject, like the epileptic, is a dangerous subject, a veritable *malade*, since he allows a very simple manœuvre to make him commit a crime. It is absolutely necessary to put him beyond the possibility of doing harm. Moreover, it is probable that the dread of punishment exercises a restraining influence over the minds of those who submit voluntarily to be hypnotised. In fact, Binet holds, many persons who are slightly hypnotisable may resist hypnotisation successfully, and ought to be responsible for consenting to submit themselves to the experiment. There is the strongest reason for this conclusion if the subject knows in advance, before going to sleep, that a criminal suggestion will be given to him.

There is one curious hypothesis that Campili has not anticipated, and one which well-known facts render extremely probable, and that is that we may find some day in some band of thieves or assassins a hypnotic subject who of his own accord yields himself to criminal suggestions. The usefulness of hypnotic suggestion under such circumstances is easily understood, for those who are under the control of a suggestion have more audacity, more courage, and even more intelligence than when they act of their own accord. There are patients who, dreading to be put to sleep by someone they dislike, offer to the hypnotic suggestion of one of their friends a power of resistance that they do not have naturally. Others, wishing to accomplish some act, and fearing that their courage will fail at the last moment, suggest themselves the act that they wish to do. In these circumstances the subject should be punished as the principal and the hypnotiser only as an accomplice. The Paris correspondent of the *Medical Record* writes last December that an epidemic of hypnotism prevails there, and he paints the prevailing distemper in exceedingly dark colours. Every steamer brings some new book on hypnotism or mental suggestion, and the amount of literature that has accumulated within the past year is enormous. Public exhibitions of hypnotism have been interdicted in Germany, Italy, and Austria. This is but one side of the shield, however, and brilliant therapeutical results have been reported by the skilled coteries of French physicians that has advanced our knowledge of hypnotism so much within the past few years. Yet on the whole, perhaps, it is a matter of congratulation that the more stolid American mind has been little affected by hypnotism up to this time, not even to the extent of furnishing sufficient subjects for the Society for Psychical Research. It may be that the "mind cure" is our cross, and at any rate the connection between this and hypnotism offers a promising field to the investigator.

ZINCOGRAPHY AND ZINCO PRINTING PLATES.

As these two processes are very similar up to a certain point, we give the following description: The zinc plates for either are sold ready polished, and differ only in thickness, the zinco block being four times as thick as those used for drawing upon. The zinc for drawing upon is not ready for graining until it has been washed with strong potash and rinsed in clear water, and the graining must be done with sand and water, in a manner similar to that adopted for the stone. If for crayon work, it must be very sharp in the grain or it will not take the crayon. If for ink, in line or stipple, an inferior grain will do. In case of drawing anything that may require erasing, the zinc must on no account be scraped, as it would roll up solid black. It is better to take out with a piece of clean rag dipped in benzine anything that is wrong, and let it dry, when the crayon or ink may be used without fear over the same part. For convenience of working, the white portions may be stopped out as on stone, but the gum used should have a few drops of glacial acetic or nitric acid mixed with it to the strength one would use for a "strong etch" on stone.

When the drawing is completed, take a solution made as follows, and etch the plate with it for ten minutes, not longer: Put two dozen nut-galls into a saucepan—preferably one glazed with earthenware—and cover them with a pint of water. Simmer over a slow fire until it is reduced to half a pint or rather less. Strain through fine muslin into a clean vessel, and let it stand until cold; or it may be kept in a stoppered bottle. Take of strong gum and the above tincture of galls equal parts, and add a drop or two of glacial acetic or nitric acid. The former is preferable, as in washing the acetate of zinc is more soluble than the nitrate.

This solution should be rapidly passed over the plate, whether chalk or lime, just as the "etch" over a stone. After ten minutes' etching, wash off with a clean sponge and plenty of water, and roll up in the usual way, bringing it up with a roller. Some prefer to allow the plate to dry all over during the rolling up, and keep rolling until the whole plate is one black mass, when they wash out the job with "turps" and water and roll up again. Others are careful to prevent the plate drying in the white or clear parts by wiping very frequently with a very slight etch of gum and acetic acid, feeding the job with the roller all the time in between. If a transfer is required, a few impressions should be run off before again washing out, when the job will be found strong enough to roll up in retransfer (litho) ink, and the transfers pulled may be put down upon *polished* zinc for the bath.

Zinco blocks for letterpress printing *must be polished*, unless, perhaps, for coarse poster work. The grained surface would not answer in the printing. To polish the zinc, take the ordinary pumice powder, very fine, and, with a piece of soft, preferably linen, rag and a little water, rub it down till an even polished surface appears; after which, with the same powder, *dry*, complete the polishing till the surface reflects like a mirror. Immediately put the transfer down exactly as if it were stone; then, before rolling up, dip it in a very weak bath for a minute or so, and rinse and dry without heating. It should not be washed out, but rolled up in litho ink, and may then be put in the trough and rocked in the usual way, being heated from time to time, and rolled agai
the ordinary varnish.

Sufficient care is not usually exhibited i
land in biting up these plates for zinco b
The writer has had the advantage of seei
process as conducted in Paris, where the plat
carefully examined through a strong magi
glass; and if any tendency to undermine the
is shown on arriving at a certain deptl
operator takes a varnish brush and protec
shelving sides with it, and also touches u
parts of the surface which seem feeble. I
specks of "scum," or "dirt," adhere to the si
the lines or among the chalking, he takes a g
and cuts them away, taking care to touch
graver out with varnish, so as to prevent the
sequent bath from undermining the line. T
care is due the superiority of the French, a
that matter the American, process work.

Some houses, before subjecting the trans
zinc to the weak bath, etch it with the tinct
galls and gum for five or six minutes, whic
clear away all scum, and then rinse off with
clear water, and immerse in the bath.

Almost every operator has his own fav
mixture of ink for rolling up the zinco
during the biting up, which he pretends to l
profound secret. But anything which will
the job, and prevent the acids in the trough
impoverishing it, will answer the purpose
factorily. Cobbler's wax, resin, and wh
yellow wax, all of which are rendered fluent
heated plate, in various proportions of admi
form the bases. Like the earlier receip
transfer paper, retransfer paper, transfer s
transfer ink, and the photographic proce
earlier days, there always has been an amo
pretended secrecy that imposed upon the cre
of the many, but had no reality about it.
the principle is understood, the rest goes w
saying.—*Printing Times.*

MECHANICAL FOOLHARDIN

CARELESSNESS kills more mechanic
old age or disease, and the number of ac
resulting from somebody's carelessness ca
estimated. There is not as much danger i
risky jobs and undertakings as there is in th
day risks which are met with a contempt b
about by a long acquaintance therewith, and
are hardly regarded as risks by the men w
them. The architect takes risks which are n
when he guesses at the strain to be overc
beam or truss, and also, and doubly so, w
also guesses at the strength of that beam o
The builder in turn takes a risk when h
defective construction with the guess a
hope that "'twill hold." In driving pilin
block of houses in Harlem, the writer notic
some of the piles were driven 12in. to 20in.
last blow of the hammer, and he wondered
risk taken by the builder for the sake of s
few dollars thereby. In building a railroad
in New Hampshire, the contractors put
piling where the last blow drove some pi
In this case some piles were driven too far,
upon the risky, rascally contractors laid
said piles and pulled them up again unt
were in the required position.

In erecting buildings, hundreds of ri
taken by the workmen themselves, by the
and by the builders also. In erecting mac
the risks continue to be taken, and af
machinery is running it seems almost as
attendants vied with each other in courting
Begin with the fireman. How many times
risk his life by guessing that the safety val
perfect order, or that the combination
gauge pipe is not plugged up? All too of
will guess that his boiler is safe, and ru
dirt, leaks, corrosion, and he knows not wh
in that straining and groaning iron shell
which he shovels coal. Why is all this, w
well ask? Is the man a lunatic? Is the
fool, or what is the matter with him? Th
just two other causes which may affect h
haviour, for he may be lazy or avaricious; t
this latter case he is a villain as well. The
tect was lazy; he didn't figure because it wa
to guess. The builder who drove the pilin
knave. He did thus in order to make more
out of the job; but the workmen who got
or killed, the fireman who lets his safety va
stuck, he is sometimes a fool, but more ofte
things happen through pure laziness, and
alone. The engineer who almost hourly
himself by walking under the expand belt
engine—this man is lazy; but he is abette
laziness by knavery, in shape of an av
owner, who grudges the few dollars necessar
up the dangerous place, and thus relieve
man's temptation.

Lazy men run all sorts of risks in put
belts, in fooling around moving machinery
monkeying with running tools, such as
saws, planers, and moulders. The man wh

osed machinery to oil or clean the same, i just as well stop the machine before ex- elf, this man deserves to be sent up for ten ery offence. Only a few days since, a party were building a 100ft. mill chimney. got up 18ft., when all at once the whole ght an earthquake had come to help ey were all on the ground among bricks, l splintered lumber, with two of their iously hurt. An examination showed ling on the last course of ledgers, only d been put into some of the posts where have been driven. Here was a clear ness and foolishness combined, with the ation—to the victims at least—of know- ly themselves were to blame. Some- carelessness becomes criminal, and is y brought to justice; and lately, where the cause of accident, it has been fre- verely punished. There is no excuse for o such accidents, and every man can nself out of it if he will.

ity is one great cause of a man getting d lazy. He works around machinery so ut accident that he thinks, if he thinks t it, that he knows all the ins and outs, gerous places and death traps, so he will be so continually on his guard. It is l of work to keep his thoughts on his the time, so our man gets a little lazy, ear a quick-running belt, and the first now he is a subject for the surgeon or . Well, the writer remembers a man t at work running a circular saw. This nortally afraid of the saw, and kept as t as possible. For twenty-three years as operated by this man without acci- one day he dropped his rule beside the ttempted to pick it up without going e table. He got three fingers and his off, all through a little laziness in not oper pains against accident. — J. F. in the *Boston Journal of Commerce*.

NKLAND'S ELECTRICAL STORAGE BATTERY.

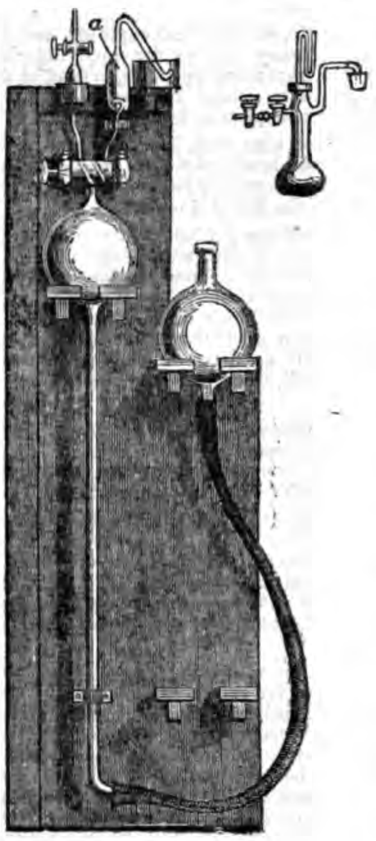
E. FRANKLAND, F.R.S., the well- n professor of chemistry, has recently me improvements which he has devised batteries, the object aimed at being the of both buckling and the gradual de- of the active composition from the ortion of the plates, both these effects ght about by the expansion of the active uring the use of the battery. This is stly, by so inclosing or embedding the position in the metallic portion of the prevent its falling out, and, secondly, ufficient strength to the plate to enable bending or buckling. Prof. Frankland s the active material the hardening oxide of lead and sulphuric acid, for ers patent were granted to him in the No. 4,303), and whilst this mixture is in ndition he moulds it into small cylin- ds of convenient length and thickness, olling, pressure through a draw-plate or her convenient means, and then flattens wo opposite sides by pressure between ards or otherwise. After these flattened have become sufficiently hard, they are ows in a casting mould of dimensions ing to the size of the battery plate nd at such distances apart and from the e mould as to give sufficient space for ty of metal necessary to impart adequate d rigidity to the plate. Suitable molten as lead or an alloy of lead and anti- hen poured into the mould until the between the flattened cylinders are filled. In this way a plate is obtained he active material is incased except on ed sides of the cylinders overlaid with that it cannot subsequently fall out charging and discharging of the battery, when subjected to considerable rough *ectrical Review*.

ND INK FOR WRITING ON GLASS.

reparation for writing on glass called mond ink," says the *American Druggist*, sed with a common pen, and at once ough surface on the parts of glass it contact with. It proves to be a very icle for labelling bottles which are to uids that will destroy common labels. quest of Prof. Maisch an analysis was ch proved it to be prepared ammonium barium sulphate, and sulphuric acid. m sulphate seems to act as an absorbing and when the semi-fluid mass is used it hite mark, and prevents the spreading of the watery liquid; it also seems to make the acid etch a rougher surface. It is made by mixing barium sulphate 3 parts, ammonium fluoride 1 part, and sulphuric acid a quantity sufficient for decomposing the ammonium fluoride and making the mixture of a semi-fluid consistency. The sample examined was contained in a glass bottle holding nearly two fluid drachms, and which was thickly coated on the outside with asphaltum, on the inside with a thick stratum of beeswax, and was stoppered with a rubber stopper. It is claimed by the manufacturer that the mixture contains no hydrofluoric acid, and does not corrode a pen; but, of course, it does corrode a pen, and hydrofluoric acid is the one thing that does the etching. Anyone making this mixture and wishing to keep it in a glass, may coat the bottle inside with paraffin, beeswax, or indiarubber. It should be prepared in a leaden dish, and is preferably kept in a gutta-percha or leaden bottle.

A NEW MERCURY PUMP.

THE mercury pumps now in use, whether those of Geissler, Alverguiat, Toepler, or Sprengel, although possessed of considerable advantages, have also serious defects. For instance, Geissler's pump requires a considerable number of taps, that of Alvergniat and Toepler is very fragile in consequence of its complicated system of tubes connected together, and that of Sprengel is only suitable for certain purposes. The new mercury pump constructed by Messrs. Greisser and Friedrichs, at Stutzerbach, is remarkable for simplicity of construction and for the ease with which it is manipulated, and also because it enables us to arrive at a perfect vacuum. The characteristic of this pump is, according to *La Lumière Electrique*, a tap of peculiar construction. It has two tubes placed obliquely in respect to its axis, which, when we turn this tap 90 or 180°, are brought opposite one of the three openings in the body of the tap. Thus the striæ that are formed between the hollowed-out parts of the tap do not affect its tightness; and, besides, the turns of the tap have for their principal positions 90 and 180°, instead of 45 and 90°, as in Geissler's pump. The working of the apparatus, which only requires the manipulation of a single tap, is very simple. When the mercury is raised, the tap is turned in such a manner that the surplus of the liquid can pass into the enlarged appendage *a*, placed above the tap, and communication is then cut off by turning the tap to 90°. The mercury reservoir having descended, the bulb empties itself, and then the tap is turned on again, in order to establish communication with the exhausting tube. The tap is then closed, the mercury ascends again, and this action keeps on repeating.



SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday evening, the 20th inst., at the Institution of Civil Engineers, 25, Great George-street, Mr. W. Ellis, F.R.A.S., president, in the chair.

Mr. Robert Barnes, M.D., F.R.C.P., and Mr. L. L. Latrobe-Bateman were balloted for, and duly elected Fellows of the Society.

The following papers were read :—

(1) "The Storm and Low Barometer of December 8th and 9th, 1886," by Mr. C. Harding, F.R.Met.Soc. This gale will long be remembered as the one in which 27 lives were lost in the lifeboat disaster off Formby through the capsizing of the Southport and St. Anne's lifeboats. The violence of the storm was felt over the whole of the British Islands, as well as over a great part of the Continent of Europe, the force of a gale blowing simultaneously from Norway to Spain. The strongest force of the gale in the United Kingdom was experienced in the west and south-west, and the highest wind force recorded by any anemometer over the country was a velocity of 80 miles in the hour registered at Fleetwood, whilst at Valencia, Scilly, and Holyhead the velocity reached 70 miles in the hour. The most exceptional feature of the storm was the extraordinary low reading of the barometer, and the long time that the mercury remained at a low level. The absolutely lowest authentic reading was 27·38in. at Belfast, and the barometer fell below 28in. over a great part of England, Scotland, and Ireland. At Aberdeen the mercury was below 28in. for 18 consecutive hours, and below 29in. for more than 60 hours, whilst in the north of England the barometer readings were equally exceptional.

(2) "Report of the Wind Force Committee," drawn up by Mr. G. Chatterton, M.A., F.R.Met.Soc. In this Report, which is a preliminary one, the committee have dealt mainly with that portion of the investigation relating to Beaufort's scale of wind force and the equivalent velocity in miles per hour. The committee have compared the velocities as recorded by the anemographs at Holyhead, Falmouth, and Yarmouth with the entries of Beaufort's scale in the logs of the neighbouring lightships and lighthouses for the year 1881, and they give the results in a table. After a careful consideration of the whole of the results of this investigation, the committee are of opinion that the velocities shown by the Yarmouth anemograph, corresponding to Beaufort's scale as recorded on board the lightships, are too high, and that the velocities shown by the Falmouth anemograph are probably too low. The committee, however, have not yet had before them sufficient data to determine with any degree of certainty the relation between Beaufort's scale of wind force and the equivalent velocity in miles per hour. Neither are they able to recommend any existing scale that can be adopted or modified.

(3) "A New Form of Velocity Anemometer," by Mr. W. H. Dines, B.A., F.R.Met.Soc. In this instrument an attempt has been made to measure the velocity of the wind by the rotation of a small pair of windmill sails, the pitch of the sails being altered automatically, so that the rate may alway bear the same ratio to that of the wind. The mechanical details are briefly as follows: A helicoid is fixed at the front, and a small pair of sail of variable pitch at the back of a steel rod, and just behind the helicoid a light fan, which can turn on the same axis, but is independent of the helicoid and sails. If the rotation be too rapid, the fan turns in the same direction as the helicoid, and by its motion alters the pitch of the sails so that their motion is retarded; if, on the other hand, the friction is increased, or from any other cause the motion becomes too slow, the fan is turned in the other direction, and the rate is increased. The motion is communicated to a vertical rod, which passes down the hollow pivot on which the instrument turns; it is kept facing the wind by a vane. It is convenient to connect the vertical shaft to the recording dial by a light flexible wire, all that is necessary being to place the dial approximately beneath the anemometer; by this means the trouble of ascending a high tower or ladder is avoided, except where oil is required.

(4) "Description of two New Maximum Pressure Registering Anemometers," by Mr. G. M. Whipple, B.Sc., F.R.Met.Soc. The simplest instrument is a modification of the Lind's, Hagemann's, or Pitot's water-pressure anemometers, provided with an apparatus for registering the maximum height the water attained during the period which elapsed since the last setting of the instrument. The second form of registering maximum pressure anemometer is derived from the ordinary pressure plate instrument; a circular metallic disc of 9⅝in. diameter, exposing a surface of half a square foot, is kept at right angles to the wind by means of a suitable vane. The disc is perforated by eight

circular apertures, each of [illegible] in diameter. Behind each aperture a disc [illegible] in diameter is loosely held [illegible] by means of a bent lever loaded with a weight. These weights are arranged so as to press upon the different discs with pressures proportionate to the values usually assigned to wind pressures measured by the various degrees of the Beaufort scale.

USEFUL AND SCIENTIFIC NOTES.

Rapid Staining of the Tubercle Bacillus. Dr. H. S. Gabbett, writing to the Lancet, says:—I can strongly recommend the following mode of staining the tubercle bacillus in cover-glass preparations for clinical purposes. It is a slight modification of Neelsen's method. The stain—which in my opinion is preferable to any of those containing solutions of aniline—is made by dissolving 1 part of magenta in 100 of a 5 per cent. watery solution of carbolic acid, and adding 10 of absolute alcohol. A sufficiency of this fluid is poured into a watch-glass, and heated on a retort-stand over a spirit lamp till steam rises freely and the temperature is not very far from the boiling point. The cover-glasses, prepared in the usual way, are then floated in the stain for two minutes; if the right temperature has been reached this is quite long enough; the watch-glass should be covered. In Neelsen's method the preparations are then decolorised with acid, and subsequently stained with blue as a contrast. I find that these processes may be very conveniently combined by dissolving methylene blue in 25 per cent. sulphuric acid till a deep colour is obtained, and immersing the cover-glasses for one minute in this immediately after their removal from the magenta. They are then rinsed in water, dried, and mounted in balsam. The whole process of staining and mounting occupies about six minutes, according to my experience. Possibly this method may have been already suggested; if so, it has escaped my notice.

Ferrous Oxide and Vegetation.—In a report on the influence of the ferrous oxide in basic cinder on the growth of plants, Mr. J. M. H. Munro describes experiments supplementary to those which formed the subject of a note some time since. Seeds of various sorts—barley, white turnips, clover, white mustard, garden cress—were sown in mixtures of garden soil with basic cinder in order to ascertain whether the large proportion of ferrous oxide in the basic cinder exercises any unfavourable influence on germination or growth. In order to put this question to the severest test, enormously exaggerated doses of basic cinder were employed, namely 10 per cent. of the mixed soil, 25 per cent., 50 per cent., and pure basic cinder without any soil. Most of the seeds tried germinated even in the pure basic cinder, and some of the plants lived until starved for want of nitrogenous food. All the other mixtures produced plants which flowered and seeded in due course—the barley plants in the mixture of equal parts of basic cinder and garden soil were actually better than those grown in garden soil alone, and produced full ears of grain of unimpaired germinating power. Since basic cinder is an alkaline substance containing free lime, it is only natural that in the three strongest mixtures fewer seeds germinated than in the three weaker mixtures or in garden soil alone. The conclusion arrived at is that the ferrous oxide contained in basic cinder is without injurious influence on germination or growth.

Krupp's Big Gun.—Herr Krupp, of Essen, is at present manufacturing a gun weighing close upon 139 tons. Its length is to be 52⅔ft. and its calibre 15·7in. The projectiles to be used with this arm are of two kinds, one of a steel shell 3ft. 9in. long and weighing 1,639lb., the other 5ft. 2in. long and weighing 2,314lb. The service charge consists of 1,069lb. of brown prismatic powder. With this charge the lighter shell will have an initial velocity of 2,411ft., and the heavier shell one of 2,099ft. per second. The lighter shell will penetrate a wrought-iron plate 45in. thick or two plates of the respective thicknesses of 22in. and 30in. placed at a short distance from the muzzle of the gun. In the case of the heavier projectile the figures are 47½in., 23¾in., and 34¼in. respectively. Herr Krupp is also reported to intend the manufacture of a gun weighing 150 tons, and of a calibre of 17¾in. The shell to be fired from this gun is to weigh 1¼ tons, and to be nearly 6ft. long.

Marion's Bromide Paper.—Messrs. Marion and Co., of Soho square, send us samples of their bromide paper, which is made in rolls, and is so exceptionally sensitive that for contact printing an exposure to gas or lamplight for one or more seconds, according to the density of the negative, is sufficient. It is, in fact, so sensitive that artificial light is recommended in preference to daylight, and the paper is therefore well adapted for those who work in the evening at enlarging and printing.

SCIENTIFIC NEWS.

The death is announced of Dr. L. Thollon, astronomer at M. Bischoffsheim's observatory near Nice and a distinguished spectroscopist. Dr. Thollon was well known and deservedly esteemed by many English astronomers, and his untimely death will be greatly regretted. Few have worked so successfully in solar spectroscopy, and his death is a loss to science, for such work as he did with his new form of spectroscope at the Nice Observatory gave promise of a rich harvest in the future.

Mr. Samuel Godfrey, who was intimately connected for many years with the great firm of Bolckow and Vaughan, died recently at the comparatively early age of fifty-four years. When iron gave way to steel Mr. Godfrey adapted the Eston Works to the new business, and laid out the famous Eston Steel Works, which have been visited by experts from all parts of the world and are acknowledged to be a monument of his skill as an engineer.

The death is also announced of Herr J. B. Obernetter, of Munich, at the early age of forty-seven years.

M. A. Gaiffe, an electrical engineer, and the inventor of many devices for applying electricity to therapeutical purposes, is dead at the age of fifty-five years. He was the first to introduce nickel-plating into France.

It is stated that Prof. Tyndall hopes to be able to devote himself to original research, now that he has reluctantly retired from his professorship at the Royal Institution.

Prof. Krueger has published a corrected orbit of comet Finlay, discovered on Sept. 26 at the Cape of Good Hope. From the latest calculations it appears that the comet cannot be identical with De Vico's of 1844, and probably had never been previously observed, although it is moving in an orbit of short period ([illegible] years), and will therefore return to perihelion in 1893.

The new United States Naval Observatory, for which Congress voted £[illegible] several years ago, is to be commenced at once, Mr. R. M. Hunt, of New York, being the architect.

Prof. Di Legge, of the Campidoglio Observatory, Rome, has published an account of observations made there during [illegible] days of the sun's horizontal semi-diameter. The combined mean value of transits observed by Di Legge, Respighi, Giacomelli, and Prosperi give 961·88.

According to a Berlin correspondent, the total eclipse of the sun on the 19th of August next is visible all over Russia from the Baltic to Eastern Siberia, and will be observed there by many of the principal astronomers of all countries. The Royal Astronomical Society of London has signified its intention to send two of its members to Kineshma, in the Government of Kostroma, where, also, the American astronomer, Prof. Young, and the Moscow astronomer, Prof. Bredichin, will be stationed. Two German stations will be established in the Government of Tver; one Italian at Krassnojarsk, in Siberia; and one French station at Davidovka, on the St. Petersburg and Moscow Railway.

The Marquis of Lothian, as Secretary for Scotland, has promised Sir W. Thomson and a deputation from the Royal Society of Edinburgh, to use his influence with the Treasury to obtain a grant of £[illegible] a year for the Ben Nevis Observatory, the only place in the world where eye observations are recorded every hour. The observatory cost, it is said, £[illegible], and the main object for which the grant is desired is to found and support another station at the foot of the mountain.

At a meeting of the Society of Medical Officers of Health held the other day, Prof. Corfield read a paper in which sore-throats were said to be often caused by breathing coal-gas. He referred at some length to the interesting investigations of Profs. W. T. Sedgwick and W. R. Nichols, of the Massachusetts Institute of Technology, in connection with the relative poisonous effects of coal and water-gas, and stated that during the past few years his attention had been gradually arrested by cases of illness, and more especially of relaxed, and even of ulcerated, sore-throats oc in persons sleeping in rooms in whi were defective gas burners or gas pipes, bu in houses of which the sanitary condi otherwise satisfactory. That the slight of gas were the cause of the sore-thr proved by the fact that the persons became quite well on the defects in burners or pipes being remedied, and other cases occurred. In 1884, Dr. Cor summoned to a large country house, w sanitary arrangements had been put in under his own direction. On inspec escape whatever was found either f drains or soil-pipes into the house. escape of gas was noticed from a burne bedroom in which the first case of so occurred; but this was not at the time to have anything to do with the matt especially as a nuisance had been create neighbourhood of that room by an eart which the men-servants had brought outside and had used without properly ing it with earth. However, after the of this nuisance, several more cases o ulcerated sore-throat occurred, some bei of visitors who successively slept in a pa room. On investigating the matter the author, who himself slept a night room, found a very evident escape of g one of the brackets there, the gas havin over, a very foul smell from being insuf purified. An examination was then the gas brackets all over the house, a escapes were found. These were all re and no cases of sore-throat have occurr Several other cases were described Corfield, who ended by saying that he had personally suffered in a similar from a slight escape of gas from a d pipe in his bedroom. He also pointed coal-gas may get into houses through t ment floor, and even up through th especially behind panelling from d mains in the streets. He had no do the cause of the sore-throats was the br for weeks or months, especially at n air contaminated with a small propo coal-gas, and he believed that the e agents in producing the irritation in th were the bisulphide of carbon and other compounds in the gas.

Prof. D. Kikuchi, of Tokio, who grad Cambridge in 1877, is editing, at the re the Education Department of the J Government, textbooks of geometry an bra, those in use at present being very factory. He has already translated a lished the syllabus of plane geometry up by the Association for the Improve Geometrical Teaching, and has also d same for Clifford's "Common Sense Exact Sciences."

It is expected that both Dr. Lenz Junker will be in London early in M will be present at the meeting of the Geographical Society on May 9. The Grenfell, the explorer of the Moban other tributaries of the Congo, has arr London; but his health is in such a co as to make prolonged rest necessary.

An expedition for the exploration country watered by the Yukon has b ganised by the Canadian Government, a start from British Columbia early in Ma the direction of Dr. Dawson, assistant- of the Canadian Geological Survey. Ogilvy will have charge of the topog work, and will make a survey and meas of so much of the valley of the Yukon in British territory. The river is bel be over [illegible] miles in length, and it is s that in many parts there are valuable of gold. Hence the expedition to a r inhospitable.

According to the *[illegible]* York) there are twenty-three towns United States in which electric tram railways are in actual operation—som two or three lines—while there are a s more places which are preparing the their introduction.

The Turners' Company announce th will award prizes for the best speci hand-turning in wood, glass, and stones. Amateurs are to be allowed in a separate class. The competiti ɜs turning in both hard and soft wood. ualities which will be considered in ng the prizes are the following, viz.:— ιty of design, symmetry of shape, utility, ɜneral excellence of workmanship. 2. copying, so that two objects produced as two cups, vases, boxes, or other s) may be facsimiles in every part, or measures of capacity. 3. Fitness of the ιnd design for the purpose proposed (for ɜe, turned work for portions of domestic ιrch furniture). 4. Ability to turn, ɜr circular or oval, in both classes of 5. Novelty in application of turning, esign. 6. Carving and polishing are ad-ɩe, and if skilfully done, any additional produced will be considered, but it must ısidiary to the turning. Possibly the ιrs may show the professionals what can ɘ; but unfortunately the efforts of the s' Company do not seem to be appre-

ιergyman in Yorkshire has obtained a for a "safety electric lamp for miners." ief feature in the device is the interposi-ᐟ wire gauze between the carbon of an escent lamp and the exhausted envelope ɜs in which the carbon is contained, so . case of fracture of the glass the carbon ᐟented from igniting any combustible ᐟe of gases or coal-dust surrounding it.

Victoria tandem or "military cycle" is ιine which runs on two tracks, no little being used. It is so fitted that any . number can be attached together, the resembling a bicycle head. A machine en riders left Messrs. Singer's place on ᐟn Viaduct last week for Aldershot, where be tested with a view to the adoption of ιn for military purposes.

the meeting of the Royal Society of ιrgh last week, the Astronomer-Royal ɔtland exhibited photographs of the solar ιm produced by the aid of Prof. Row-gratings. The spectrum had been photo-ɜd on a glass plate and then enlarged. ᐟints shown were on a scale of 46ft. for rt of the spectrum between the citron- and the middle of the lavender. They presented to the society by Prof. Piazzi , who was thanked for the gift. Sir m Thomson submitted a communica-ι "Ship Waves" in continuation of his of last December. Since then he had ɪ out the problem, and had been able to ιt a formula for the geometrical con-on of these waves in any depth of water. was being prepared, he said, a plaster representing not only the chief waves, ᐟen the slightest disturbance that was ɩe. The President also read a paper on ıbility in Fluid Motion."

ɔrding to Herr Otto Mund, it is easy to ɟuish the positive from the negative pole influence machine. When the balls, or ɜal electrodes as some people call them, ɔarated by, say, a distance of one or two ιètres (half an inch as a mean), the ι of violet-coloured sparks may be ob- to be bounded at one extremity by a f clear white light, which is always in ɜinity of the positive pole.

ı magazine of "popular science" pub- in the United States we read:—"In Britain, vinegar, until recently, has been ᐟactured almost entirely from malt. Of ɜars, glucose, cane sugar, and molasses ɔeen largely used." When a duty was ɜd upon malt makers would look about ne other source of acetic acid—at least, ιs natural that they would.

V. G. Eaton, writing to the *Popular* ᐟ *Monthly*, says that in most of the Eastern ɔf the United States fully 30 per cent. of ɜn over 30 years of age show unmistake-gns of baldness, while nearly 20 per cent. spots on their heads that are not only ɔut polished with the gloss that is sup- to belong to extreme old age alone.

ɜlectro-dynamic air-ship has been patented United States by Dr. Martin Brown, of Vincent, New York State. It is to be led by an electro-motor of about two power; but what is to drive the motor is ıted.

April meteors were observed by Mr. W. ιning at Bristol on April 17, 18, 19, and 20, but the shower proved an insignificant one. No meteors were seen shooting from the radiant of the Lyrids on the 17th, but on the three following nights 16 were noted out of an aggregate of 75 meteors recorded during 12 hours of observation. On the 18th and 19th the horary number of Lyrids for a single observer was one only, but the rate increased to two on the 20th. They were brilliant swift meteors with streaks. Contemporary with the chief display of the April period, there are a considerable number of minor streams, and Mr. Denning notes that one of the best of these is in Serpens, a few degrees W. of Beta, or at R.A. 231°, Dec. 17° N., which was very pronounced in 1885, as well as in the present year. The mean position of the Lyrid radiant was at R.A. 269°, Dec. 32° N. Cloudy, wet weather succeeded the 20th, and nothing further was seen of the display.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

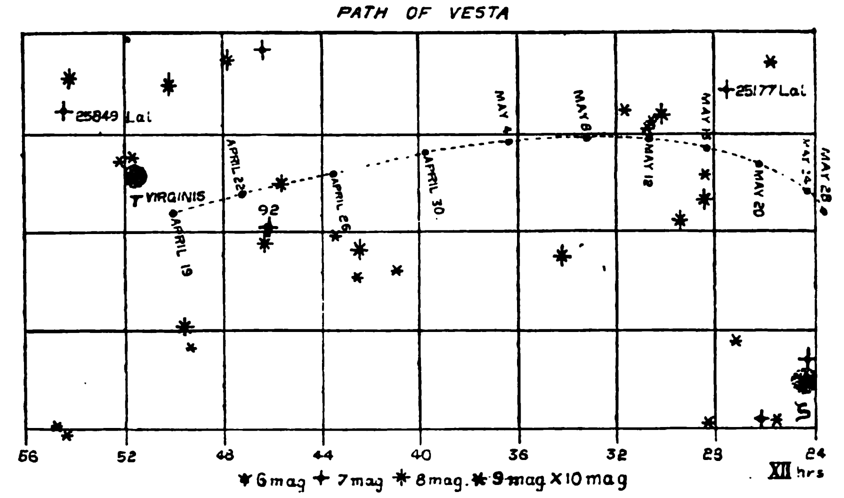
◆◆◆

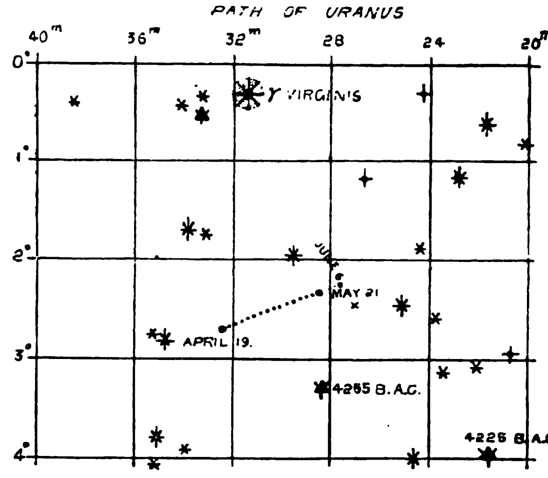
URANUS AND VESTA. — ERRATA.—VISIBILITY OF THE GREAT COMET OF 1880.

[27156.]—IN response to "G. H. B.'s" request (query 62227, page 161) I send tracings of the portions of Harding's "Neuer Himmelsatlas" (1856), in which the paths described by the planets Uranus and Vesta from April 19th to the end of May are indicated by dotted lines. As Uranus begins to retrograde about the middle of June, the chart containing his path will serve for some time longer. On the chart of the path of Uranus the stars marked 4225 and 4255 B.A.C. are rated 6⅓ magnitudes by Heis; and on that of the path of Vesta, Lalande 25177 and 25849, are each rated at 6⅓ magnitude, and 92 Virginis, 6th magnitude, by the same astronomer. The epoch of Harding's *Atlas* is 1800, and I have reduced the apparent places of both planets to this epoch.

In diagram No. 2 of letter 27048, page 124, the arrow attached to β Ursæ is too long. It should, of course, be very slightly less than that attached to γ Ursæ. In letter 27083, page 149, *for* "usual" *read* "annual." In letter 27122, page 175, table 2, *r* of σ Pegasi should be 51·4", not 41·4". Mr. Biggs (letter 27121, page 174) has apparently overlooked the fact that Dr. Gould observed the head of Comet I. 1880, till the 19th of February. No nucleus was at any time to be seen.

April 18th. **H. Sadler.**





JUPITER'S FIRST SATELLITE.

[27157.]—AN interesting observation of the transit of this body over its own shadow was made last night, April 20, 12h. 30m. to 2h. 30m. Entering upon the disc of the planet the shadow just preceded, but was partly obscured by, the satellite; it was seen to be slightly nearer the equator of the planet than the satellite. When between ⅛ and ¼ across the disc every trace of the shadow had disappeared, as seen by the 4½in. aperture (refractor); but the definition was not good, or probably a portion of the shadow might have been seen. This was at 12h. 50m. At 13h. 10m. the shadow was again visible (nearly at the centre of Jupiter's disc), and by 13h. 30m. the bright moon could be detected now *preceding* the shadow; at 13h. 45m. the shadow seemed to be free from obscuration.

Eastbourne. **F. B. Allison.**

NOTES ON NEBULÆ.

[27158.]—ALLOW me to ask attention to the Nebulæ H IV. 37. Mr. Ingall had some notes about it some time ago, but found the star centre difficult to see. I have seen this beautifully, and always judged the star to be exactly central. On April 19th, however, it was very faint, but certainly *not* central; and on the 20th I again saw it. It was a little plainer, and I am certain not in centre, but much nearer margin of nebulæ. I referred the matter to another observer with a larger aperture, and he confirms my observation, although with a little difference as to position. Possibly Mr. Tarrant will examine this, and let us know result. I do not mention the position of star so as not to influence result at all.

Dr. Draper, in his work on "Construction of a Silvered Glass Telescope," says, *re* silvering, that "a partial conversion of the silver film into a golden one can be accomplished as follows: Take three grains of hyposulphite of soda and dissolve in an ounce of water; add to it slowly a solution in water of one grain of gold. A lemon yellow liquid results, which eventually becomes clear. Immerse the silvered glass in it for 24 hours. An exchange will take place and the film become yellowish. I have a piece of glass prepared in this way which remains unhurt in a box where other pieces of plain silvered glass have changed, some to yellow, some to blue, from exposure to coal gas." Has any reader tried this, if so, with what result? How many grains of gold would be required for, say, a 12in. mirror, and how far is the colour of film affected; and lastly, is its reflective power impaired? **Edwin Holmes.**

OPTICAL PHENOMENA —NEBULA NEAR *α* VIRGINIS.

[27159.]—I HAVE made a great number of experiments with mirrors of the ordinary kind and of plate-glass to test the phenomena mentioned in letter 27102. I found in using ordinary mirrors all these phenomena were visible; but not so with the plate-glass mirror. The mirrors were revolved in every possible angle and speed, so that no mistake could arise out of a wrong position. I am, therefore, led to the conclusion that the phenomena Mr. Shrubsole observed were due to the irregular surfaces of an ordinary glass mirror, which irregularities would carry the ray while in the act of revolving upon their crenulated surfaces around the interior ray, and this becomes more obvious when the eye is shifted to a different position, for then the images at once change their position accordingly to the opposite side; while in the plate-glass mirror, owing to the regular surfaces, no such distortion exists.

Can any observer inform me whether the nebula near Spica is variable, or has it disappeared altogether? In May, 1884, it was very easily seen under low power in strong twilight; now not a trace of its whereabouts can be perceived.

D. E. P.

ON PRIMARY BATTERIES FOR LIGHTING.

[27160.]—MR. H. B. EDWARDS (letter 27125) evidently wishes my opinion on what he says, and I have the more pleasure in giving it as I feel sure it will interest others.

First, as to size of cells, I do not see that this offers much difficulty in manipulation provided that the batteries are good in mechanical construction as well as electrical efficiency. I feel more inclined to set the limit at 400 Watts for this reason, that we cannot get a really efficient engine of much less than half-horse power. I am, however, hopeful of introducing a good engine of from half a man power upwards, which will open up a new field for small electric lighting installations.

As regards coal *versus* zinc, we find that in such small engines as are in everyday use, we are fortunate if we get four brake horse-power hours out of 30lb. of coal. Suppose, however, we take it at the higher efficiency of four electrical horse-power from the above amount of coal; or with coal at 20s. per ton, for 3½d. or thereabouts. Let us now compare this with zinc. Theoretically, we should get 1 ampère hour for every 1·2133 gramme of zinc consumed. Practically we have to consume 1·5 gramme to obtain this. If we take the E.M.F. at 1·5 volt, we get 1·5 watt-hour for 1·5 gramme of zinc.

These figures are easily remembered, and are sufficiently correct for most practical batteries. Now one electrical horse-power is 746 watts, so to obtain this for an hour at 1·5 volt, we want to produce 497·3 ampères, or in other words, to consume 746 grammes of zinc. This is a little under 2lb. of zinc, or say, 5d. per horse-power hour.

This gives us the ratio of zinc to coal, as 7 is to 1, very nearly.

The battery I have written about gives of course a higher efficiency than this, because the E.M.F. is higher, and the local action very little indeed; but my experience of other batteries has led me to the conclusion that the above figures are very near the mark.

I have also found that the consumption of zinc is only from ⅓ to ¼ of the whole cost of working, as the oxidant is usually an expensive luxury, and that the cheapest to buy is often the dearest in the end, as it has not the great staying power of such materials as chromic acid, which are dearer.

According to this rule we get the cost by battery power for 746 watt-hours at about 1s. 8d. to 1s. 10d. as opposed to about 1d. in ordinary engines, reckoning depreciation.

To go a little further, if we allow a loss of 46 watts in the leads, we have still available for lighting purposes 700 watts, which should give a light of 260 to 280 candles. I have had some lamps specially made for me by Messrs. Shippey Bros., which I think would suit this work, as they give 15c.p. with 16 volts, taking 2·25 ampères.

I mention this particularly because other lamp makers have assured me that this was an impossibility to make, although I was convinced it could be done, and having obtained it at last, I hasten to let my brother electricians know that such a useful adjunct to lighting by batteries, primary or secondary, is at last to be obtained.

Electrician.

[27161.]—I AGREE with "Electrician" that I "*should* find all the information" required in his letters, but I can't; hence my letter of inquiry on p. 154, which is quite plain enough for any one. However, so that your correspondent should have no difficulty with "technical nomenclature" (p. 175), will he say definitely what other element he uses besides zinc? What is the "zinc solution" mentioned on p. 99? and also, what is the "depolarising solution" at 1s. 6d. per gallon? I have no doubt that "electrical nomenclature is so familiar" to him that he has "difficulty in avoiding its use"; but that surely can be no reason why he should invite readers to waste two stamps in writing to him. I prefer to let the sunlight into these matters in the pages which all can read; and I ask again, Why he told us so much of what his wonderful battery could do, and so little of its composition? I would point out to him that the practice is unusual in the columns of the "E. M."

Nun. Dor.

MASSEY'S (OR ENTWISLE AND KENYON'S) VICE.

[27162.]—WE notice in your issue of April 15th a favourable notice of a vice which you call Massey's patent vice, and which you say is patented by Mr. Massey, of Chicago.

Permit us to point out that both the English and the United States patents for the vice in question are ours, and that Mr. Massey is licensed by us as sole manufacturer for the United States. The vice in this country is known as Entwisle and Kenyon's instantaneous grip* vice, and in the States as Massey's E. and K. patent vice.

Entwisle and Kenyon.

Accrington, April 19th.

OPTICAL PHENOMENON.

[27163.]—ALLOW me to thank your correspondent, W. H. Shrubsole, for the very interesting letter (27102) which he has placed before us.

The explanation appears to be that the two surfaces of the glass are not exactly parallel to each other. When, from the principal image, a number of other images less and less bright are seen running down towards the observer, then he has the thick edge of the glass towards him.

When the phantom images appear running upwards and away from the observer, then the thin edge of the glass is towards him. It is, I think, the most delicate test for want of parallelism in the two surfaces of a plate of glass which has yet been discovered.

Perhaps the most puzzling part of the phenomenon is when *no supplemental images* are seen. In that case it will be found that the thick edge of the glass is turned either to the right or left hand, and in consequence the extra reflections pass off to the side, and do not reach the eye.

Pen-y-van.

THE CATASTROPHE OF 5,000 YEARS AGO.

[27164.]—IN reply to "E. L. G.'s" inquiry (27052) as to what I mean by "extreme antiquity," I say I mean about the time he says the Flood occurred. I refer him to "The Ancient Empires of the East," by Mr. A. H. Sayce, Deputy-Professor of Comparative Philology, Oxford, where he will find enough respecting ancient Egypt and Babylon to prove that mankind was *not* reduced to a single family 5,000 years ago.

At page 25 Mr. Sayce gives a list of eminent authorities respecting the date of the beginning of the regular Egyptian monarchy, and the lowest figures given refer to a period 5,510 years ago by Baron Bunsen. Mr. Sayce's own estimate makes it about 7,000 years ago. All the writers agree that Egypt must have been populous and fairly civilised for long before that time.

Babylonian history is much the same, and stretches into the extreme distance. Babylonian ancient records assert that 36,000 years elapsed between the Flood and the Persian conquest. This assertion is clearly mythical, but makes it clear that at a very early period the Babylonian scribes thought that their monarchy had existed for an enormous period, and was not a thing of yesterday.

At the earliest periods of which records (pictorial or in writing) exist, and they are very early indeed, the personal peculiarities of the various races of men are clearly marked, and are similar to their descendants to-day; also the peculiar methods of writing, such as by arrow-headed characters and hieroglyphics, are fully elaborated and found only in special localities. The various religions are also well marked, quite different, and show signs of being very old when first we met them. All these things prove that the statement that the human race started from a single small family 5,000 years ago is a complete fable.

But why does "E. L. G." say 5,000 years ago? The Hebrew Bible makes it 4,235 years ago, while Usher calculated it at 4,235.

The Septuagint asserts it was 5,032; but the Septuagint was written in Egypt, and made an attempt to suit itself to Egyptian history. But, as it is not considered to be canonical, I wonder why "E. L. G." takes it as an authority against the regular Bible.

"E. L. G." says I "must remember that three races entered the Ark." I reply that I remember nothing of the sort. Not a word is said on the subject in the Bible, so I ask him for his authority, not for his surmise.

The marriages between "the sons of God" (of the Elohim, it ought to be). In Job i. 6 the "sons of Elohim" are the nobles; the "sons of the Elim," the other form of the plural, is rightly translated "mighty ones" in Ps. xxix. 1), and the "daughters of of the Adam," not Adams, cannot possibly be what he says, and the best commentators consider that the sons of Elohim were simply the descendants of Seth, and that the others were the descendants of Cain. But why the marriage of Sethites with short-lived inferior "flint races" should produce "mighty men" is beyond imagination, and to suppose such children born about 2448 B.C. were the originals of Jove, Pluto, and Neptune is ludicrous in the extreme.

But as Noah and his family were selected, it must be supposed they were the right sort—not a collection of bad natural curiosities, whose immediate descendants immediately invented a lot of different false religions, though they had (it is said) full knowledge of the one true God. That the three men called Noah's sons in the Bible are to be considered grandsons is another of "E. L. G.'s" inventions, there being no foundation for it but fertile fancy. How can I or any one argue against mere words—baseless fabrications made to bolster up an improbable story?

According to "E. L. G." there ought to be as many races as mixed marriages, and that Negroes, Chinese, Red Men, Patagonians, Lapps, Jews, Greeks, Celts, Saxons, and all the rest were all rapidly and easily produced in a few short years from the inmates of Noah's Ark; indeed, that small receptacle was like the conjuror's inexhaustible bottle, for it seems to have produced any number of wonderful things in a short time, and in the same neighbourhood, and under similar circumstances.

The Bible, however, says nothing about such marriages or queer races. The "flint" wives are, as far as I can see, a pure invention of "E. L. G." or some other such person as far as Noah and his family are concerned.

What does he mean by "the daughters of Adams"? does he refer to several distinct and separate commencements of the human race? If so, he flies flat in the face of orthodox theology. As why should the descendants of the other "Adams" suffer because the head of the Edenites fell? Again, we are told that our old friend Adam fell, but we are not told that any other originator unconnected with him did; yet "E. L. G." is virulent against the Adams of which we know nothing, and considers the Edenites, whose forefather brought by his sin all the woes and death on the world, as delightful people—indeed, sons of God. I suppose he considers that the devil made the rest?

"E. L. G." says that my assertion that fossil faunas are as local as living ones is contradicted by every observer. This denial of his I flatly contradict, and offer the following quotations as conclusive evidence against him:—

Prof. Owen says, in "British Fossil Mammalia," Introduction, page 39: "According to the hypothesis that all existing land animals radiated from a common Asiatic centre within the historical period, we must be prepared to believe that the nocturnal Apteryx, which is neither organised for flying or swimming, migrated across the wide seas, and found its sole resting place in the Island of New Zealand, where alone the remains of similar wingless birds have been found fossil; that the wombats, dasyures, and kangaroos as exclusively travelled to Australia, where *alone* have been found in pliocene strata and bone caves the remains of extinct and gigantic species or families of Marsupialia; and that the modern sloths, armadilloes, and ant-eaters chose the route to South America, where and only in the warmer parts of North America are to be found the fossil remains of extinct species of those very peculiar edentate genera." Again he says: "Not a relic of an elephant, a rhinoceros, a hippopotamus, a bison, a hyæna, or a logomys has yet been detected in the caves or the more recent tertiary deposits of South America. On the contrary, most of the fossil mammalia from those formations are as distinct from the Europæo-Asiatic forms as they are closely allied to the peculiarly South American existing genera of mammalia."

Then Mr. Page, in his "Introductory Text-Book of Geology," says, at page 205: "In respect of its fossils, the tertiary era exhibits a remarkable difference compared with the chalk, oölite, or coal. During these epochs, the plants and animals in every region of the globe presented a greater degree of sameness or identity; whereas during the tertiary epoch geographical distinctions and separations like those *now existing* began to prevail; hence the difference between the tertiary mammals of Europe and those of South America, which represent its present sloths, ant-eaters, and armadilloes."

These extracts entirely disprove "E. L. G.'s" denials, and prove my case. I now ask him, Did the animals now alive allied to those peculiar fossils in South America have direct ancestors in the Ark? and if so, how did they get transported alone to where their fossil ancestors existed?

"E. L. G.'s" assertions that a special gravel is found at a depth exactly indicative of 5,000 years deposit all the world over is simply preposterous. Does he suppose that that particular gravel was stirred but once after being broken? Where did such a mass of newly-broken gravel come from? Has he any evidence that all the rivers and valley bottoms have been carefully examined? He must know they have not, and that he is simply prophesying all out of his own head. Take the Nile, for instance—from year to year it brings down matter in varying quantity—some floods will carry away what others deposited, and large masses of desert sand will, at times, be blown into it, so that it would be impossible even for "E. L. G." to swear to a year or even a century—though he professes to know exactly.

Geikie says: "But extensive though the terrestrial sedimentary deposits may be, they can be regarded merely as temporary accumulations of the detritus; save where protected and concealed under the water of lakes, they are everywhere exposed to a renewal of the denudation to which they owe their origin."—("Text-Book of Geology," p. 452.)

The Mississippi has been more carefully studied than any other river, and yet only approximate results have been gained by its study; but "E. L. G." assumes that all is known about every river, and that the exact age of the deposit of a layer of gravel in it can be ascertained with nicety. "Geikie" says, of the discharge of sediment in a group of the greatest rivers, of which he gives figures: "It is not pretended that these results are strictly accurate." They all differ, and would differ still more, if more carefully studied.

"E. L. G." is, however, given to guessing, as he says "but in similar valleys 15,000ft. above it, in the Himalayas or Andes, he *might* doubtless find the very same," and "not only does the vale of *every stream* attest this, but the countless vales that contain no stream, winding for leagues upon leagues, with dry bottoms, through *all the* deserts and our English chalk downs." Of course, "E. L. G." may be familiar with "all the deserts"; but I defy him to point out evidence of any one-day flood 5,000 years old in an ordinary chalk bottom, where change has occurred steadily day by day for ages.

His notion of the formation of the Mediterranean Sea is strangely funny, and he quite forgot in his last letter to reply to "F. G. S.'s" conclusive arguments about the formation of the delta of Egypt. "E. L. G." calls Lower Egypt "monumental," and so it is. It occupies the delta of the Nile, and has been thickly peopled from the dawn of history. Will he assert its surface commenced to be deposited 5,000 years ago? As if a great Mediterranean valley occurred before that period, the Nile would not have overflowed Lower Egypt, but would have rushed from old Memphis hastily down to the bottom of his deep valley, where a deposit would have been made. It could not have been formed unless the sea-level was where it is when it was commenced, and it began near Cairo. Anyone familiar with the formation of deltas will be able to explain fully to "E. L. G." that his statement on this point is wholly false, and it is to be hoped he has some friend with knowledge enough to prevent him continuing to publish such absurd statements.

His argument from the Tomb of Theodoric at Ravenna is strangely wrong. He forgets that Ravenna was built on a sandy lagoon like Venice, and that the little tomb has an enormously heavy roof, cut out of a solid stone, weighing 200 tons, and by its means has sunk into the soft ground. Ravenna is *not* being besieged by the sea: the latter is retiring from the city, which used to be on the shore, but is now four miles inland.

The foundations of St. Mark's at Venice are shaky, and the pavement is now so markedly irregular that some have thought it was meant to represent the waves of the sea; and as to the level of the sea there in olden times, Ruskin says, in the second volume of "Stones of Venice," page 9, 10:—"Had there been no tide" (a lower one would be the same), "as in other parts of the Mediterranean, the narrow canals of the city would have become noisome, and the marsh in which it was built pestiferous." "Eighteen inches more of difference between the level of the flood and ebb would have rendered the doorsteps of every palace a treacherous mass of weeds and limpets," so the water must then have been as now when Venice was built.

In conclusion, let me ask "E. L. G." how the Ark could float for five months, and only be caught on a new high mountain, when there existed, according to him, large spaces for the water to rush into, which he seems to assert it did in one or two days.

Speaking of his own peculiar gravel, he says it was deposited in the London Valley and elsewhere by "a most hasty and violent operation, must the whole carriage and deposit have been. A very few days would have rolled them much rounder." Yet Genesis says the rain fell for forty days. He has apparently assented to the notion that "the lands were cleared of all plants," but does not say on what the graminivorous animals lived when they came out of the ark, or why the carnivora did not finish them off in a few days. **Memnon.**

[We hoped this was done with, but are, we suppose, compelled to admit "Memnon's" reply, as he was asked certain specific questions. But if "E. L. G." is constrained to respond once more, that *must* be the last of it.—Ed.]

SOME EXPRESS RUNS.—II.

[27165.]—The journey to Manchester from Derby over the Peak is one of our steepest express routes, the gradient being 1 in 90 for several miles on either side of the summit in Peak Forest Tunnel. The following run was made in Sept., 1886, engine 1,566 and 7 coaches:—

M.	Ch.		h.	m.	s.	Speed.
		Derby..................	1	10	8	—
4	0	Mile Post	1	16	26	38·0
10	0	"	1	23	18	52·4
12	40	"	1	26	28	47·3
18	40	"	1	33	43	49·6
24	40	"	1	41	10	48·3
27	40	"	1	45	48	39.5
34	40	"	1	56	35	38·6
36	40	"	2	0	6	34·1
39	55	Chapel-en-le-Frith	2	3	52	50·7
48	65	Marple	2	13	13	58·5
62	59	Manchester	2	33	1	—

Remarks.—Due Derby 1.9, Manchester 2.25. Slacked through Ambergate, and two minutes lost between Marple and Manchester by signals at Stockport.

Shortly afterwards I travelled from Preston to Carlisle with the 8.0 p.m. Euston, 2 engines and 20 coaches. Owing to signal delays, six minutes were lost. We stopped at Tebay for a bank engine (this made three engines), and again at Shap summit to detach the pilot engine.

A subsequent run to Edinburgh with the 3.33 a.m., booked to run the 98 miles from Carlisle in 2 hours 20 minutes (no stop until Portobello, 95 miles) was spoilt owing to delays caused by an engine off the road at Newcastleton. This run is *the* steepest of our express journeys; but we never exceeded 60 miles an hour.

April 23. **Kappa.**

RAILWAY SPEEDS AND MYTHS—EXPRESS TRAINS.

[27166.]—"Zulu" asks which was "the swiftest and most powerful engine in England" that I mentioned having tested. I wrote the plural word "engines"; but it was accidentally misprinted in the singular. It would puzzle me to award the palm for swiftness and power among the many classes of splendid engines now in use.

"Lincoln" reminds me that I gave, in a contemporary two years ago, a run "Stoke to Tallington on the G.N.R., 15½ miles in 12½ min." Here, again, I must plead a misprint. I recollect the case referred to, and have looked it up. I find it was written in my manuscript as 15¼ miles in 12min. 40sec. On that occasion the fastest bit was from Corby to Essendine, 8 miles 52 chains, in 7 minutes, or at the rate of a little over 74 miles an hour, the maximum being 75. In this same communication mentioned by "Lincoln," another misprint represented a fabulous speed on the Midland line. I was made to show a run from passing Ampthill to the 49 mile-post (7½ miles) in 5min. 35sec., the correct figures being 6min. 25sec. Thus accidents *will* happen!

"French Loco." (p. 412) is quite out in his "booked time" for the Midland Leeds expresses. The 3 p.m. down is booked to *leave* Kentish Town at 3.6, and to *arrive* at Kettering 4.27. He has given the arrival time in the former case, and the departure in the latter. The up-train is booked to leave Kettering at 1.31. The down "best" run was a very poor one for that train. I have known it done in 5½ minutes less. I am surprised that one of the 890 class should have been used on the up journey, as they have long been taken off express work. Has 896 been rebuilt? If so, she probably would have 18in. cylinders and larger boiler-power.

Wellington, N.Z. **Charles Rous-Marten.**

CONTINUOUS BRAKES.

[27167.]—On page 179 "Brake Attendant" addresses a question to me with reference to the working of the Westinghouse brake, which I shall be glad if he will put more clearly. If the air be let out of the brake pipe the gauge could not show 80lb. pressure, and the reduction of pressure would apply the brake, and the driver would be unable to start his train till the pipes were again properly connected and the brakes taken off.

Mr. G. Kiernan appears to be making a great point about the *name* of a brake; it is well known that at the Gisburn trials the Automatic Vacuum brake was known as Sanders. Now this form of apparatus is supplied by the Vacuum Company, Limited; this, however, has really nothing to do with practical results. The 12lb. of atmospheric pressure acting upon an 18in. piston has the same power to-day as it had in 1880. And, as a matter of fact, no vacuum brake can now give a better result than was obtained under the name of Sanders or Sanders-Bolitho.

The fact that the loss of life at Penistone was entirely due to the failure of the non-automatic vacuum brake, is too well known to railway-men and to the readers of the "E. M.," for me to have to occupy space in again proving it. I have only to refer them to the back volumes published soon after the accident.

Mr. Kiernan is quite incorrect in the conclusions he draws from the action between Mrs. Woodhead and the railway company.

The *first question* which the Judge left to the Jury was "to say whether they were of opinion it was negligence on the part of the company not to have discovered the crack in the axle." Of course, there could be but one answer: the breaking of the axle, as I said when I first saw it, and as I wrote in your columns, was a pure accident.

The plaintiff in her case did not urge any neglect with reference to the axle, and it is a legal point whether the question should have been put to the jury or not. Mrs. Woodhead having lost her husband, had not the financial means to proceed further, and consequently the case was obliged to fail; but that most certainly does not alter the actual fact that the loss of life was due to the absence of an automatic brake.

Clement E. Stretton.
Consulting Engineer Amalgamated Society of Railway Servants.
306, City-road, London, E.C., April, 25.

RAILWAY BRAKES.

[27168.]—Your correspondent, "Brake Attendant" (27145), propounds a riddle in last week's issue that plainly shows he has not attended a great deal to the brake he writes about. If "the air is let out of the coaches," why, of course, on goes the brake, and there you stick till the tap is opened and the driver gets the brake off, so that your correspondent's difficulty is only an imaginary one.

Geo. Kiernan (27146) seems to be as far at sea in this issue as he was in your last. The vac. brake of to-day is practically that of 1880, all the difference is in name; then it was Saunders and Bolitho, with the Clayton hole. Now Saunders and Bolitho have come to grief, and Clayton sold his patent to the Vacuum Brake Company. The Vac. Co.'s brake of to-day can't get a bit better result than did Saunders and Clayton in 1880. The proper way to test this is for the Board of Trade to appoint an independent committee of experts to make a series of experiments and report the result.

As to Geo. Kiernan's remarks anent the Penistone accident, they are the purest bosh. Here was a train at 50 miles an hour and 243 yards, yet could not stop. Even the automatic vacuum, with all its faults, would have prevented it.

A poor widow fighting the M. S. and L. (of string renown) and Vac. Co. She had not money to work up her case properly or to go on with a new trial, so what does that show? Not justice, but the force of money.

I trust your correspondent will consider these things well, and perhaps his eyes will be opened to the true state of the question. **Rover.**

SUSPENDED FISH-PLATES FOR RAIL JOINTS.

[27169.]—YOUR correspondent, Mr. Hy. Lanchester (letter 27148), does not seem to belong to the railway business, otherwise he could not have made the suggestion he did. This question of suspended fish-plates *versus* fish-plate joint resting on a sleeper is a very old one, and has been solved long ago in favour of the first arrangement. Mr. Lanchester will consult with advantage the valuable book of your distinguished collaborator, Mr. E. Stretton, on "Safe Railway Working," where this point has been treated in a first-rate manner. For my part, I can only speak as a man who has seen both sorts of arrangements in use, and I must confess that the suspended fish-plate joint is decidedly theoretically and practically the one to be recommended. It is, in fact, the only one now adopted on most Continental railways, where in early days also it had been a common practice to make the rail joints over a sleeper, and in most cases to make such joints alternate—that is to say, not to allow the joints of the two lines of rails of one track to be opposite each other. Nothing is gained by such an arrangement, although it diminishes the pitching motion of the cars; but then the alternative of the supported or suspended joints creates another sort of oscillation, causing the vehicle to rotate round a horizontal axis passing through the centre of gravity and parallel to the line.

Although the supported joint is somewhat better with the Vignoles broad-based rail, which requires no chair, its adoption has long ceased on most railways. A suspended joint requires a nicety of execution which is scarcely to be expected, and which time and train running destroys. As there remains still a solution of continuity, that place gives always rise to a springing action when the wheel leaves one rail to go on the other. Something must give way; the rails or chairs imbed themselves in the sleepers, and the fastening gets loose. The suspended joint provides the necessary amount of elasticity, the deflection being reduced to a minimum by bringing the end sleepers near the ends of the fish-plate.

When a wheel runs over the portion of a rail comprised between two sleepers the greatest strain is on the furthest section of encastrement, so that from a theoretical point of view there is no reason to lay the joint over a sleeper. Having run thousands of miles over both systems of lines, I must emphatically declare that the suspended joints give the soundest road and the smoothest running. Besides, the use of bogies for carriages greatly diminishes the jerk caused by the wheels passing over the joint. **Ed. Gobert.**

7, Ducie-street, Longsight, Manchester.

ANOTHER SCREW-CHASING ARRANGEMENT.

[27170.]—SEEING the interest taken in screw-chasing arrangements as applied to the single-geared lathe that has arisen since the description of Niblett's chasing arrangement was illustrated in these pages, I have also considered to send the following arrangement, hoping it may be of some service to other amateurs besides myself. I designed the apparatus some short time ago as a simple, inexpensive arrangement, all of which can be made by any amateur, save, perhaps, the chasing tools themselves. Fig. 1 is a front view of the main casting to be bolted on to the front of the lathe bed, and consists of an iron casting. I bored out the arms A and B to take the brass bearings carrying the shaft, Fig. 2. The brass bearings were held in their places by a small stud through each side of the casting. The shaft, Fig. 2, is turned out of a piece of 1in. bar iron; the thick part of the conical journals is left ¾in., and tapered down to ½in., and the shaft should be turned to ½in. at the end D and between the journals. At the end marked C it should be turned to about ⅜in., and the outer half screwed to take a thimble tapped to match the thread. The thimble I used was turned up and bored out of a short piece of 1in. bar iron screwed 8 threads to 1in. The threads were left on, only the ends turned up. The extension piece marked D (Fig. 1) is drilled slantways to take the shank of the double eye, shown in Fig. 3, which carries a small pulley between the jaws for the purpose of tightening the cords used for driving the whole arrangement. The pulleys that fit on the end D of the spindle, Fig. 2, are turned out of wood, iron, brass, &c., as the constructors may choose for themselves. Into the extension piece marked C, Fig. 1, a small stud, Fig. 4, is screwed for carrying the nut, Fig. 5, working into the thread on the thimble. The hole marked B, Fig. 5, is for taking one end of the guide rod, shown in Figs. 6 and 7, a pin marked C, Fig. 5, passing through the holes in Figs. 6 and 7, which also show how the tools are fixed for both inside and outside, the tools resting on the ordinary T-rest. After the arrangement is made, it is bolted on to the lathe bed, as shown in Fig. 8, a cord passing round the two pulleys A and B, which are of exactly the same size. The chaser is brought up to the work, and a screw may be cut on the work exactly 8 threads to the inch; so, should I require one of 16 threads to the inch, I then take off the pulley B, and put one on in its place just one half the size, and so on for the different pitches of screws I require. I turn up a stock of different sized pulleys to suit the speed pulleys on the mandrel, so that I can get any pitch of screw. By tightening the belt with the small pulley C, Fig. 8, any screw may be turned correctly. For left-handed screws I simply cross the belt, and set to work as usual. I leave a space behind the thimble on the shaft, Fig. 2, so that when the nut has got to the end of its travel, the nut falls into the space and lets the turner know the rod wants taking up another hole. By keeping the chaser in its place, and lifting the nut and drawing along the stud, Fig. 4, and then placing it in the beginning of the thread on the thimble, you may go for another length, and so on. The belts I prefer made from sewing-machine straps (round) with three simple wire connections. The drawings are not made to scale. Hoping some fellow readers may find it of some use to them, I shall then be amply repaid for my trouble in describing it.

Skinningrove, R. S. O.

FIG 5

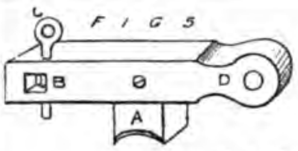


FIG 6

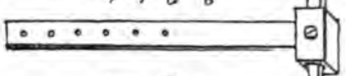


FIG 7

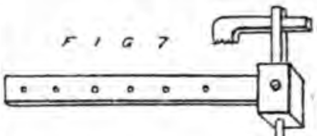


FIG 8.

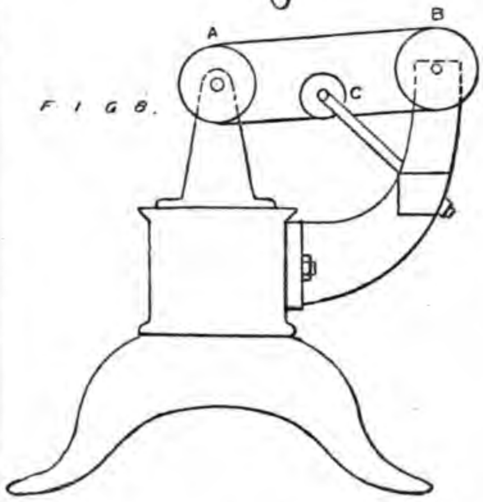


FIG 1

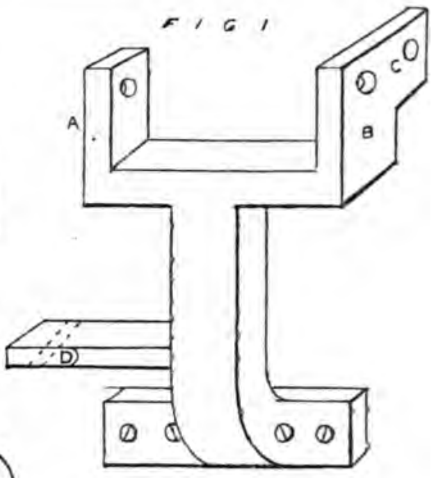


FIG 2

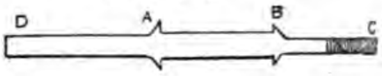


FIG 3

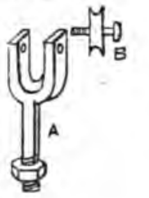
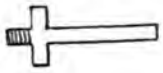


FIG 4.



NIBLETT'S APPARATUS.

[27171.]—WILL "J. McG." kindly understand that "O. J. L." and Niblett are not identical, and that it matters not one straw to the former whether or not the latter may sell a thousand of this piece of machinery or none? The interest of "O. J. L." arises from his innate love of mechanics, which induces him to report upon any novelty which appears worthy of notice. His "imprimatur" is neither asked nor given, and is of no value whatever, any more than that of "McG's." But "O. J. L." does feel for an ingenious man like Niblett, and he sincerely hopes to find that, after all counterblasts have been blown, this clever contrivance will find such a market as it deserves. These counterblasts have already blown off some dust which at first obscured some of the merits of this contrivance. For instance, the letter of H. C. Pocklington replies to F. H. Wenham's assertion that the arrangement is "radically wrong in principle." In point of fact, it is nothing of the kind. "O. J. L." is from home, and cannot make the experiment suggested by "McG.," who is fully answered, however, by H. C. Pocklington. As to praise or blame, the former can hardly be sought by "O. J. L.," as he has not the credit of the invention, and with respect to blame, he thinks it is hardly his due for bringing this clever contrivance before the reader. He will not, in any case, suffer very much from "McG.'s" sarcasm.

O. J. L.

LATHE MANDRELS.

[27172.]—IN your issue of 15th April Mr. Newall mentions a way of making fits by cones. His remarks are correct as regards fitting alone; but I doubt if a cone would suffice to insure true bedding of a large chuck. The cone on the nose would of necessity be short, and a cone would not bring up the face of chuck without a suspicion of wobble. Dr. Edmunds's idea of a broad base to the nose and chuck cannot be improved upon in my

FIG 1

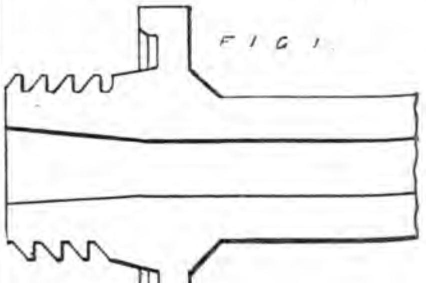
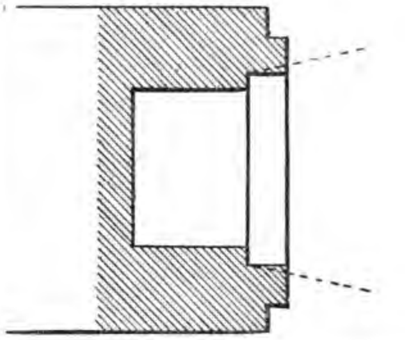


FIG. 2



I venture to offer a sketch of a nose e essentials of Mr. Gray's description), ı the chuck would be centred and brought face true. The cone would play the part ng only, leaving the base to correct the huoks would be turned up and bored as in pped to nose-thread ; then the part indi- dotted lines would be cut off by degrees ter trials, base of chuck bedded truly. ıld like to remark that if Mr. Massey vice you illustrated in last issue) is *not* the of the v ce made by Entwisle and Ken- Accrington, England, he has succeeded in a very good copy of a vice by them I have ıse some four years, the only difference at mine is for wood. **Silke.**

LATHE MANDRELS.

.]—SINCE writing my last letter I have of the "J. K. P." die-chucks made for the l Cooke lathe which I described in the " last year. It will interest "O. J. L." to at with this Cooke lathe there is a copy such as I suggest for use in the slide-rest, t this "J. K. P." chuck was finished off ever seeing the lathe-head, much less g it up and sending it away to have the tted to it." When this diechuck came d was put on to the lathe, *it ran dead true.* nly the facts are not complete unless I also t the chuck was made by the hand of our J. K. P." himself, and that a more perfectly- l die-chuck or a more finely-executed f work I never saw. But here ve, in addition to the demonstra- rmerly published by me in the "E. M.," evidence of the practicability of that which ." is "morally sure will never be done." J. L." would like to see this Cooke lathe "J. K. P." die-chuck to which I now refer, will do me the honour to appoint some n, I shall be happy to secure him access to e and its appendages.

e position taken by the ornamental lathe- hus stated in Holtzapffel's Catalogue (vide) :—"Although all lathes of the same size, in. centre, have their screws exactly alike liameter and thread, it is only by mere t that the same chuck runs truly upon t lathes." Now, this statement is, un- tely, perfectly true of our present costly ıtal lathes. But the position which demonstrated is this: that the misfortune o the present mandrel-heads not being pro- ade ; and I say that, with a proper standard l-head kept in the manufacturer's office which all mandrel-heads which he sends ıform, we should need only to order by ny chuck we want, and have it sent by Post and put it on to our lathe. It is obvious this Cooke duplicate-mandrel enables P." to make a die-chuck which runs per- rue upon the lathe, the same chuck would rfectly true upon any number of other whose mandrel-heads are exactly like it. e mandrel-head which I have argued for , as Mr. Gray points out, on two features. he cylinder-base which eliminates eccentric ns; second, the wide true face-bearing eliminates angular variations. All the ns of a drunken chuck are, in fact, re- into two components—one consisting in icity upon the lathe-axis, the other consist- angular divergence from the lathe-axis. ıte both those components, and you get a which runs dead true. Now, the cone-bearing ed by Mr. J. W. Newall in his very l letter, combines my two rectangular sur- to one surface which contains both my com- . If that would really effect the object, le surface would be a simplification, and re an improvement. I trust that Mr. will think his proposition out and us with engravings—actual size—of ign. We shall then be able to discuss ould venture to suggest cone-bearing would better if combined with the buttress-thread combined with the V-thread—the V-thread s a second disturbing-cone. The question whether we should combine our two com- into one cone surface, or put them into two s at right angles to each other, as we do by ing the cylinder-base with the wide flat aring. Which are the more easily manu- d so as to work with multiple bearings? And, nanufactured, which is the more efficient tor of both components of variation? The tures being secured, all other points are mere ns of dimension, and are important only , without identity of dimension as well as of form, we cannot get interchangeability. hall be much indebted to Mr. Newall if, s view as a scientific manufacturing engi- would favour us with a drawing—like that Gray's—of the mandrel-head and front which he advises. But the diameter of t bearing must depend upon the reduction caused by fitting on the pulley and back gear; we require, also, an open tubular mandrel-tail strong enough to take change wheels, dividing-plates, screw-guides, swash-plates, and such other apparatus as geometric turning may require to be rigged up thereon. Practically, therefore, we are now advanced to a point at which we need to ask Mr. Newall for three drawings—the first drawing to show the open tubular mandrel-tail, with its screw-nut and shoulders, and the back bearing; the second to show the most perfect fitting for pulley and back-gear, with the minimum increase of diameter; the third, having dimensions determined by the requirements of the first two. In fact, while we determine the form of our interchangeable mandrel-head by principles which are self-contained, we depend for its dimensions upon the requirements of our tail-piece and pulley-fixings, and must build up from behind. If, therefore, Mr. Newall would favour us with three drawings, shown actual size, of these three sections of the mandrel, we should be much indebted to him. If Mr. Newall could really give us a bore of $\frac{5}{16}$th throughout with a front-bearing of only $\frac{3}{8}$ths, that would be very satisfactory. My own reasons for discarding the coned mandrel-face were that it would be very difficult to fit to it the multiplicity of chucks, and that abrasion would prove more serious than with the cylinder-base and flat mandrel-face. I gave soft wood-turning on the one hand, and boring out a small engine-cylinder on the other, as extremes for which our model mandrel might, perhaps, occasionally be taxed. Practically, soft wood-turning would be done by resorting to an ordinary wood-turner's lathe; the engine-cylinder should be fully roughed out by a mechanic upon his slide-lathe, and we are not bound to provide for these extremes.

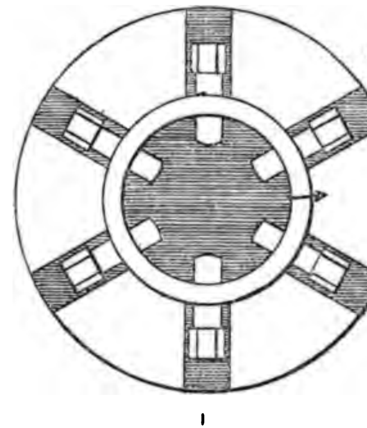
4. I trust that "N. D. F. P." will trot his mandrel out; but unless his design goes to the above questions, it will not help us in our present discussion. The question of price, and the fitting of the steel collars to which "N. D. F. P." also refers, will best be considered later on. The steel collars would probably have to be left small enough to bear grinding out until the mandrel runs easily in its seat, and finds the oil-borne fit which I have described.

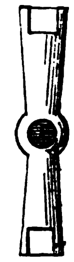
5. We have to thank Mr. Gray for a valuable and ably thought-out contribution to our subject. In his wide nose I see substantial advantages.

James Edmunds, M.D.

8, Grafton-street, Picadilly.

A BELL CHUCK.


A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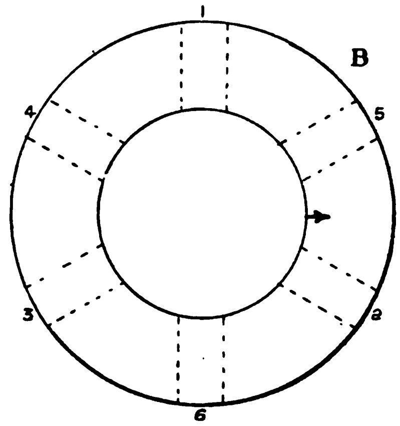

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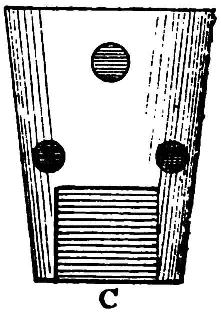

C

[27174.]—EVERY turner will not soon forget a "rap on the knuckles" from the projecting heads of the radial screws, from six to eight in number in the old pattern bell chucks. *Experientia docet.* At first I used a piece of wood bored to size of the bell. This is very liable to breakage, and looks untidy; next came a solid indiarubber ring, thick enough to surmount the screw-heads when placed up against them, and making a pleasant buffer in collisions; lastly, the present idea, to which pattern I have finished one chuck and am now busy on another. A, full size of the whole chuck put together; B, the ring guard with its side holes—1, 2, 3, the large holes for three radial screws; 4, 5, 6, the lesser ditto; first-mentioned in front, last in rear. Metal of the ring guard 1in. broad and 1in. thick, of wrought iron case-hardened (this part I am making of gun-metal for the chuck I have now in hand); screws hardened in grease. C, the bell tapped with six screw-holes, two sizes; an arrow head is cut on the edge of ring guard, to tally with a line on the rim of the bell when inserted, and lightly tapped with a mallet; this is to insure correct fitting and save time. D is a double key, its ends adapted to tighten the screws on work; hole in the centre to receive a bit of iron wire for turning round this key. I centre anything in this chuck with the wood screw tool I described two months ago. **Eos.**

THE STANDARD MANDREL.

[27175.]—I, LIKE "O. J. L.," am a little incredulous that manufacturers will adopt the standard mandrel, for the reason that there will not be sufficient demand, especially as it is only for one-sized lathe. If it had been proposed to make a standard mandrel to every-sized lathe, from the smallest to, say, 8in. centre, there would have been greater probability of universal adoption; but as there is to be a standard mandrel to only one-sized lathe, and that one not used by the majority, it will hardly pay manufacturers to adopt it.

I think Mr. Gray makes the diameter of the nose unnecessarily large. In a back-geared lathe with small bearings the diam. of nose at the bottom of the thread should be the same diam. as the front bearing. In a formula I have in millimètres for "präcisions Drehbänke" the proportions of nose run as follows:—

Diam. of nose	·23 to ·28 of centre
Length „	·24 to ·29 „
Diam. of chuck seating	·37 „
Thickness „ „	·05 „
Diam. of cylinder base =	diam. of nose + ·09 of same
Length „ „ =	·04 length of nose
Bore of mandrel	·36 of its diam.

For an ornamental mandrel I would not make the nose longer than ·75 of its diam. The disadvantage of having a thread of five per inch would be that the chucks would come off too easily when turning the lathe backwards. If the jamming of the chucks must be avoided, a clutch fitting will have to be used instead of the screw.

A. F. Shakespear.

Lüttichau-strasse 14 III., Dresden, April 20.

LATHE MATTERS.

[27176.]—ALLOW me to tender my hearty thanks to Mr. H. C. Pocklington for his demonstration of the theoretical correctness of the Niblett apparatus. I think probably every practical man felt just the same objection to it that Mr. Wenham expresses. I argued the same way myself at first; so did "Vulcan"; so, I believe, thought "O. J. L." when he wrote "It is, I am told, a spiral." We all concluded it must be a spiral; but it is not. The face of the swash-ring, as already pointed out, lies in a plane, and the compensatory curve is correct for any angle. I should like to ask Mr. Wenham how far he thinks his appliance would do for general work? Would it, for instance, cut a screw of, say, 8-pitch in an iron chuck to fit the mandrel without requiring to be made much stronger. My own impression is that 20-pitch would be about the limit. Perhaps it could be altered a little to make it do larger work without becoming too cumbersome.

Referring to the Ballon mandrel, illustrated this week, I think there is an advantage in having the cylinder fit at the end of the nose, because the chuck could be tried on to it without any interference on the part of the screw, by reversing the chuck. I think if the centring is to be determined by a cylinder fit, it must be so perfect a fit that a difference of temperature would make it too loose, or a little dust too tight. I should resolve the cylinder and face-fitting into one blunt cone shoulder.

When trying the little cutter illustrated this week, I was surprised to find it was really universal. Beginning with the vertical position of the spindle, I could incline it till it was horizontal without having the band come off the lead pulleys; but, of course, when nearly horizontal these pulleys are not required, as the band runs straight up. I had never seen this arrangement before.

F. A. M.

TITANIUM ORE—PLATINUM IN FILINGS — BUTTERINE — SILICA IN FLUOR SPAR.

[27177.]—IN reply to "Murano" (query 62105, page 113), who asks about "titanium ore," I regret to say that I have no recollection of what I wrote "a few years back." Rutile (not rulite, as quoted) is titanium dioxide, as also are the minerals brookite and anatase. Ilmenite or menakanite is a titanate of iron, or more probably an isomorphous mixture of the sesquioxides of iron and titanium, $(FeTi)_2O_3$, and titanite or sphene, $CaTiSiO_5$, is a titano-silicate of calcium. Magnetic iron ore often contains a notable proportion of titanium. Some of the ore occurring in Norway contains as much as 20 per cent. of TiO_2; but it is quite useless as a source of iron, owing to the practical difficulties in the way of smelting it. The sand of the seashore for forty miles in the neighbourhood of Taranaki, New Zealand, consists largely of ilmenite, and it is also abundant near Wanganui, and on some parts of the coasts of Italy. The sand of the Mersey, opposite to Liverpool, is said to contain it. It is quite possible that titanium has been utilised for producing a blue glaze; but I was not aware of it. Its chief use hitherto has been to spoil the tempers of analytical chemists and blast-furnace managers.

"Platinum in Filings" (query 62149, page 114) might be separated from the brass and soft solder by treating the filings with mercury; but I do not think the method would be of much value in practice. I should prefer to treat the filings with nitric acid; then boil with water, and remove all soluble matter. The heavy particles of platinum could then be easily separated from admixed metastannic acid by a stream of water; the last traces of tin could be removed by heating with strong sulphuric acid, letting the liquid cool thoroughly, adding twice its measure of hydrochloric acid, and then hot water, when all the tin will be found in solution.

"Butterine" (query 62245, page 185) is made by thoroughly incorporating carefully-chosen and prepared fat with milk and salt, and colouring the product with annatto or similar matter. No acid is employed, unless it be a trace of butyric acid. I am not aware that butterine is more digestible than ordinary fats, and very much doubt if any systematic experiments have been made on the subject. In my opinion, butterine is a very useful and, if carefully manufactured, harmless product; but, of course, it should be sold for what it is.

"Silica in Fluor Spar" (query 62187) can be determined, as described by "Sm." on page 160. The method given by M. Isader on page 184 is quite useless.

Sheffield, April 23. **Alfred H. Allen.**

HARDENING AND TEMPERING STEEL.

[27178.]—THE reading of your interesting article on the above subject revived in me a very old interest, which you, perhaps, will kindly allow me to mention in your valuable publication.

Fifty-eight years ago I heard an edge-tool maker of some repute in the South of Devon say, while holding in his hand a tool, the similitude of which may be seen supported by two brawny arms in front of the Curriers' Hall, London-wall, "There, if I could temper that sort of knife as required by the currier it would be a fortune for me, as there are only two makers in the world who can make such worth having." I got to know later on that the name of one maker was Cox, and the other Lane. I also got to know that the secret was how to temper a cutting-tool so that it would, after being brought to a fine cutting edge, bear that edge being turned aside so as to form a "wire edge" at an angle to the blade according to the hand of the workman, and which would in his hands cut "shavings" from a tanned hide or skin as large as half-sheets of note-paper and hold that cut for a day or two, aided only by the simple application to the "wire edge" of a small tool, called a steel (not roughed), now and again, when the cut legged.

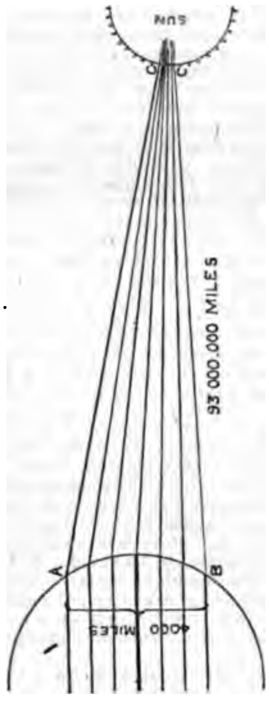
Now I think this a real secret tempering case. If anyone of your numerous readers would just say how the matter stood, and how it stands now, he would greatly interest an old reader of the "E. M."

April 25. **Hobbin Mill.**

THE SEXTANT AND ITS USES.

[27179.]—WOULD you let me ask some of your more impartial readers to tell me whether I am mistaken in the idea that neither quadrants nor sextants ever could have been constructed to be used on a spherical and rapidly-moving earth for taking the altitude of a motionless and very distant sun? From A to B is, say, about 4,000 miles. From one extremity to the other there must be thousands of ships at intervals of 50 miles at the very least. What and where is the instrument that could mark such infinitesimal angles as would be required under such conditions, to say nothing of the orbital speed of 1,000 miles a minute of the observer. I may be under some misapprehension, but I cannot at present see how it is possible.

Perhaps you might find room for my rough sketch. It must be remembered that from a base of 3,000 or 4,000 miles the sides of the triangle are distant from 93 to 95 million miles. I am sure there must be some among your readers who will understand the nature of my question and endeavour to solve it for me.



Let me, at the same time, ask another, which would, perhaps, be equally difficult: A base from the Torrid to the Frigid zones would be much within 2,000, or at least 3,000 miles. At one angle of this base the thermometer is often more than 120° above zero, while at the other it is often 50 and 60° below zero. The two sides of the triangle are put down at 93 million miles! How is the tremendous variation to be accounted for?

Balham. **John Hampden.**

DECAY OF TIMBER.

[27180.]—MANY timber trees, under certain conditions, speedily rot, while under other conditions they are almost imperishable. Basswood, in Canada and the United States, was sidered a poor wood for fencing, as it easily. Observations showed that with on it soon rotted, but without the bark it sound. The same thing is true of elm, lesser degree. Beech rots very early if e the elements, but under shelter remair If covered by water it will remain sou long time. Oak, if exposed to the weat its sap-wood, but the old wood remains s many years. I believe all young timbe either be put in water immediately after or put under shelter, as the young wood rot very quickly if it is alternately w dried. It follows, then, that deteriorati place to a far greater extent than we im letting young trees lie out in all weat their bark on, as they cannot resist wet having been first dried. In my opinion, should be either put into water immediat being cut, or at least when spring come absolutely necessary that all timber s water-soaked before any attempt is made It is a well-established fact that boards quicker if the logs have previously lain for the reason, perhaps, that the sap dissolved out of them. Of course, much on the nature of the wood, oak answering fencing where elm would be altogethe place, rotting very soon at the ground lev

J.

SCRAPS FROM MY WORKSH

[27181.]—THE jewellery of Southern hibits marvellous skill in the goldsmith's texture, the woven filaments of gold a more nearly resemble lace than any met stance, especially the manufactures of Tric and Cuttack. The former city has been brated for its gold chains. I remember o broken in England about 50 years ago, an long search a Chinaman was the only pe undertook to repair it. They are high-p the spot where they are made. Cuttack, (not far from the well-known Temple of naut), is equally celebrated for its fragil ornaments. I have a whole suite in sil pattern suggested to the workman by an man. This set is composed entirely of r fuchsia pendants to each piece of jewe delicate for frequent wear, and better ad show in a glass case. These silver orna much discoloured and tarnished from causes—the human perspiration, sea air, t sphere of gas-lit and smoky rooms. I v requested by ladies for information on them; but I did not then know how. Th to think of a way, and I astonished a sent me a suite much discoloured and when I returned the same to her spark white as snow.

Squeeze out through muslin a tea- lemon-juice. First scald the ornaments i of boiling rain-water, then attach a stout each piece, by which you can lower it int of juice; leave them there for a few hour dirty), then lift them out by the thread, cold rain water slowly over them to wa acid. Cut a few thin shavings of white to put in a block-tin saucepan with some bo water, beat to a lather with a stick; when solved, put on a hot hearth till it boils, all the jewellery by the threads into the boil a short time, remove by the threads time to a clean plate, pour boiling rain-w slowly over them, changing the plate seve to get rid of all soap. Lastly, lift then clean cloth, folded up on the top of a sto put before a hot fire; when quite dry, pair of clean gloves, cut off the threads, the ornaments each separately in tissue p

THE WOODTURNER'S HAND P

[27182.]—IN that practical book, the " Mechanics' Workshop," at p. 129-30, struck by the principles therein explain at once constructed a hand tool for rou linders of hard wood, and thereby saving and-tear of gouges and chisels. I hav over 15 years, and, excepting an occasio on the hone, the tool is as sound as ever 1½in. broad plane iron $\frac{3}{16}$in. thick, turn sharp end to a right angle; cut off the ot 2½in. long from the bend; cut off the tw drill two ¼in. holes in a central line on make two round-headed bolts 1¼in. screwed ends and nuts, for these holes brass plate with two corresponding h exactly on same shape of plane iron, plate ⅛in. thick. Make a brass wedg slope ½in. to ⅛in., 1½in. broad, 2½in. lo holes to correspond with both the othe Turn a hard-wood handle, and stock o pear, the flat part 2½in. long, handle 5 or holes through centre of flat. When all together by the two bolts, a gap must

FIG. 1

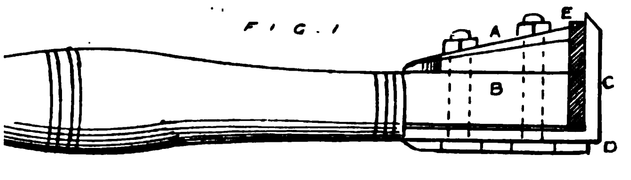
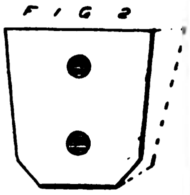


FIG. 2



the upright iron and the fittings for the cape of dust and shavings. The bevel is he edge, ½in. broad, angle 35°. A little will soon prevent "catching in." The gh and irregular the surface of the wood, r this tool works. The edge should be p.

DESCRIPTION OF FIGURE.

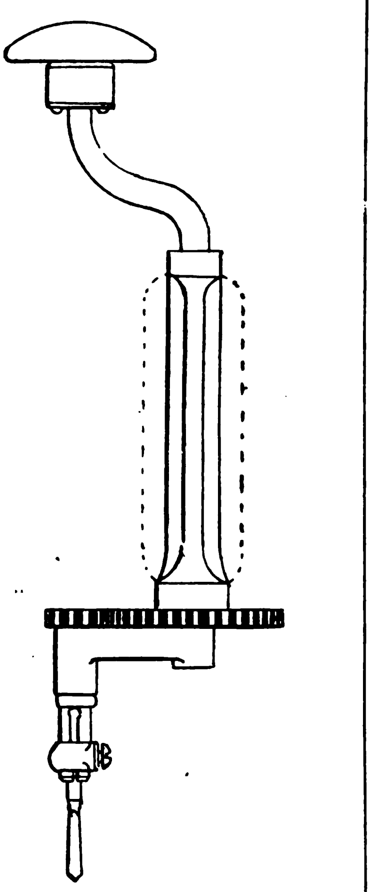
d-planer full size; A, brass wedge in place. ge A full size. When the plane-iron edge lown by use, this piece of brass can be ait. B, the flat part of hard-wood handle; nt plane iron; D, bottom plate of sheet round heads of screw bolts sunk therein; p for quick escape of the shavings.

Eos.

A GOOD HAND-DRILL.

]—IN my early experiments I often felt of a good hand-drill for work outside the l I bought every obtainable tool of that out satisfaction.

w-drill slips, and is too slow in action;



wheel drills are all abominable, especially erican ones: the more force you apply the stick and twist about, as the thrust is direction of the motion of the drill. A l drill I have seen used in Italy, and once e hands of a woman mending china. In lrill spindle has cast upon it a leaden nd from its extremity two cords pass the ends of a cross-handle which slides spindle. On giving the spindle a start ng the cross-handle, the cords twist upon e, pulling up the handle. On forcing handle the spindle reverses, and again he handle for another stroke. This is, I ery ancient form of drilling apparatus.

r drill, converting this alternating into s motion, I once saw doing good work. he spindle had also about it a weight flywheel; the end of spindle turned in Motion was imparted by pulling a cord ed by spring and ratchet that, on re- e cord at the end of a pull, it wound up ready for another pull, the spindle revolving continuously. This drill I saw in Churchill's catalogue; but he had given up their sale when I went to buy one.

After trying various plans, I succeeded in contriving a drill which I consider better than any I have seen, and which has been of good service to me. I inclose sketch of same. Last year I took out a provisional patent for it, and after paying my four guineas and making arrangements for its manufacture, I was informed it had been anticipated. I should like to know if any of your readers have seen this form of drill in the market? I had hoped to make a modification of a good tool for sculptors in marble in place of the bow-drill. I can recommend the drill-holder as excellent for small drills, as it is not "patent." Perhaps some of your readers can tell us of another good hand-drill.

Silke.

CHINESE PAPER VARNISH.

[27184.]—TO protect the covering and printed paper on their tea-chests, the Chinese always give one or more coats of the following wash:—Borax is dissolved in boiling soft water, then broken shellac is added; the pot is put on the fire until the lac is melted. It is applied with a brush while hot, and is waterproof.

Eos.

MEDICAL ELECTRICITY.

[27185.]—I MUST refer all of our readers who are doubtful or ignorant of its potency to the professional books I have already quoted on the subject—especially the "Guide to Medical Batteries" of Dr. Garratt. I will merely give my own last bit of experience. About 12 months ago a man who gained his living by angling for trout at night, and who used to supply my table with fish, was reported to me as unable to stand from enlarged ankle joints and swelled feet. He was advised to visit me, and with some difficulty reached my house on crutches. It appears that he got rheumatic fever through sleeping in a damp bed five years before. The wet grass and night fogs of this county in his occupation of a night-fisher had produced the late serious attack. About half a dozen applications of a Pulvermacher chain, from the toes to the ankle joints, cured him thoroughly; he has had no recurrence, and has been made a rural postman, with a daily beat of about three or four miles and back in a hilly country in all weathers. Where are the pills, and embrocations, and plasters which could have done as much?

In my own case I use no other remedy, and have just got an extra broad Pulvermacher, the effect of which is to throw out a wholesome eruption as a counter-irritant, which I have long ago found beneficial in my case.

Eos.

ELECTRO-PLATING—GAS-TAR COATING.

[27186.]—YEARS ago I obtained the following very interesting process for rendering all surfaces good conductors, and was constructing a glass apparatus for carrying it out, when I was obliged to leave my abode rather suddenly, and have not worked at batteries since. It may possibly prove a novelty to some of our amateurs. (1) Make a nearly concentrated solution of nitrate of silver in pure alcohol. (2) With a soft brush rub this solution over your moulds, whether guttapercha, wax, or plaster of Paris. (3) With a similar dry brush wipe off superfluous moisture. (4) Have a reservoir of sulph. hydrogen gas ready, and place your work, before the surface is quite dry, within a jar or other receptacle communicating with the gas by an indiarubber pipe. (5) This sulphide of silver is not inferior to graphite as a conductor. Fruit, or the soft bodies of reptiles will take a coating.

I suggest as a convenient form of cover to the articles the broad glass domes used by confectioners in the display of edibles. The decomposing jar connected with the same by the rubber pipe passing through a hole in the wooden stand of cover. Acetate of copper can be used instead of the nitr. of silver; but this sulphide is inferior as a conductor.

I could get no suitable receptacle for my argento-cyanide bath. I required depth, having two brass table-lamps I wished to plate; of course, I took the component parts to pieces, but the tubes (for holding candles), were still rather long articles to manage. I bought a new bucket of wood and saturated the interior two or three times with boiled tar, which soon dried hard under a tropical sunshine. I duly filled the tub with solution, and when this latter became in good working order I immersed some of my pieces, and connected them with the battery; I left them for the usual period, and then made an inspection of the contents. On lifting the brass work I was astonished at the dreadful black slime in which it was enveloped. "Here is a fearful mess, and a gallon or two of solution spoiled," said I. I poured boiling water over each article as I removed it, and how my feelings changed! The dirt was all washed away, and only a dull sort of film, like the bloom on fresh grapes, remained. A soft brush and prepared whiting soon brought out a lustrous surface, and I found I had produced a bright reguline deposit by mere accident. This must have been due to the sulphur and carbon of the coal-tar increasing the conductivity of the brass. I think, though, some of our electricians may be able to give a better reason. A BAVARIAN PROCESS:—(1) Argento-cyanide solution. (2) Coat the objects with zinc filings, and apply the solution. (3) When finished rinse the filings in distilled water; they can be used again repeatedly. (4) Coat iron with copper in same manner, using copper solution in cyanide, over which you can plate afterwards.

I only tried the first of these once, and failed; perhaps battery-power or solution were defective.

Eos.

AMMETER BY BOTTONE.

[27187.]—I SHALL have great pleasure in seeing an ammeter (patented, too), in the market, without magnets, and exceeding my idea of accuracy, at the modest price of 5s. The one I have I shall forward to Mr. Bottone shortly, as he states in his letter, and look for the new one eagerly, as it is a great thing to place a reliable instrument in the reach of students who have a lamp or two, and wish to measure what current it takes.

Iota.

"JOURNAL" OF THE ROYAL MICROSCOPICAL SOCIETY.

[27188.]—I DID not overlook "F.R.A.S.'s" first letter, and indeed, felt highly flattered that, contrary to my expectation, he had tried to follow my advice, and *inquired* before rushing into print, which was as it ought to be. I had, however, as I was sorry to see, so irritated him last year by what he styled elephantine (and which I thought microscopic) chaff, that I hesitated to point out that this time he had been the victim of a hoax. I would even still have suppressed it, but that, after his second letter (27115) your readers will be looking to me for an explanation.

That "F.R.A.S." made his inquiry at King's College none would deny—as he says so. When he got there, however, he met some irreverent wag who, being no respecter of persons, personated an authority of the R.M.S., and delivered himself of the ludicrous quasi-explanation reported by "F.R.A.S.," who straightway departed without to this day seeing how he had been taken in.

I should add that when I discovered this I made personal inquiry at the library of the society, and both officials (the only ones) certified to me that not only did they not give such an answer to "F.R.A.S.," but that no such inquiry, verbal or written, was addressed to them.

Advice to inquire is followed neither in letter nor in spirit unless you inquire of

One Who Knows.

DYNAMIC EFFECTS—OPTICAL PHENOMENON—SUPERNATURAL DARKNESS—AQUEOUS VAPOUR.

[27189.]—ABOUT the two experiments suggested by Mr. Wakelin, p. 128, I cannot doubt that the steel spring, already depressed, would be further depressed by any impact, however small; even a single ounce falling a single inch. The load that he supposes being hoisted would also continue its rise a little after being disengaged, however slow the hoisting were.

Any optical textbook ought certainly to have led Mr. Shrubsole, p. 154, to see the necessity of what he describes. The multiplied images imply the glass to be wedge-shaped. When he turns it there are two positions—that in which the thickest or thinnest part is next his eye, that opens out the images widest. At the two intermediate positions they close up; the section of the glass by a plane containing his eye being then a parallelogram, and a glass with perfectly parallel faces would give but a single image. Good sextant glasses do so.

The origin of the pulpit gammon at St. John's, Darlington, p. 156, happens to have escaped both "F.R.A.S." and "Amateur," pp. 173, 180; one of whom knows only of Phlegon, and the other only of the sham "Denys Areopagite." It is full two centuries, perhaps three, since the last attempts to defend the latter as aught but a forgery. The second century produced a swarm of forgeries on this Dionysius or Denys, first Bishop of Athens, because St. Luke, calling him at the end of Acts xvii., "the Areopagite," had implied him to be the highest-bred Christian yet made. An Areopagite, being a town councillor of the most cultured city on earth, was the nearest thing then to being now a French Academician. Well, this is how the self-styled "Areopagite" was represented writing to Polycarp (a man who could hardly have been born during Paul's convert's life). Addressing a friend, Allophanes, plainly not a believer, he asks, "What say you to that eclipse while our Saviour was on the Cross? For we both were at Heliopolis, and, standing together, we saw the moon eclipse the sun quite preternaturally, the time being far from that of conjunction. Nay, afterwards, from the ninth hour till evening, was she not diametrically opposite the sun?" This last absurdity hardly the most unlettered would have perpetrated. If the moon was in opposition (as she must be on the Passover day), how could they see her "from the ninth hour?" She could not rise till the twelfth. Later on, an unknown scribe, quoted by Suidas, invented for "St. Denys," or his friend, or both, the exclamation: "Either a god is suffering, or sympathises with some sufferer." Then, in the Middle Ages, this is modified into the Latin quoted by "Amateur," p. 180 (all the above having been Greeks), and so on till, at length, Darlington, in 1887, gets "a celebrated Egyptian astronomer." But the grievous point of this system, that Ruskin calls "hiring young consecrated persons to tell us in pulpits what they do not know," is that the preachers of such stuff are exactly the sort never to know nor inquire whether facts were supernatural, or were facts at all.

A failure or fainting of sunlight, at no lunar conjunction, and even such as to let stars be seen, is not supernatural in itself, but natural, though very rare. Plutarch, in the second century, reminded his readers they had all witnessed such an event. Again, for the shadow to go back on a dial is rare, but natural. I once saw a parhelion that certainly caused this effect. But if a prophet announced, as Isaiah to Hezekiah, that this would occur on his dial that afternoon, and it did, that coincidence of time would be supernatural. So was the coincidence of that extremely rare phenomenon, a darkened sun, happening the day and hour of the Crucifixion, and according to predictions of Amos, Zechariah, &c., centuries before. That it did so is certain by stronger testimony than Phlegon's. Tertullian would not have dared write this to heathens who had not publicly accessible chronicles containing it. On relating the darkness, he adds: "It is true that they who knew not that this had been foretold about the Christ, then thought it an (ordinary) eclipse. But on being reminded that this could not be [naturally] at full moon, they denied it to have happened; and yet you have it in your annals." Again, the martyr Lucian, A.D. 311, told them the same. Now the above alone, and still more in connection with the language of the pseudo-Denys (certainly of as early date, though a forger), shows plainly how the vulgar must generally have regarded the event. It passed for an ordinary total solar eclipse, and only those of some education would remark that the time of month was preternatural for such an event. It was during the early manhood, as "F.R.A.S." says, of Seneca, but only the boyhood of the elder Pliny; and both these writers were in their native provincial places, one of Spain and the other of Italy. Their neighbours would regard it as an eclipse, and none happened to remind them the season was unnatural. Only public chronicles in city libraries recorded that fact, as Tertullian says, "*yet you have it in your annals.*"

The silence of St. John is really somewhat stranger than Pliny's; but was fully carrying out his principle to supplement the other Gospels, and repeat nothing of theirs unnecessarily. Of all the sayings he ascribes to Christ, only that before Pilate had been told before; and of all the miracles he tells, only two had been told before, feeding the 5,000—the most public one—and healing Malchus's ear, the last before dying, and most benevolent one. Even the Transfiguration, which he and no other Evangelist had seen, he considered sufficiently told by others. Of course, then he would say so of this more repeatedly told prophetic fulfilment.

Again, the quotation from Phlegon (on which Whiston and others wrote some volumes) refers to no "eclipse" as we now apply that word; but to the Good Friday sun-darkening. He used the word *eclipse;* but so perhaps did St. Luke, for some early copies of him had "by an eclipse (i.e., fainting or failure) of the sun." The word had by no means then become narrowed to its present almanac sense. Phlegon is not quoted as using numeral words, like "F.R.A.S." on page 173, but only ciphers; either "In the year 4 of the 202nd Olympiad," or "But in the year of the 202nd Olympiad"—his *delta* with a stroke meaning perhaps 4, or perhaps only "But." Now, in either case, as "F.R.A.S." remarks, "the date disposes of the question"—settles it against "F.R.A.S." The "fourth year" (as he translates) would be from July, 32, to July, 33, in which twelvemonth no total solar eclipse happened to any part of the Old World. But if, as I think likely, Phlegon said only "the year of the 202nd Olympiad," this would cover any time within a year before or after the race-meeting of July A.D. 29. There was a total solar eclise in November of 29 and another in November of 30, and these were the only ones visible from Europe or Asia in that Olympiad, or in all the five years the Crucifixion has ever been deemed possible in; but the totality was in neither of these of so much as average length, nor did it occur at noon anywhere near Phlegon's country. Though he names no season, nor the year with certainty, and does not say the darkness lasted three hours, he most positively made it begin about noon, and called it the greatest (longest) ever known. Both these facts are contrary to any regular eclipse of those years. His words also most naturally (though not necessarily) connect this and the earthquake injuring Nikœa (the nearest large city to him) as contemporaneous. Many recent earthquakes have affected areas as large as might have reached to both Jerusalem and Nikœa.

"Kensingtonian" has been capitally answered by "F. C. S.," p. 176, as to the impossibility of iron decomposing steam in presence of oxygen, but the different meanings of "aqueous vapour" and "steam" have not been touched. I submit that the latter has irrevocably got so wide a meaning as to include both, all aqueous vapour (of high pressure or low) and all aqueous cloud besides; moreover, steam-cloud, from the most opaque to the slightest mist or haze, need not contain any aqueous vapour. The high cirri and marestails are often proved by the halo of 45° diameter that they produce round sun or moon to contain ice crystals. With this exception cloud and mist by no means consist (as "F.R.A.S." lately taught) of *droplets*, but always of *bubblets*. Any droplets, however small, would give, when your back is to the sun, the same two bows that a shower of rain does, and any spray-making machine will show this; moreover the quantity of water, if in droplets, to make such opacity as that of a locomotive's breath, or even your own in frost, would exceed the density of probably Noah's downpour. Even the heaviest tropical storm is not so opaque as a very slight English mist; all mist must be of bubblets, and the late discovery of dust being necessary to enable cloud to form suggests the probable cause of its buoyancy. If each bubblet has a dust particle, where can this be but in the centre? If this and the water-film be then similarly electrified repulsion may keep it distended with neither air nor vapour, but a vacuum between the solid nucleus and film, rendering the whole a balloon. Hardly ever does cloud or fume fall through air (as droplets always would), but commonly rises. I had a remarkable case of this last summer on seeing, for the first time, fuming ice. Blocks of ice were being moved in London on the morning of a hot day that soon became very rainy. The cooled layer of air, pouring from each block's top down its sides, condensed the invisible vapour into cloud, just as hydrochloric acid gas would do. This first fell to the pavement, but then immediately curled up and spread higher than its orgin before dissolving. Now, as the mere rebound of heavy bodies cannot carry them up higher than their starting place, here was plain proof of the fume being buoyant in air, which no droplets could be, but bubblets may be. Clouds not opaque enough to hide the sun will give him the coloured rings called *coronæ* (far smaller and commoner than the halo), whence Brewster showed how to determine the size of the bubblets. They may sometimes have, instead of dust, ice crystals for nuclei, and so produce the coronæ and halo together.

24th April. **E. L. G.**

P.S.—"Amateur" says, p. 180, that Dr. Smith's "Classical Dictionary" treats of Denys the Areopagite, without giving the eclipse story; but in the same editor's "Dictionary of Greek and Roman Biography, &c.," 1844, I find it gravely related, though the article proceeds to deny that any genuine relic of Denys is extant, and the sole source of this "incident" was one of the numerous forgeries in his name.

THE SUPERNATURAL DARKNESS ON THE FIRST GOOD FRIDAY.

[27190.]—ACCORDING to the "Encyclopædia Britannica," it was Dionysius the Areopagite, mentioned in Acts, 17th chapter 34th verse, who is credited with making the observation alluded to. He was, according to Suidas, an Athenian by birth, and eminent for his literary attainments. He studied first at Athens and afterwards at Heliopolis, in Egypt. Whilst in the latter city he beheld that remarkable eclipse of the sun, as he terms it, which took place at the death of Christ, and exclaimed to his friend, Apollophanes, "Either the Divinity suffers or sympathises with some sufferer!" Chambers's and Kitto's "Cyclopædias" make statements to the same effect.

A few years ago, Dr. Thomas, minister of Stockwell Chapel, London, and editor of the *Homilist*, published a series of discourses entitled "Resurrections: Thoughts on Duty and Destiny." On the first page of the 7th discourse he says: "The crucifixion of Christ was signalised by phenomena in nature the most extraordinary and terror-striking. The material creation seemed to have been moved into convulsive throes of sympathy with the last agonies of the Son of God. The sun refused to shine, and the earth robed herself in mourning. 'From the sixth hour there was darkness over all the land until the ninth'—that is, from twelve o'clock, our mid-day, until three in the afternoon. All the region round about Jerusalem was wrapped in mysterious gloom. This darkness was not a natural event, it was not a common eclipse of the sun, for it was at the time of the Passover, and that was at full moon, when an eclipse is impossible. Besides, a total eclipse can never last longer than a quarter of an hour. It is reported that Dionysius in Egypt observed this portentous gloom, and exclaimed, 'Either the God of Nature is suffering, or the machine of the world is tumbling into ruin!'"

Albert Barnes, in his New Testament Notes on the 27th chapter Matthew 45th verse, says: "A dark, thick cloud, shutting out the light of day, and clothing every object with the darkness of midnight, was the appropriate drapery with which the world should be clad when the Saviour died. This darkness was noticed by one at least of the Pagan writers. Phlegon, a Roman astronomer, speaking of the fourteenth year of the reign of Tiberius, which is supposed to be that in which our Saviour died, says 'that the greatest eclipse of the sun that was ever known happened then, for the day was so turned into night that the stars appeared.'"

I should like to see what "Sigma," or some other of our critical contributors, have to say about the possibility or impossibility of the above reported occurrence. **James Eatock.**

Grange Brook, Hindley, near Wigan,
April 18.

[27191.]—IN reply to Mr. Arthur Gardner, the astronomer who, seeing the overspreading shadows, exclaimed, "Either the gods are suffering, or the mechanism of the world is breaking up!" was the Egyptian Dionysius. There are traditions of the supernatural darkness reaching other countries.

It is worthy of note that both Tertullian, at the beginning of the 3rd century, and Lucian, the martyr of Nicomedia, who died in 312, appealed to the national archives as testimony to the fact of the supernatural darkness at the death of Christ. "Examine your own annals," wrote Tertullian to the Romans, "and there you will find that in the days of Pilate, when Christ died, the sun disappeared in full day, and the mid-day light was interrupted." **Dorsetiensis.**

[27192.]—I AM no less surprised than shocked to find that men can venture in the present day to cast suspicion on the veracity of the New Testament writers. Dionysius the Areopagite dwelt in the city named Heliopolis, in which was an academy devoted to philosophy and divinity, and its authority in all the arts and sciences was universally acknowledged. Dionysius and his learned contemporaries were far too familiar with the true facts of astronomy than to describe the supernatural darkness at the Crucifixion as an "eclipse"; and those who dare to make such assertion only betray their own ignorance or bigotry. The exclamation of Dionysius, as quoted by "Amateur," was recorded by Josephus and scores of the fathers whose writings were published during the lifetime of those who had been eye-witnesses of the events recorded. The Evangelists themselves published their Gospels in their own lifetimes, and openly preached, and boldly asserted the truth of the facts there recorded. We have no need of such confirmation as was given by Dionysius: we have the far more indisputable evidence of uncontradicted testimony of both friends and foes, that there was such a phenomenon as three hours' darkness in midday, while none but blaspheming infidels have ever ventured to describe it as an "eclipse"; and, most unquestionably, it was never so described by even any of the heathen writers. Neither true science nor "pseudo-science" has a word to say upon the subject; and writers only expose themselves to the derision and contempt of honest men when they dare insinuate doubts as to facts which have never been gainsaid or refuted for nearly 2,000 years. Do let me urge "Amateur" to invest 2s. in a copy of Paley's "Evidences," and Keith's "Demonstrations." It ought to be unnecessary, in this professedly enlightened age, to have to argue in favour of the truth of New Testament history. Any doubts upon the subject are as unscientific as they are impious, whether it respects the Old or the New. So the "woful trash in the shape of pseudo-science" comes rather from the professors than "the pulpits."

Balham, S.W. **John Hampden.**

[27193.]—Referring to this abnormal phenomenon, we are not bound to find an astronomical cause for it. The reality of the fact hinges upon the veracity of the narrative and the *bona fides* of the historian. There is no hint that the three hours' preternatural darkness was due to an eclipse of the sun, or anything of the sort. The implication intended to be conveyed by the narrator is that it was a miraculous event, symbolical of the temporary extinction of the "light that had come into the world." We are a little too prone to seek in astronomy for a solution of certain Bible mysteries.

The "Star of Bethlehem" is a case in point. That which had the appearance of a star was not necessarily a star at all; nor is it a self-evident fact that the Magi were astronomers following the track of a star in the upper heavens till it attained a vertical position over the place "where the young child was"—a thing altogether incredible, and contrary to science and the simplicity of the narrative. On the same principle, the "fiery sword," said by one of the prophets to have been hanging over Jerusalem, has been erroneously supposed to be a comet! The genius of the Bible is altogether opposed to such a notion. Doubtless these appearances were as phenomenal and exceptional as the "burning bush."

Scarboro, April 23. J. C. H.

ON THE LAWS, REACTIONS, AND CONSTRUCTION OF SOME FORMS OF PRIMARY BATTERIES.

[27194.]—This is the first of a series of letters which I propose to write in "Ours" on above subject, and, as I should like to make the series as complete as possible, I should feel obliged if makers of different batteries would send me particulars for publication, reserving to myself, however, the right of selecting those which have something good or novel in them, and omitting such as are simply Groves's or Bunsen's.

In this first letter I must treat of Ohm's law, which is the first thing necessary to learn before we can possibly understand the behaviour of any form of battery.

This law, then, is that the strength of the current is equal to the electromotive force divided by the resistance. Now, this resistance means not merely the resistance outside of the cell, but also the resistance of the cell itself; hence we should write it thus— $C = \frac{E}{R + r}$ where r = internal resistance of the cell.

Hence it is plain that E.M.F. current and resistance are so mutually dependent on one another that any change in one affects all.

Hence, if we have a battery running one lamp well, and switch on another lamp, we halve the external resistance, and ought to double the current; but we don't, because, as more current is passing through the cell, the internal resistance rises, and a greater portion of the total E.M.F. of the cell is consumed in overcoming this resistance, and so less is available for use outside the cell. Consequently, we obtain two lamps in circuit, neither of which give as much light as the one did before.

To get the same light as before we have either to reduce the internal resistance of the cells, or else add another cell to raise the E.M.F., so as to overcome the additional resistance. When $R = 0$, we can only increase the current by reducing the internal resistance, as if we add fresh cells we also add fresh resistance in the same proportion.

In all textbooks the statement is made that the best result is obtained when the external resistance is equal to the internal. This is quite correct; but for lighting purposes it is far preferable to have the external resistance at least three times the internal. The reason for this is that a certain definite quantity of zinc consumed in any form of cell when zinc is used (and the same can be said of any other metal), if we neglect local action, will always produce a certain definite quantity or current density; for example, 1·2133 grammes of zinc will always produce, if consumed in an hour, 1 ampère hour of current—this is independent of E.M.F.; consequently, if we want to run a 50-volt lamp taking 1 ampère, if we use those cells I described in former letters, we should only need 26 of these, and each of these would in one hour consume 1·2133 grammes of zinc, or 30·3325 grammes in all. If, on the other hand, we used Daniell cells giving only 1·07 volt per cell, or 1 volt in practice, we should have to use about 50 of these (more, in all probability), each of these also consuming 1·2133 grammes of zinc, or 60·665 grammes in all, being just twice as much zinc as before.

In the same way, if we took those cells that I have been writing about, and instead of taking their best discharge of 6 or 7 ampères from them we took 13 or 14, we should reduce the E.M.F. very much, and so would have to use more cells to make up for this, and as each cell consumes its 1·2133 grammes per ampère hour, each cell added means so much more zinc consumed.

In this case, then, we have to maintain our E.M.F. very high in order to economise our zinc, and by economising our zinc to also economise our oxidant.

This last remark leads to the chemical action of a cell, which I shall treat more fully shortly, but at present must content myself with saying that a certain quantity of zinc, in combining with a certain quantity of acid which, by combining with the zinc sets free a certain (equivalent) quantity of hydrogen—this hydrogen would, in a battery, be given off at the negative plate were it not for the oxidising solution which, containing a certain portion of its oxygen loosely combined, parts with this portion to the hydrogen, which combines with it to form water. Hence it will be seen that for every given quantity of zinc consumed a certain portion of the oxidant is deprived of its usefulness, and, consequently, the less zinc is consumed to do a certain amount of work, the less oxidant is used up. I hope in my next to go into the chemical reactions of different cells at greater length, but will trespass no further at present.

Electrician.

ON MAGNETISM AND ITS POWERS.

[27195.]—Some letters on magnetism and its effects, which appeared in your columns in Vol. XLIII., disclosed the fact that very little is known of that mysterious force, which in its simplest and best known form resides in a piece of steel which has once been subjected to an electric current. What is it which gives that little bar the power to attract and hold with some tenacity other pieces of steel? I do not know, but I should like to hear opinions; and I thought, therefore, I would send you some remarks from Mr. Force Bain which appeared recently in the *Electrical Review* of New York. The writer says, pertinently:—

One of the most familiar phrases that greets the ear when talking of electricity is, "Electricity is only in its infancy." Do we ever hear any one say that magnetism is only in its infancy? Have we ever heard any fanatical enthusiast exclaim that there is "nothing impossible with magnetism?" Susbstitute the word electricity for magnetism, and the sentence becomes a "chestnut." How quickly the "electric telegraph" usurped the more appropriate appellation, the "magnetic telegraph." Probably very many of a younger generation would hardly comprehend the meaning were an "old timer" to speak of the telegraph as the magnetic telegraph. Once it was the electric-magnetic, but now electricity does not divide the honours in any way, but keeps all. Electricity without the aid of the electro-magnet was a complete and dismal failure for telegraphic purposes. I for one am ready to call a halt. While there has been so much thought and time given to the study of electricity, I cannot see why magnetism has been so shamefully neglected. Since the discovery of electro-magnetism by Oersted in 1819, very little advance has been made in a theoretical knowledge or practical application of such knowledge. Every capable electrician is familiar with the absolute and practical units of electrical measurement. Various galvanometers, voltmeters, ammeters, wattmeters, &c., have been devised for measuring the properties of the electric current. Can any one direct me to an instrument for measuring magnetism? There is no such instrument in the market, and if I had such an instrument how could I measure and express the magnetic units, since there is no name for them? To investigate the laws and properties of magnetism understandingly, the unit of resistance is as essential as the ohm; the unit of potential as necessary as the volt; the unit of strength as important as the ampère, and the units of quantity and capacity as desirable as the coulomb and farad. The only means of measuring magnetism at present is by comparison—the strength of an electro-magnet can only be approximated by calculation from an electrical standpoint, which leaves out of the question the material and condition of the core of which the electro-magnet is composed. DuMoncel, Jamin, and Deprez have given some excellent ideas n regard to the practical construction and proportions of electro-magnets, but their results have been wholly arrived at by experiment, and have not been demonstrated by mathematical calculation. We are all familiar with the error made in the proportions of the field magnets of the dynamo of one of the largest and most prosperous electric-light companies extant. Compare one of its short magnet machines of to-day with one of the older forms; observe the difference in length and material, and reflect upon the necessity of a more thorough knowledge of this important branch of electro-kinetics, magnetism. I can cite a hundred experiments which show that magnetism requires a conductor; that this conductor offers a resistance to its passage. Why not have a unit of resistance and a means of measuring it? I can show that magnetism is limited by the capacity of the conductor—why have we not a unit of capacity and a means of measuring that capacity? Density of magnetism should be arrived at in a similar way, and so should residuary charge, condensed and consequent magnetism. And the element of time in electro-magnetism, too, is a more important factor than is usually considered, if considered at all. In some experiments the persistence of magnetism has proven to be the vital element of success, while in others it has been as the death-knell to hope; and yet by a knowledge of the practical construction of electro-magnets, this persistence may be varied at will. I say a knowledge—I mean such knowledge as is gained by patient labour and experiment, which is an expensive way of acquiring knowledge, but the same results might be attained far easier by mathematical calculation, if there were only a starting point —if we possessed certain definite units of measurement expressing the various qualities of this most subtle of all forces. I do not assert that magnetism cannot be measured, or that its strength cannot be calculated; but I do say that it is only done comparatively. It is a very easy task to construct instruments which will accurately measure in practical units the various characteristics of permanent or electro-magnets—in fact, the writer has such an instrument, which he has constructed and used for several years. Its readings are comparative, but well understood by its possessor. It detects, if there exist, any consequent points in a field magnet; it indicates the degree of saturation of the magnet, and shows the direction of the lines of force. As magnetism is the kinetic force of most all electrical apparatus, in order to produce the best effects through this motor agent, is it not well to give it some thought and study? A magnet, either electro or permanent, is a simple thing of itself. Very possibly its very simplicity may account for its being so utterly ignored. An iron bar, having a bit of wire wound around it, with a current of electricity passing through the wire, will become magnetic, and this is the way electro-magnets are too often constructed, without any attention to detail. The length, size, shape, or mass at the core is not properly considered; the position or location of the coil, the proportionate length or thickness, the manner of connecting the coils in circuit, seem hardly to be matters of particular consequence. Latterly we have heard something said about the number of ampère turns to produce certain effects; but this is an electric, not a magnetic, expression.

Mr. Bain thinks that if more attention were devoted to the study of magnetism more strange things would be discovered than are dreamt of in our philosophy, and I think he is right.

Brooklyn. J. B. G.

USEFUL AND SCIENTIFIC NOTES.

Migration of Herring.—A remarkable illustration of the puzzling migratory habits of the herring has just been observed on the south-west coast of Norway, at the so-called Jæderen, between the towns of Stavanger and Egersund. This district used to be one of the richest herring-fishing grounds in Norway during the spring, but about 25 years ago the fish suddenly and completely disappeared from the coast. Last month enormous shoals once more came under shore, first "striking land" at the same spot as in former times. The quality of the herring is exactly the same as it was 25 years ago, and the shoals were accompanied by numerous "herring" whales.—*Nature.*

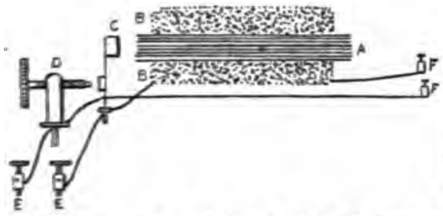
Plates of zinc, such as are used in lithographic and zincographic establishments, may be spoiled by a single drop of water being left on them by inadvertence. Mutton fat is an excellent means of preventing oxidation and the influence of humidity. Before using it, the plate must be rubbed perfectly dry with a smooth and clean linen rag; then the fat is lightly rubbed over the surface. When the plate is to be used again, the grease may be easily washed off with spirits of turpentine. This process is used with the best results in German and Austrian lithographic establishments.

It was formerly the practice in the locomotive department of the Philadelphia and Reading Railroad to draw the anthracite fires after each trip, and light up afresh. This involved a large expenditure of wood, owing to the immense grate area of the Wootten engines, and the expense for kindling wood was very considerable, and a large number of men were employed in looking after the fires. After some experiments, it has been determined in future to sprinkle the fires with a small quantity of soft coal at the end of the day's work. The fire then remains alight until needed next day. The saving in cracked fire-box sheets is also expected to be considerable, as the temperature is, of course, more uniform.

REPLIES TO QUERIES.

⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

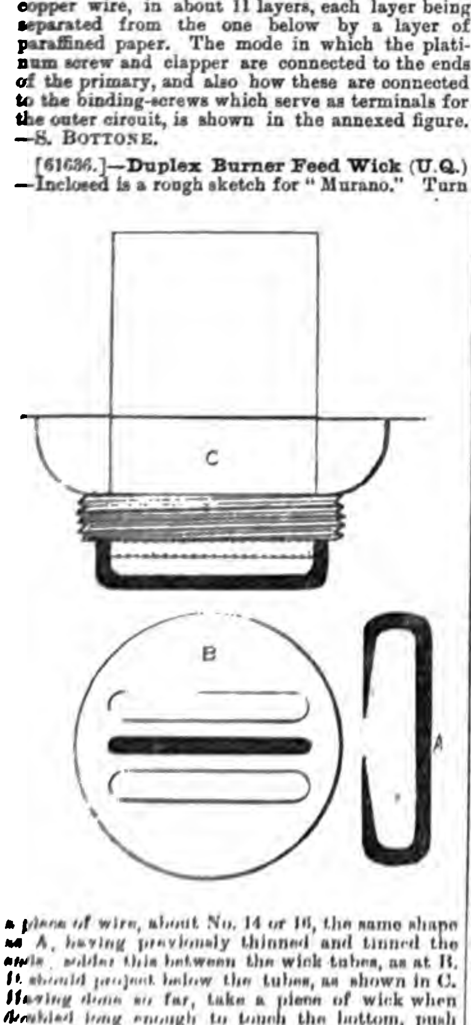
[61498.]—**Induction Coil (Medical).**—In the ordinary run of cheap shocking coils there is no secondary coil at all; and unless a current of high intensity is required, it really is not needed. I have already fully described the making of a medical coil at No. 1,121, Vol. XLIV. of the "E. M." But I give a brief outline of the mode in which a coil may be made up with a single coil of primary wire. Take a bundle of iron wires (about No. 18 gauge) ½in. in diameter and 4in. long, put a layer of brown paper over it, and glue it round. When dry, dip it in melted paraffin wax.



A, iron bundle; B B, layers of wire; C, clapper; D, platinum-tipped screw and pillar; E E, terminals for attaching the handles, &c.; F F, terminals to which the battery is connected.

Now wind on about ¼lb. of No. 26 silk-covered copper wire, in about 11 layers, each layer being separated from the one below by a layer of paraffined paper. The mode in which the platinum screw and clapper are connected to the ends of the primary, and also how these are connected to the binding-screws which serve as terminals for the outer circuit, is shown in the annexed figure. —S. BOTTONE.

[61636.]—**Duplex Burner Feed Wick (U.Q.)** —Inclosed is a rough sketch for "Murano." Turn



a piece of wire, about No. 14 or 16, the same shape as A, having previously thinned and tinned the ends, solder this between the wick tubes, as at B. It should project below the tubes, as shown in C. Having done so far, take a piece of wick when doubled long enough to touch the bottom, push one end through loop, sew both ends together just below loop and midway also. This will give you no trouble for a long time. The feed wick will only want renewing about once in six months. Write again if necessary. BRONCENICUS.

[61678.]—**Walnut Veneer (U.Q.)**—Take a piece of thin sheet iron and put it on the outside or round part of the walnut, when you take it out from the steam, and turn both together; keep it close to the wood; that will prevent the grain from rising.—J. W. M.

[61716.]—**Lighting by Primary Batteries.**—I am very sorry I have not been able to reply sooner; but I was prevented from writing before. In reply to "Electrician," I may state that I have tried several batteries for electric lighting, but have had no success in working direct, though I succeeded fairly well by using secondaries. I have spent over £100 at this branch of electrical science, so I think even "Electrician" will see that "I am writing what I know, and as much as I know, but no more." I have tried the Higgins battery to charge accumulators, and it did well, by using the solution to best advantage. I myself have tried a small Upward battery, and I know of two of my friends who have had great success in lighting a small house with an old-type set. The Schanschieff battery I know most of by hearsay, but I was quoting the words of an electrician who tried some cells not so very long ago. I still maintain that direct working by any primary battery except Schanschieff's is so troublesome and expensive, that it can only be taken up as an advertisement, or as a test in a laboratory. We all know it is quite possible, but could not become anything like general.—IOTA.

[61717.]—**Chemical Precipitate.**—TO MR. HARDY.—Many thanks for reply. I have tried adding excess of ammonia, but with no effect. Adding more silver nitrate appears to slightly reduce precipitate. I don't think the silver can be impure, as I have tried several samples. The precipitate usually occurs in about an hour. It is at first a dirty drab colour, but turns black in a few days. The amount of precipitate is about one-fourth of the silver and copper combined.—J. B. BLEW.

[61839.]—**Twist-Drill Apparatus.**—My best thanks are due to those correspondents who have replied to my query. "R. T. J.'s" method of making twist drills is, however, not quite what I want; but I shall wait with interest to see his drawing of an apparatus in the ENG. MEC., and I hope it will appear soon. "Vulcanite's" reply is more like what I require. However, I do not see why he should begin by saying that he found the manufacture of twist drills a waste of time, and then name four practical methods of manufacturing them. Besides, in No. 1 the cutter would work parallel to the axis of the blank, and could hardly produce flutes for different-sized drills, except I had cutters of different diameters. No. 2 was condemned as impractical when it first appeared in the ENG. MEC.; and "Vulcanite" now names two more objections to the apparatus. I presume a prefix is omitted from the word "stability." No. 3 seems to be just what we amateurs want, but no particulars are given. No. 4 is out of the question altogether, and only fit for manufacturers. I hope "Vulcanite" will kindly give more particulars of his third method, as now used by himself. Could he not send drawings of it to "Ours"? I am sure it would be welcomed by many of us. I have read Mr. F. Carre's letter on the subject with great interest. The forging process would hardly suit me, as I take great pride in the appearance of my tools, and a drill so made must be a more or less rough-looking affair. I should like to try his method for making smaller drills; but I fear it would mean having a separate twisted handle for each pitch of drill. This, to me, would be a fatal objection. I have done a good deal in model work, and if I had an apparatus capable of making twist-drills with the lathe (a consummation devoutly to be wished) I should have no dread of not being able to produce satisfactory results, although only—A COUNTRY PARSON.

[61840.]—**Re Gas-Engine.**—For the size of engine you require, the cylinder would have to be ⅜in. thick at least, the size of inlet ¾in. wide, and 1⅛in. long, the exhaust about the same; it would not hurt being a trifle bigger; power, 1½ man. If "G. E." would like further help, I would gladly give it him. I have just made an engine about the size he wants, and it might serve as a model for him. He can advertise his address in the proper place for addresses.—H. F. F.

[61901.]—**Sewing Machine.**—I should advise to loosen the set screws on rocking-arm, and move needle-arm a little to the left; then screw up both side screws and set screws, so that looper clears needle; then adjust looper so that point of looper comes to needle when the eye is about ⅛in. below point of looper when needle is just rising. Try this, and if correctly done will work right.—J. I. S.

[61907.]—**Telephonic.**—Would "Zirconium" kindly advertise his address, as I do not care to make the information asked for public. If he cares to do as suggested, however, I shall be very pleased to help him as far as possible.—IOTA.

[61947.]—**Electrical Query.**—"Ajax" might be recommended to read such a book as Sprague's "Electricity," and then he will be in a position to put more definite queries if, which is unlikely, he finds it necessary to a comprehension. I suppose he knows that the bulk of the work appeared in the article columns of this paper, and therein was subjected to the criticism of the keenest critics. Those who opposed Mr. Sprague's views most strenuously have, in many cases, acknowledged that his is the best theory yet published. For other information "Ajax" might refer to recent volumes.—NUN. DOR.

[61950.]—**Photo. Enlargement in Crayon.**—This querist was answered in the number following the insertion of this, his second query; and as to that, all that can be said is no one can answer without seeing the apparatus. It does not seem difficult to throw a carte-de-visite (life-size) on to a screen; but the apparatus will not do the crayon business—the "artist" will have to do that. —J. M. T.

[61951.]—**Legal: Dentists Act.**—In reply to "Os," "L.D.S.Eng.," and "M.D.," and to save the repetition of charges of ignorance, &c., either in regard to the Dentists Act, or anything else dental, I may just say that I am a regular dentist of forty years' experience, registered, and all the rest; so that to me the Act is a matter of perfect indifference in any way whatever. But my sympathies are all in favour of my poorer brethren, and I fail to see any just reason why they should be crushed by any Dentists Act whatever. It's an Act with which I have no sympathy (having been behind the scenes), as, no matter what the pretences are by which it is justified, it is, in reality, nothing more nor less than a barefaced attempt to create a monopoly, by seeking to place the whole dental business of the kingdom into the hands of the comparatively few who have money, and by preventing the more numerous but equally worthy regular dentists (who happen to be guilty of the awful crime of being poor, or comparatively so) from entering into practice for themselves, and by blocking up the road to improving their position so crowd them together as to cause a fall in salaries (low enough now), and so add to the profits realised, or expected to be realised, by the favoured few. It is a beautiful scheme certainly. Whether it will be successful or not is more than I can tell; but I should doubt it, as in the event of prosecutions being pushed against the regular dentists, and their being stripped of their rights as citizens under the common law, the public will soon begin to "smell a rat," and, as is the case nowadays, steps would soon be taken to remove the injustice—the more especially as this Act was got by representing dentistry as being a profession, while in reality it is a trade, and a dentist is nothing more nor less than a skilled mechanic and a manufacturing tradesman. Of course, I know perfectly well that this is awful heterodoxy to the (let us pretend to be a doctor) clique; but it's the sober truth, and not only so, but the profitable part of the dental business is the supplying of artificial teeth, and if there was nothing more to be got out of it than what stoppings and extractions would bring, there is not one of the men who talk so largely of the "dignity of the profession" who would so much as touch it with their little finger, and the instant that any invention should be brought out that would enable artificial cases of teeth to be made in stock, and kept in drawers, so as to fit anyone in a few minutes, like hats or boots, why, the exodus of those highly dignified and faluting men would be a "sight for the gods." And now, as regards the pretence put forward for this Act—viz., "the protection of the public"—it's a huge piece of imposture; the public never asked for protection, and, not only so, they never knew they required it, and the ignorance among the public is simply profound as to the existence of this Act. And no wonder, there is such a supply of dentists, from the man who does sixpenny extractions and half-crown stoppings (and does them well), through all grades up to the one who gets his one, two, and more guineas for the same thing, as also the supplying of artificial cases from 3s. 6d. per tooth up to three and four guineas for the same. The demand is met by the supply, and the very common phrase is so often heard nowadays ("my dentist"), showing that there is general satisfaction, as at present the public can exercise their judgment; but if the Act could be enforced, the public in general would either be compelled to employ the monopolists with their very high charges, or go without. "M. D." asks for my definition of a "regular dentist"; why, it's simply this: a regular dentist is one who enters the business by the legitimate door of a regular apprenticeship under a stamped indenture, the same as in any other trade, according to the custom of said trade, in contradistinction to the man who, having failed in something else, takes to dentistry, and calls himself a dentist, and I place medical men and surgeons in that category, the same as the barber or any other man. Dentistry is an art of which any man who is competent may be proud; it is well able to stand apart on its own proper basis, and does not require or deserve the degradation of being made an out-work, or tailed on to the medical profession, and neither dentists nor the public require to be bothered by any such "paternal" legislation as this miserable "Dentists Act."—DENS.

[61952.]—**Hot-air Engines.**—The vessel referred to by "E. W. O." (the *Ericsson*) was intended to show how much more economical the hot-air engines might be made than were those in the Cunard liners then running. A good many trips were made, during which Ericsson learned much, and he obtained another patent in 1855. The vessel did actually run from New York to Washington, but used an enormous amount of tallow. She was subsequently fitted with steam-engines and boilers; but what was her ultimate fate I do not know.—SAML. RAY.

[61954.]—**Lamp and Bellows for Blowpipes.**—There is an oil lamp by Col. Ross on page 175, 1048, which may suit this querist, and a good deal about bellows and blowpipes in back volumes, as he will find if he looks through the indices. He might read Shenstone's little book on "Methods of Glass Blowing."—C. T. L.

[61959.] — **Clearing and Cultivation of Forest Land.**—"Borneo" might find what he wants in Todd's "Colonial Agriculture," published by Spon at a guinea; but works of the kind desired are more likely to be published in the United States and Canada than in this country.—SILO.

[61962.] — **Windmill for Pumping.**—As "Mechanical Power" apparently does not want to construct his windmill pump, I might suggest that he will find all details he requires in back volumes, or in the catalogues of makers. Messrs Warner and Co., of Cripplegate, will no doubt be able to supply him with a suitable windmill pump, or those who have recently written on horizontal windmills can possibly help him.—C. K.

[61966.]—**Balancing Fast-running Pulleys.**—It seems to me that this querist should read an article entitled "High-speed Machines and the Art of Balancing," in Vol. XXXVII. p. 328. He will also find several notes or articles on the subject in back numbers; but it is of too technical a nature to describe in answer to a vague question.—SIMPLEX.

[61975.]—**Singing Flames.**—A gas-bag filled with coal-gas and weighted can be used, of course; but it would be a waste of energy and experiment with singing flames in such conditions.—NUN. DOR.

[61976.] — **Galton's Whistle.** — I believe a description of Francis Galton's whistle has appeared in these columns—about the time the exhibition of scientific instruments was open at South Kensington (1876); but Mr. Bartel can easily ascertain all about it by inclosing a stamped envelope to Mr. Galton, or by calling at Mr. Hawksley's, 307, Oxford-street, W. Messrs. Tisley, of 172, Brompton-road, S.W., made the whistles for Mr. Galton. The base of the inner tube is the foremost end of a plug which can be advanced or withdrawn by means of a screw having 25 threads to the inch. The more nearly that plug is screwed home the less is the depth of the whisle, and the more shrill the note becomes.—N. E. CHILD.

[61982.]—**Gas-engine Bag.**—There is no rule; but obviously the bag ought to be large enough to contain more than a single charge for the engine.—T. K. L.

[61984.]—**2 H.P. Gas-Engine.**—I should think the best thing "H. W." can do will be to read up Clerk's book or Macgregor's, and then invent his own engine. He will, however, by referring to back volumes, find an almost complete chronological history of the gas-engine.—J. R.

[61986.]—**Thermopile.**—If "J. H. B." must have such a thermopile as he hints at, he would probably find the requisite details in No. 750 (Sudré's); No. 790 (Noé's); and so on; but if he wants current at an economical rate, he will not trust to thermopiles.—NUN. DOR.

[61988.]—**Peroxide of Hydrogen.**—Methods of using peroxide of hydrogen for bleaching have been frequently given. See an article on the subject so recent as July 2, 1886, p. 389. There are others, I am sure; but have not time to look them up.—E. N.

[61989.]—**Calculating Speed of Launches.**—There is no rule for calculating this, so much depending on the build of the launch. For steam-vessels Rankine's method is as good as any. Power required equal the area of augmented surface in square feet multiplied by the speed in knots per hour and cubed; then divided by 20,000. See formulæ in Macrow's "Pocket-book."—J. M. C.

[61990.]—**Turret Clock.**—The convexity will depend to a certain extent on the projection of the arbor carrying the hands; but an eighth of an inch should be ample thickness for the glass.—SELMO.

[61993.]—**Cotton Belting.**—I should dress the canvas thoroughly with Stockholm tar dissolved to a thin solution in wood naphtha: but possibly steeping it in boiled linseed-oil might suit your purpose.—J. B. C.

[62002.] — **Centrifugal Pump.**—No; cannot be used to make a vacuum unless a valve is fitted to prevent return of air drawn out. The Messrs. Gwynne could, no doubt, give querist all particulars.—E. R. S.

[62003.]—**Irregularity of Watch.**—It is not likely that anyone will even attempt to guess the cause of the irregularity. Keep it always in one position, and then see how it behaves.—HOROLOGOS.

[62008.]—**Bright Parts of Machinery.**—The composition desired was mentioned on a page preceding the query, but I think in the majority of cases the bismuth is omitted and tin substituted.—FOUNDRY.

[62010.]—**The New Herz Telephone.**—This new telephone, which somehow obtained a splendid advertisement from the *Times*, can no more be made for half a crown than the report sent over can be trusted? Here is a description I have seen:—On a board, measuring about 5in. by 10in., is fixed a call bell, to the terminals of which wires are brought on the back of the board from the telephone proper, which is placed just underneath, the terminals serving for the line and battery wires, one of them being common to line and battery. The transmitter is contained in a metal box screwed to the board; and the telephone receiver is fitted over with a bayonet joint, and is removed when the instrument is used for speaking. The central button serves for the call, and when pushed it rings a call bell at the other station. When the receiver is placed over the transmitter, one of the pins of the bayonet joint presses back a spring, thereby breaking connection with the microphone, and establishing connection with the bell circuit. In this condition the instrument is ready to receive a call from the other station or to transmit one. Upon removing the telephone receiver from the transmitter, the spring recedes, the connections are changed, and the latter is now in circuit with the battery and the primary of a pair of induction coils. In this condition the instrument is ready for speech. The carbon block is held in a disc of ebonite, of the same diameter as the diaphragm; and the induction coils, as well as the different springs and contacts, are all placed behind the diaphragm. The Herz telephone was described so long ago as No. 831; but the above is no doubt an improvement.—NUN. DOR.

[62022.]—**Photographs.** — There are several causes for prints appearing flat and bad colour when toned and fixed. First, they may have been under-printed. If they are not deeply enough printed to start with, they never look well at the finish. Secondly, they may have been over-toned and over-fixed. If you tone too long you will get a flat, grey colour. You should stop the toning just about chocolate tint or a little darker. Thirdly, the effect may be due to poor negatives; a thin and poor negative will yield only flat and poor prints, whereas a brilliant negative, with plenty of contrast and pluck, will give brilliant prints, which tone well. I do not mean, of course, to advocate an under-exposed and chalky printing negative. Try the bicarbonate of soda toning bath.—ICTHIUM.

[62055.]—**Musical Clock.**—Divide the distance round barrel into 32 equal parts by drawing small lines from end to end. This will be your guide for time. Then mark as many lines round barrel at equal distances apart as you have bells. This will be your guide for the different notes in one tune. Pins for another tune must be put $\frac{1}{16}$th of an inch on one side of the note lines, and so on till the barrel is full, the time lines being the same for all the tunes. The easiest tunes to put on would be those having 16 bars in them, as there would be two time lines to each bar of music. I suppose you understand music. If not, I doubt if you will manage it. I may say I have pinned eight dance tunes on a barrel on the above plan to act on the hammers of a small piano, and it answers well, playing and repeating the tunes in correct time, which is not so in some of the paper organs I have seen. I wish an abler correspondent would give a little advice on pinning barrels. I think it has been asked for once or twice before.—FISH.

[62068.]—**G. and S.W.R. Engines.**—I am obliged to "G. and S.W.Ry. Fitter" for his reply. The *Railway Engineer* is responsible for the mistake as to valve-gear, as some years ago it gave an elaborate view of a Sou'-West bogie, something similar to 136 class, fitted with the valve-gear in question, while the text was misleading in not showing that the engine existed only on paper. Can "G. and S.W.Ry. Fitter" kindly give similar details of the four bogie tanks No. 1 class?—G. H. F.

[62123.]—**Mounting Emery Wheels.**—In all the composite wheels I have bought the holes are quite smooth and true, in those I have made I did it with a hot iron rod in circular stones after they were cut and bored by the workman; I had to true them with compasses, and then smooth the holes with emery. I hear that "bort," or black diamond, is the only way of cutting and repairing emery wheels, steel being useless. "F. C.'s" plan of two wheels on a spindle, the centre left blank and both ends screwed well, do very well on a proper chuck. I should prefer cast brass flanges, or turned brass, to ferrules. All depends on the work you intend to do; mine is only light, and occasionally small lathe tools, and cutting on the 3in. wheels. I use the best steel rods for such small wheels. I find 3in. or 4in. apart suffices for my work; the steel rod may be $\frac{1}{2}$in. to $\frac{3}{8}$in., according to the likely strain on the same. All my larger wheels of emery kind are mounted on single spindles of clean rod iron, screwed and fastened with shoulder disc and nut, rod $\frac{1}{2}$in. thick. I keep them on a rack in proper order; they require much grease to keep down rust.—EOS.

[62145.]—**Ammeter Constant.**—"Ohm," in issue of April 1st, makes some statements that accord well with that date, and can therefore be excused. He accuses me of asking questions that are ridiculous, but does not state what they are. I await his reply, and shall then give him full satisfaction. I maintain that friction does more harm to the accuracy of a galvanometer if the moment of its needle is small than if it is large. I leave "Ohm" to account for the change in my Bottone ammeter, and having recalibrated it, must say I am very pleased with it. I don't recollect saying that the Thomson galvanometer "was subject to the same newly-discovered changes," nor do I see where I have made "a gross mistake."—IOTA.

[62181.]—**Lunar Clefts, &c.**—To "F.R.A.S."—Many thanks for reply. My reason for thinking that the effect of a meteor on the moon's surface would sometimes take the form of a cleft or deep furrow was that such of these bodies as become visible to us in our atmosphere move in many cases (especially at the commencement of their visible path, before their own proper motion has been reduced by friction in our atmosphere) in nearly horizontal lines. The moon having little or no atmosphere, the effect of a solid body with a high velocity of its own, approaching it in a path nearly tangential to its surface, would surely be to form a furrow in that surface. I do not know if the velocity of meteors in space is usually such that the moon's pull on them would invariably reduce their paths to nearly perpendicular to its surface. If so, they would, of course, only pit the surface. Is their speed always so low as this? It is the curious way in which these clefts appear to be carried through mounds and other irregularities of surface which gave me the idea that they might be formed by a rapidly moving body ploughing along and through the surface.—TAU.

[62182.]—**Electric Clock for Factory.**—I am exceedingly obliged to "Electrician," "Sm.," and H. Austin for their notice of my query and suggestions. The idea of "Electrician" and H. Austin are the same, and I think good. Will H. Austin kindly say how I can prevent the bell ringing during the night, for the circuit must be quite ready to ring at five minutes to six in the morning? The only way that I can see is to have a 24-hour clock. I could arrange to have the circuit broken from one o'clock on Saturdays till Monday morning. I may say that I only want the clock to start a relay so as to ring a large gong fixed in a tower on top of the works to be heard for about a quarter of a mile round.—MANUFACTURING ELECTRICIAN.

[62183.]—**Wooden Pendulum.**—"A. W." may be pleased to hear that I have a wooden pendulum to my eight-day house clock in satisfactory use for over sixty years. It was made immediately after Capt. Kater, among his many clever inventions, proposed to make them. Mine had a lead bob 14$\frac{1}{2}$in. long by 1$\frac{1}{2}$in. diameter, and is supported at bottom on a washer and screw nut; the rod is deal (I believe yellow pine) $\frac{1}{2}$in. diameter, split or cleft from the plank so as to retain the straight grain all through; it was put in a piece of gas-pipe, filled up with linseed oil, put up a large kitchen chimney, and left there for some weeks to soak the oil; when taken out it was finished and varnished. I have never tested it very closely for compensation; but I know that it is over-compensated, and would be improved by taking an inch off the bob. Zinc is a better material for the bob, it may be a trifle shorter, and is a more rapid transmitter of temperature. Should "A. W." be in town, I shall have much pleasure in showing it to him.—ROBT. J. LECKY, 3, Lorton-terrace, Ladbroke-road, W.

[62183.] — **Wooden Pendulum-Rods.** — The general impression has hitherto been that astronomers were rather a knowing sort of folk—as folk go—and when they gave long pric
clocks, and urged clockmakers to do the
design and workmanship, they knew wit
what they were about. It has even been
that their demands, severe though the
had no little influence in improving clo
also been supposed that an astronomer w
a clock at all had the means of test
manner that admitted of no illusions
But it seems that all this is itself an ill
astronomers have been giving £100
that they might have obtained for a

of shillings, getting a better clock withal at the lower price! For, according to "Sm.," all the astronomer in search of a clock has to do is to get "an eight-day clock, reverse the escapement, making it a dead beat, fit a wooden pendulum-rod, and attach a lead bob by a pin at its centre of gravity," and then congratulate himself upon the cheapness of his clock. Whether he will congratulate himself on anything else is perhaps another matter. Seriously, is it possible that astronomers have all along been throwing their money away in the absurd manner suggested by "Sm."; or, on the other hand, is that gentleman quietly poking fun at them? Feeling that this ought to be cleared up, I would respectfully ask "Sm." if he would explain what he means by "reversing the escapement to make it a dead beat"? A sketch or diagram would, of course, be very serviceable in this connection. Also, how the alteration in length in a wooden pendulum-rod can be compensated by a lead bob attached by its centre of gravity to the said rod? And again (though this is a mere detail), if the bob is attached by a pin instead of resting on the usual regulating nut, where and how the regulation is effected? And if, finally, I might ask one more question, how was the rate of this wonderful clock ascertained, and the fact that its performance was superior to the "£100 astronomical clock" demonstrated? Being a little sceptical about miracles in general, and a hardened unbeliever with regard to *mechanical* miracles, I may perhaps be pardoned for a slight want of faith in "Sm.'s" astounding bit of mechanism, and excused the desire to be further enlightened about its details and performance.—W. J. R.

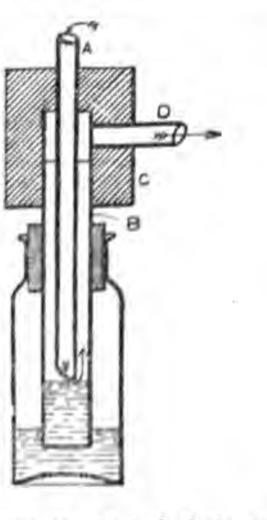
[62184.]—**Steam.**—In my reply inserted in last number of "Ours" the position of crank should be O B instead of O A. The rest of the diagram remains as before; the angle between crank and eccentric is thus B O C, and to cut-off at ¾ stroke B O C.—ELAG.

[62184.]—**Steam.**—In the diagram of valve motion *re* this query published this week, I think "Elag" has misunderstood the querist, as the angular advance should be 30° from O D, which is position of eccentric when crank is at O B, the peculiarity of this (which is known as Zeuner's) diagram being that motion of crank is reckoned from A in direction of arrow, instead of from B in the reverse direction.—T. C., Bristol.

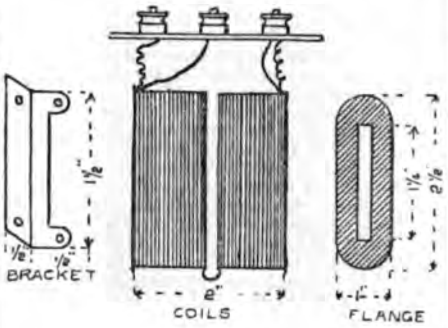
[62202.]—**Granite Turning.**—In the reply to this query (p. 184) by "Eos," he mentions his being unable to get corundum in England. If he were to apply to the Messrs. Ash and Sons, 8, Broad-street, Golden-square, W., they might either supply some or inform "Eos" where to get it. Thanks for many hints in his pleasant letters.—DENS.

[62202.]—**Granite Turning.**—"Eos" (and Holtzapffel also, if he says so) is wrong in supposing granite cannot be turned in the lathe. Messrs. Farmer and Brindley, of Westminster Bridge-road, London, have turned columns upwards of 20ft. long, and are frequently turning smaller sizes. They are first chipped, then put into the lathe and turned with a steel tool, and a very slow speed, then ground with sand, next with first and second grit, and finally glossed with putty powder, all used with water. They frequently chip in turning, and when necessary pieces that chip off are stuck in with shellac. When finished the joints are invisible.—F. F. GARRETT, Dunstable.

[62203.]—**Incubator (Thermostat for).**—I send a design of a very simple thermostat for use with gas if that can be had; I do not know Hillier's patent. A is a glass tube through which gas enters and descends into a tube B, reascending through B to a space in the cork C, and issuing through glass tube D. A little mercury at bottom of the bottle rises as air in upper part of bottle expands, and closes the gas-way. The bottom of A is cut aslant, the bottle should be long; stopper made air-tight with paraffin. Temperature adjusted by sliding A.—GLATTON.



[62205.]—**Detector Galvanometer.**—"Quieppe" will find that a galvanometer with a combination of 500 and 5 ohms is most useful for ordinary requirements, more especially line testing. The high resistance is made up of 36 B.W.G. silk-covered wire, and the quantity is roughly 8oz. The low resistance is 26 B.W.G. silk-covered wire, about 4oz. The exact quantities will have to be ascertained by careful measurement with bridge. I have sent rough sketch of principal parts, with measurements, and hope you will succeed in making a good instrument.—H. B. EDWARDS.



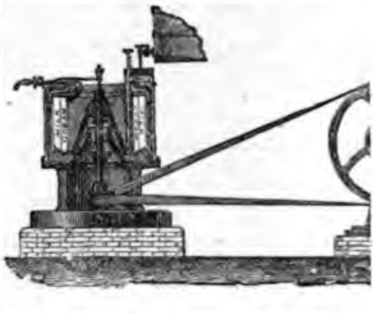
[62209.]—**Relation of the Resistance of the Field Magnets to that of Armature in all Dynamos.**—1. The theoretical resistance in a series-wound machine (suitable for arc lighting) of field magnets should be the same as armature; but in small machines practice shows it more satisfactory when armature resistance is a little less than fields. Again, theory shows in shunt-wound machines the field magnet's resistance to be about 400 times that of armature; but in practice 300 times would be much better.—G. J. BROWN.

[62210.]—**Celluloid.**—Celluloid can be softened in boiling water or at an equivalent temperature. This is the way in which it is usually worked for knife and umbrella handles, &c., so as to avoid waste. It, however, can be turned and tapped just like brass, and is a pleasure to work for the amateur who forms shirt studs and various knick-knacks from it. It is rarely made larger than 1¼in. diameter. The edges and surfaces of celluloid can be effectually joined by a solution of celluloid in sulphuric ether, or acetate of amyl, or camphorated spirit, and one or two other solvents. A joint so made is as good as if the two surfaces were one solid piece. The price to the public per pound is from 7s. to 13s.; but lower prices are quoted in the "Sixpenny Sale Column" for Feb. 25th of the "E.M."—PAUL WARD.

[62220.]—**Mildew in Silk.**—Wash with gin, and put in the sun.—HENDON.

[62229.]—**Induced Currents.**—In the case referred to by querist, he is confusing primary and secondary effects. The primary effect produced by approaching a permanent magnet to a soft iron bar inside a coil of wire is to make that bar a magnet *pro tem.* If the north pole is approached, it induces a south pole in the end of the bar nearest to it. This produces a momentary secondary effect by inducing a current in the coil which would tend to reverse the magnetism, if strong enough. But the very fact of this tendency must be to weaken the induced current by reducing the power of the inductor magnet. The reasons, then, why the magnet is not reversed are: 1. The loss by magnetic inertia. 2. The loss by inefficiency of conversion of magnetism into electricity. 3. The loss by the induction of the current reacting on the magnet, and so also on itself. 4. The effect of the magnetic lay in preventing the momentary current from affecting it. 5. The proximity of the stronger permanent magnet.—ELECTRICIAN.

[62199.]—**Separation of Cream from Milk.**—The machine referred to by "Grass" is the Danish Cream Separator, which was awarded the gold medal at the Inventions Exhibition. Its action is as follows: The milk to be separated is placed in the tank over the separator, whence it runs through a regulator on top of the separator; this regulator has a conical tube, inside of which slides a rod, shown in the above cut. According to the position of this rod, the inflow of the milk is regulated; the drum, which is made of pressed steel, is carried by a conical spindle, this latter carrying also the pulley for driving the machine. On the top plate of the separator will be seen in the cut two spouts; the action of these is most peculiar. When the drum is rotating at the necessary velocity for separation, varying wit
of the drum and quantity of milk, these
by means of the screw regulator screwe
drum until they touch the walls of skim
cream; the steel points of these tubes ke
off the cream and milk, which then
through them. As shown in the cut, th
provided with an internal flange; this,
does not reach to the edge of the drum
⅛in. When separation commences, the s
or heavier portion, is forced furthest



centre of the drum, rises through the ope
in the internal flange, and would, if the s
tube were not in use, travel between t
and the top of the drum until it cam
opening, whence it would be expelled by th
fugal force. By means of these two t
cream can be obtained of any desired con
as by screwing the skim-milk tube furthe
drum, more is taken through this tube
other; if it is screwed outwards, more of
milk is removed with the cream. "Gr
find the address of the sole agents in t
column.—H. E. M.

[62232.]—**Speed Pulley.**—I have seen
gany pulley on one of Holtzapffell's
GLATTON.

[62232.]—**Speed Pulley—Lignum**
This you would find about as difficult t
cast-iron. However, the woods you h
should not split if properly bored and
HENDON.

[62232.]—**Speed Pulley.**—I don't un
"as soon as I get the mandrel put right"
you will bore the wood a few days before
it and put it in a dry place to dry thoroug
then dress out hole afresh before final
mandrel for turning, it may cure it, as I
may be the wood springing on the mandrel
cause of splitting. I have used beech.
Bristol.

[62235.]—**Honey.**—By taste, smell, and
of sediment when subjected to heat, and b
cal and microscopical tests besides. If
information is desired, I will look up some
on the subject by Otto Hehner, analyst to
Beekeepers' Association.—J. I. S.

[62241.]—**Piston.**—The piston cannot
well, but easily. The rings should be
little larger than piston, and then cut and
in, when they tend to recover original d
and consequently fit the cylinder closely.
Bristol.

[62244.]—**Large Field Eyepiece.**—In
with the microscope and camera lucida, an
of half the power and interchangeable
usual A eyepiece, giving, say, a power
13 with the 2in. o.g., 110 with ¼in. o.g., w
very useful if the field remained as ap
large as with the A eyepiece. Will som
kindly describe in ordinary everyday Engl
to make it, giving the foci of the lenses
distance apart in inches, and stating the f
the lenses thus—bi-convex, plano-conve
simple or achromatic?—O. P. Q.

[62246.]—**Steam Ferry.**—There are
such as you describe, but on a larger scale,
Portsmouth and Southampton. They have
fixed to each shore, which the engines wind
drop astern.—T. C., Bristol.

[62246.]—**Steam Ferry.**—The mouth
Itchen, east side of Southampton, very
answers to "Jack's" description, and h
crossed by such a ferry, worked now, I think
years. The mouth of Portsmouth Har
treated earlier, was its exemplar.—E. L. G.

[62249.]—**Proportional Size of F.M.**
a Motor.—So long as you adhere to your
pattern, there will be little or no gain in
the F.M.'s. Were you using a Siemens or a
armature I should say use F.M.'s at
times as heavy as the armature. If the
is series wound, let the F.M.'s and the
nearly balance one another in running re
Lay as much wire on the F.M.'s as will
section three times what the section of

ore itself is, and put on such a gauge of wire as ill nearly balance the armature. I append a list f gauges and conductivity, which is given by early every wire coverer, and also by Sprague.

No	Decimal of an inch.	Equivalent in m/m.	Yards to the lb., approximate.		Ohms per lb., approximate.	
			Silk covered	Cotton covered.	Coppr.	G. Silvr.
0	·134	3·35	6	6	·01150	·161000
2	·100	2·45	9	9	·03417	·478352
4	·080	2·03	15	15	·08500	1·19000
6	·062	1·58	25	24	·22392	3·13488
8	·048	1·21	45	41	·69000	9·66000
0	·041	1·04	64	59	1·2100	16·9400
2	·032	·802	119	109	3·1000	43·4000
4	·025	·650	167	156	7·0000	98·0000
6	·019·7	·482	266	244	26·219	367·066
3	·016·0	·406	414	383	52·137	729·918
0	·014·0	·353	542	500	88·493	1245·20
2	·010·0	·276	870	800	126·00	1764·00
4	·009·6	·248	1,170	1,080	402·00	5628·00
5	·008·7	·221	1,475	1,360	596·41	8349·74
6	·007·9	·200	1,660	1,530	877·23	12281·2
38	·006·8	·183	2,480	2,280	1177·0	16478·0
40	·005·8	·158	3,050	2,805	2300·0	32200·0
	·005·0	·125	3,090	3,585	6000·0	84000·0
	·004·0	·100	5,700		14000·	196000·
	·003·0	·075	9,800		42812·	599368·

—S. BOTTONE.

[62252.]—**Hydraulic Ram.**—This looks as if the valve in air chamber does not fit properly, and also pulse-valve, which does not appear to drop well to seat, and so cause recoil of water, which assists fall of pulse-valve. Bending of delivery-pipe should not affect ram; but are you sure your joint of air-vessel is sound also?—T. C., Bristol.

[62252.] — **Defective Hydraulic Ram.** — Doubtless your trouble arises, as you suggest, from air in the drive-pipe sucked in probably through the pulse-valve during the recoil, and owing to the dip in the pipe not swept out before the next stroke, but accumulating until the impact becomes too feeble to work the ram. Weighting the valve simply delays its rising, and gives the water more time to gain velocity—the stronger flow sweeps out the air at each stroke, and the ram works stably but more slowly. Increasing the length of the stroke would have the same effect. I presume yours is a small American ram with no air-chamber on the drive-pipe, which accounts for you having had no previous trouble with it.—W. A. S.

[62254.]—**Creasote in Consumption.**—Several of my friends have undergone treatment with this inhaler without suffering from any irritation, provided the directions were fully carried out.—S. BOTTONE.

[62254.] — **Creasote in Consumption.** — Creasote, or, better still, carbolic acid, is useful in many catarrhal ailments where there is much irritation of the air passages. It acts when inhaled off a Coghil's inhaler as a local anæsthetic. After the discovery of the Bacillus tuberculosis by Koch, great hopes were entertained that it would act as an antiseptic and germicide; but these hopes have not been realised. Nevertheless, as I have said, its use gives great relief in cases where the cough is troublesome. The inhaler may be worn night and day for weeks with perfect safety.—DOCTOR MEDICINÆ.

[62255.]—**Spiral Cracks in Glass Bottles.**—These you can make by heating a poker in a forge fire and applying to bottle. This will produce a small crack, which you can make travel fairly in any direction with care by following up with the hot poker.—HENDON.

[62255.]—**Spiral Cracks in Glass Bottles.**—In my country (Italy) the street jugglers often amuse a gaping crowd by cutting a thin tumbler into one continuous spiral by means of a pencil made of a mixture of powdered charcoal, saltpetre, and gum water. This is lighted, and when it burns with a red glow, is drawn along the surface of the glass, when a cracked line follows the point of the pencil. There is absolutely no difficulty in doing this, only the "knack" that practice gives.—S. BOTTONE.

[62255.]—**Spiral Cracks in Glass Bottles.**—"R. H. H." can make spiral cracks in glass bottles by first filing a deep line where he wants the spiral crack, and then making a pencil of the following things:—

Lamp black	180	grammes
Gum arabic	60	„
Benzoin....................	23	„

Mix the whole into a stiff paste with water, and then make into the form of pencils, and dry. Sharpen one of these pencils to a point and then ignite it. Then work up the file mark, when the glass will crack where the file mark is. Or, if he does not want the trouble of making a pencil, he can heat a piece of steel or iron wire ground to a point, and then work up the file mark. The file should be moistened with turpentine and camphor. —OMEGA.

[62257.]—**Keying Permanent Way.**—Please refer to page 561, Vol. XXXVIII. (or the number for Feb. 29, 1884); you will there find a long letter from the able pen of "C. E. S." It gives much more information than can be given in these Reply columns.—AN OLD MEM. SOC. ENGS.

[62257.]—**Keying Permanent Way.**—When the keys are placed inside all danger from spreading of the rails is avoided, even if some keys do fall out; but the line is made very rigid, and chairs are sometimes broken in consequence. Outside keys, by introducing wood between the rails and the chairs, provide a certain amount of elasticity, reduce noise, and prevent the breakage of chairs. For further details as to the pros and cons., I would refer "J. O. B." to pages 25, 26 of my "Railway Safe Working."—CLEMENT E. STRETTON, 306, City-road, London, E.C.

[62261.]—**Electric Lock.**—A great deal depends on the length of "Rachos's" purse. I think I could suggest a plan to him if he would write to me.—ELECTRICIAN.

[62262.]—**Engine Query.**—At end of stroke piston is 4ft. distant from centre of shaft. When crank is at right angles the piston is $\sqrt{5^2 - 1^2} = 4{\cdot}9$ft. from centre of shaft, or $4{\cdot}9 - 4 = {\cdot}9$ft. from end of stroke, and since stroke = 2ft., $1 - {\cdot}9 = {\cdot}1$ft. from middle of stroke.—ELAG.

[62262.]—**Engine Query.**—Consider the connecting rod as the hypothenuse of a right-angled triangle; the base would then be $\sqrt{5^2 - 1^2} = \sqrt{24}$, or 4·89ft. = 4ft. 10¾in. The crosshead, and therefore piston, have travelled 5ft.—4ft. 10¾in. = 1¼in. past half-stroke.—T. C., Bristol.

[62262.]—**Engine.**—Let A B = length of crank, C D length of rod; then $\sqrt{AB^2 - CD^2}$ = distance of centre of piston from centre of crank − 5 = distance from centre of cylinder $\therefore \sqrt{5^2 - 1^2} = 4{\cdot}899 - 5 = {\cdot}101$ft., or 1·212in. from centre of cylinder. —THOMAS T. MASON, New Delaval.

[62263.] — **Azaleas, Cultivation of.** — The treatment of azaleas is similar to the so-called "American plants": they have fibrous roots, which are seriously injured or killed by drought; at the same time they must not be soddened. The azalea should be planted in "heath mould," or where this is not obtainable, a substitute may be manufactured by mixing thoroughly silver sand, leaf mould, rotten sawdust, rotten tan, little bits of stick, and any vegetable refuse. A moderately cool and shady house (free from frost or damp) will do very well for the azalea after flowering until such time as it is desired to force them again for blooming. There are many hardy varieties which stand the winter well out of doors, and these do best (like their relatives the rhododendrons) in situations where they are sheltered by trees. But the great secrets of culture are heath mould and equal moisture.—S. BOTTONE.

[62263.]—**Azaleas.**—These are very delicate subjects to manage: I have a great number of them—have one smothered in bloom of various colours, others (the larger and finer plants) have not a single flower bud. They come from different places; the last named have evidently been neglected, though they have abundant green leaves. When bloom is over, promote growth by syringing frequently with tepid rain-water; give plenty of this when cold winds are over; eventually, if you have pure country air, put the pots out under a north wall till the warm nights are over. In winter keep out frost, and no more, as they like a temperate clime. For very early blooming, some artificial warmth is requisite. My stock has been in a cold greenhouse, only turning on heat in the worst periods of this last bad winter in a northern county. When transplanting, remember the roots are very susceptible of injury. Sandy peat and pasture loam make the proper soil. Mine were shifted in early spring months and never turned a leaf.—EOS.

[62265.]—**Marine Boiler.**—I think the figures you give are wrong. I make total heat in steam at 280° = 1082 + (280 × ·305) = 1167·4°, which is therefore that in the steam evaporated and which had 1167·4 − 100 = 1067·4° given to it, while that blown out had 280° − 100 = 180° given to it. As the entering water is $\frac{1}{33}$, and water in boiler is $\frac{2}{33}$, it is evident half is evaporated and half blown out, so boiler receives 1067·4 + 180 degrees of heat, and blows out 180° = 1247·4 ÷ 180 = $\frac{1}{7}$ loss, or 100 ÷ 7 = about 14 per cent.—T. C., Bristol.

[62266.]—**Steam.**—Work done in 24 hours = 18·75 × 62·5 × 19 × 7·25 × 60 × 24 = 23,245320ft.-lb., or $\frac{23245320}{32\text{cwt.}}$ = 726416ft.-lb., or units per 112lb. of coal.—ELAG.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Broscenicus" has replied to 61636; "J. W. M." to 61668.

61701. Gas-Engine, p. 552.
61706. G. and S.W. Locos., 552.
61708. Superphosphate, 552.
61713. Ferrules, 552.
61718. Leeds Parish Church Organ, 552.
61723. Moulding Rubber Goods, 552.
61734. Iron v. Steel, 553.
61736. Harp, 553.
61744. Emery Wheel, 553.
61749. Lathe Matters, 553.
61758. Legal, 553.
61760. Fan, 553.
61761. Table of Sizes, 553.

61953. Loco. Engines, Narrow Gauge, p. 67.
61858. Photographic, 67.
61978. Perambulator Wheels, 68.
61979. Seibert's No. 7 Water Immersion, 63.
61995. Casts, 68.
61998. Reversions, 68.
62005. Battery with Non-Conducting Elements, 63.
62007. Plaster Trusses, 68.

QUERIES.

[62269.]—**Turkish Baths.** — (1) What is the best system of heating Turkish baths, two rooms, 24ft. by 14ft., heat from 140° to 180° Fahr.? Is it best to use coal or coke, and what kind? What amount of fuel per week would it require? (2) For hot-water baths, what would be the average cost per bath for water alone, not including the heating of the water? What is a good system for hot-water baths?—LIVERPOOL.

[62270.]—**Parochial Law.**—Can anyone tell me of a book which gives an account of what I may call parochial law? I want to learn how vestries and boards of guardians are elected. What is the qualification of the candidates and voters, and how the election should be conducted? Similarly with regard to the jury lists, both special and common. How are they prepared, and who (what official) makes them up? I have looked in several likely works, but can find nothing whatever, practically, about subjects which one would think must be of interest to many—all ratepayers, at any rate.—C. KERR.

[62271.]—**Petroleum Engine.**—Wishing to make the above, I should be glad to receive instructions from some kind reader as to how these are made, and whether it would be a success to drive a small launch or workshop. —R. A. WHEELER.

[62272.]—**7in. Spark Induction Coil.**—TO MR. HIGGS.—I should be greatly obliged if you would furnish me with the following particulars: (1) dia. of circular heads, (2) dia. and length of core, (3) thickness of paper insulation over iron core and thickness of vulcanite tube to incase primary, and (4) how far to wind the primary from the ends of iron core and distance between circular heads for secondary wire? I wish to wind in three sections, and obtain results, if possible, with about three or four bichromate cells.—ENGINEER.

[62273.]—**Water Mark**—Please inform us the best method of putting in a water-mark, or imitation water-mark, into paper after manufacture. — DOUBTFUL, Wolverhampton.

[62274.]—**House Lighting by Electricity.**—On page 483, Vol. XXXVII., "E.M.," Mr. T. P. Barkas partly describes a battery, and then goes on to say: "I anticipate that in a few weeks these batteries will be fairly before the public; but in the mean time I refrain from naming the inventor." Consequence is we have heard no more about them. Also, he says: "The attention of the readers of the 'E. M.' is directed to a voltaic battery for lighting purposes, described by Lord Bury in the *Nineteenth Century* for July." Would some able correspondent describe one or both of the above batteries?—L. J.

[62275.]—**Vapour of Linseed Oil.**—I am about to make varnish from linseed oil, and should like to know if it would be dangerous to lead the vapour (arising from the oil) into a shaft or flue where it might possibly come in contact with fire?—E. C. M.

[62276.]—**Piano Soundboard.** — I am making a small iron-frame mechanical piano, four octaves complete, from F below the bass stave upwards; but I don't know how to proceed with the soundboard. What kind of wood should I use? How thick should it be to give a good loud tone with wire, size 22, for tenor C? Can I get the board in one piece, say 2ft. 8in. wide, or should I have to join it?—FISH.

[62277.]—**White Shellac Varnish.**—In your issue of April 8th, there appeared a letter from "Three Compasses" dealing with the preservation of paper scales by means of coatings of shellac varnish. Would "Three Compasses," or some other of your readers, kindly tell me how to make best white shellac varnish (with alcohol, not methyl) for the purpose of preserving paper scales?—DRAUGHTSMAN.

[62278.]—**Dynamo.**—Would Mr. Bottone kindly give dimensions for dynamo of Mather Platt type, with laminated Pacinotti armature, suitable for arc lamp of 2,000c.p.? Also say which would be the best plan of winding—compound, series, or shunt?—BROMIDE.

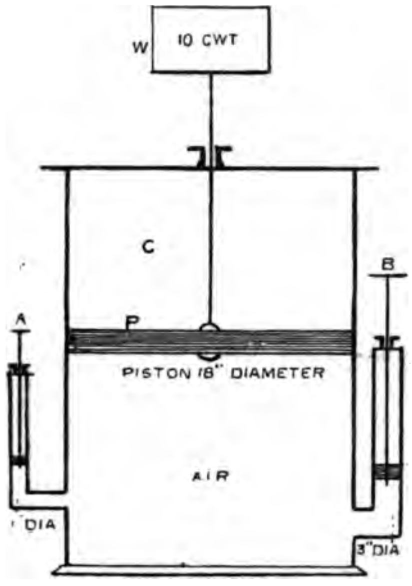
[62279.]—**Door Springs.**—Will any of "ours" kindly tell me what is the best kind of spring to put on an iron gate, size 7ft by 5ft, to make it shut? Would the following do? A square bar of steel same length as gate, one end fixed to bottom of gate post near the hinge, the other end fixed to top of gate, and centre of bar fixed about centre of gate, the bar to be free to twist at this point. If so, what size of bar would be best, and is there any special make, and where to be had ?—JUMBO.

[62280.]—**Warming a Chapel with Hot Air.**—The chapel seats about 600 people, and contains about 4,700c.ft. Will some reader of the "E. M." kindly say what should be the respective dimensions of the hot air chamber, furnace and flues, and inlet and outlet openings for the air ?—H. P.

[62281.]—**Valve Gearing.**—Will someone inform me whether it is necessary for the reversing quadrant link of a locomotive to have its radius struck from centre of crank shaft, as is generally the rule, and does it make any difference whether the link is longer or shorter (as the case may be) to the working of the slide valve ?—INQUIRER.

[62282.]—**Small Arc Lamp.**—To MR. BOTTONE.—I am making a small arc lamp, the same as described in the "E. M." about three years ago in the article "Experiments with the Hand Dynamo." Will you please state the size of carbons in millimètres for the above ? How many of these lamps will a 40c.p. dynamo supply in series or parallel, and also describe the mechanism for separating the carbons by means of the current in the above lamps, so that they will be self-regulating, without requiring to be adjusted by hand ?—SCUD.

[62283.]—**Water Power.**—C is a cistern, 18in. diam. by 3ft. deep; *p* is a piston, which fits airtight. Now, if a weight, 10cwt., was placed in W, what weight would it force up on A and B respectively, but only one of them working at a time—the other cut off with a tap ? Also, would it force the same weight up on B if it was connected by an inch pipe 3ft. long ?—A HUMBLE INQUIRER.



[62284.]—**Model Engine.**—Will "T. C., Bristol," please tell me how to calculate the H.P. of small engines, locomotive and stationary ones, those of a decent size, and not mere playthings ? Do the same rules apply to them as to the large engines ?—INQUIRER.

[62285.]—**Telescope.**—I have by me an ordinary terrestrial telescope; object-glass, 1⅜in., two lenses, uncemented. By the way, would they not be better if cemented, and, if so, what is the advantage ? The o.g. is about 17in. focus. Would this be of any use if converted into an astronomical glass ? If the o.g. is a fair one, would it be as good as a common chromatic 3in. o.g., and what power eyepiece would it bear ? I understand that the rule for determining the power of the eyepiece is by multiplying the focal length of the o.g. by the eyepiece—that is to say, supposing the o.g. is 30in. and the eyepiece is ½in., then the object is magnified 60 diameters. If this is the rule, is it the focus of the eye lens or the eye and field lenses combined ? It has been a subject of regret for a long time to me that Mr. Lancaster's answers do not often appear in "Ours" now. For many years I used to look for his answers week by week with the keenest relish. He was always so ready to help amateurs, and his answers evidenced painstaking. In common telescopes I believe the eyepiece is composed simply of one lens. What is the advantage of having two lenses of different focal lengths, 1 to 3 ?—DERBY.

[62286.]—**Brass Boiler Tubes.**—Can any reader give me any information as to the effect on brass of the fumes of a wood fire ? Does the ligneous acid rot the brass more than the sulphurous acid from a coal fire would do ? Is it usual where wood is burnt in steam boilers to fit brass tubes or iron ones ?—GLATTON.

[62287.]—**Billiard Cue Tips.**—I am much perplexed with keeping the tips on cues at our billiard boards. One says glue, another giant cement, another wafers, and so on. Would some of your talented subscribers inform me of something which would keep them on ?—STEWARD.

[62288.]—**Flannel.**—Can any of our readers give me any information on flannel drying ? The machine I have does not dry the selvage, and if I put on a stronger blast with a greater heat so as to dry the selvage it makes the flannel very crisp and brittle. I would like this to dry the flannel more gradually. The flannel is dried by hot air, which is blown through a heater heated by steam by a fan. The air is delivered between the flannel from a 20in. pipe at the front end of the machine where the flannel returns. I thought of putting a perforated tube between the flannel and the sides of the machine, 22in. by 6in. by 60ft., and perforated on the top and bottom of the square tube with very fine holes at the beginning, and go gradually larger all the way along to the top end, so as to get an even blast throughout the length of the flannel. The flannel is carried on two side frames by two endless chains, with needles projecting on their outer edge to receive the flannel, which is driven by a small engine at the top end of the machine. I should like to dispense with this engine. If any kind reader could inform me how to vary the speed of the machine, I should like to drive it off the main shafting, if possible, for the man to regulate the speed of the flannel at the bottom end.—G. C.

[62289.]—**Burnishing Bowls.**—I have some bowls to turn up. Can any reader tell me how to burnish them by some ready method ? When they came to the shop at first they were as smooth as glass. This is how I want to get them.—BOWL.

[62290.]—**Grinding Tools for Haydon's Cutter Bar.**—In your issue for July 17th, 1885, appears a sketch and instructions for grinding tools for Haydon's cutter bar; but I find I cannot obtain the correct angles from that scale. My stone is 29in. diam. I attempted to grind a cutter for iron by first grinding the plan angle 120 at the mark 100 steel, and then the face at 120 iron, but this only gives a cutting angle of about 45°. I find to get cutting angle of 60° I must only raise the tool to 80° steel. I have made the drawing three times, and have tested the angle of the cutter bar, which is 55°, and cannot find any error. I cannot see any instructions about the necessary angles to obtain the plan angles, and should have been at a loss, only a friend sent me a copy of his, which appears to give the desired result. Will Mr. Atkinson Haydon, or "O. J. L.," enlighten me ? I advertise my address in Sale Column in case they are good enough to write direct.—STEPHEN BOYES.

[62291.]—**Legal.**—The other day my man was coming through the turnpike gate with a cart fastened behind his horse and waggon, when the gateman stopped him and demanded payment for the two vehicles. He paid for one. Now what I want to know is whether it is right to pay for the other, as only one horse and cart was there, and that was paid for ? Is it legal and right that I should pay double fee just because another cart was fastened behind ?—ONE GATED.

[62292.]—**Ornamental Wood Turning and Staining, &c.**—Will some experienced correspondent kindly intimate how I am to proceed about the following ? Having turned a pair of vases (of odd wood lying by) of mahogany and beech to match a clock case, I should like them the same colour—viz., black, and prominent parts gold (gilt). Please mention how I am to get the dull black characteristic of clock cases. Also the best woods for general purposes, and the use of the wood-turner's chisel on various woods, and how to fill up the pores of woods before or after staining.—AMATEUR.

[62293.]—**Vice Repairs.**—How shall I repair a vice which had a thread (square thread) brazed in the socket of stock, but now the thread is of no use, being smashed to pieces ?—AMATEUR.

[62294.]—**Folding Screens.**—I wish to make a pair of these about 5ft. or 6ft. high. Will somebody kindly give details—viz., number of boards, hinges, what wood, and what to cover them in ? I might mention they are to be covered with coloured scraps (pictures).—AMATEUR.

[62295.]—**Walking-Stick.**—I wish to polish a walking stick. I cannot polish in the usual way, because it has spines all over it. At present it is white. I want to make a good job of it.—AUTOMATON.

[62296.]—**Hack Saw Frame**—I wish to forge a hack saw frame. Would someone kindly tell me what is the best material to use and a hint as to the best manner of doing it ? I see some frames with the handle at the top. Is it not better to have it in a line with the saw blade ? What is the peculiarity of the "star" hack saw, and what is the price ?—C. H. T.

[62297.]—**Tempering Steel Tubes.**—Will any fellow-reader tell me the best way to temper steel tubes, ⅜in. dia. outside. I have a quantity which require to be bent to certain shapes, and then tempered so that they will spring back to their original position. I want to dip them when hot into some liquid which will harden and temper sufficiently at the same time.—AERATED.

[62298.]—**Condenser, ½ and 1 Micro-farad.**—Please give description and instructions how to make a condenser with tinfoil and paraffined paper of ½ and 1 micro-farad.—IOTA.

[62299.]—**Battery for Surgeon's Lamp.**—What is the best battery to light a fairy lamp taking 3½ volts and 1 ampére, for throat examination, say 20 times of half-minute each a day and not requiring to be touched oftener than about once in six months ? Constancy and long life most important points; price a secondary matter, but would like it non-fuming, if possible.—DISGUSTED M.B.

[62300.]—**Schuckert Ammeter.**—Would some electrical correspondent kindly describe this ammeter and its mode of working ? Also, is it considered a good reliable instrument ?—IOTA.

[62301.]—**Correspondence.**—What advantage has lime chromate over potash or soda bichromate in a battery? Urquhart recommends it in his book strongly. Why is that ?—IOTA.

[62302.]—**Cogs for Patterns.**—Can anyone tell me the best wood to make cogs and cog-wheels of for patterns ?—OMGA.

[62303.]—**Stopping Wax.**—I should be obliged for a recipe for stopping wax for patterns in wood.—H.

[62304.]—**Equation.**—I have during the last six months vainly tried to solve the following system of equations:

$$x + \sqrt{y} = a$$
$$y + \sqrt{x} = b$$

but without result. Perhaps some mathematical reader will attempt to find the proper solution, for which I shall be much obliged to him.—E. GOBERT.

[62305.]—**Pitch of Propellers.**—Will some able reader kindly tell me the easiest way to find the pitch of any old propeller ?—JACOB JONES.

[62306.]—**Solution for Coating Oil Tanks.**—Could someone who has had experience in constructing tanks for the storage of oil, particularly petroleum, say what is the best solution to apply for making tight ? Caulking is very little use, as the oil finds its way even through the rivet holes, and it is evident some composition is needed.—LEAKY TANK.

[62307.]—**Promissory Note.**—Will some of your legal correspondents kindly say if an ordinary promissory note, payable on demand or after notice, and bearing interest, requires to be renewed every six years, provided the debt has been acknowledged during the six years by the payment of interest, even if irregularly or once only ? I have been informed that it does in any case. I can understand that the Statute of Limitations may apply if during that period no interest has been paid or any other acknowledgment of the debt given; otherwise I am hard of belief as to the soundness of my informant's opinion.—N. N.

[62308.]—**Chloride of Silver Cell.**—I have lately made one of these cells, as described Vol. XLIII. It was made from a piece of glass tubing which contained the elements, and sealed with sealing-wax; but I cannot keep it from leaking. Have tried several ways without success. I see one correspondent recommends the space between silver and zinc to be filled with blotting paper saturated with the solution; but would not that lessen the current a great deal by there being a greater internal resistance ? Would it be better to turn a wooden cell ? If so, how could I make it waterproof ? What wood should I use, &c. ?—V. M.

[62309.]—**Violin Query.**—Will someone kindly tell me if cracks in belly of violin can be repaired, and how ? Also how to remove resin from belly without damaging varnish ?—F. J. B.

[62310.]—**Refining Crude Copper by Electrolysis.**—Will any reader of the "E. M." kindly give information as to the above operation on the large scale ?—IVANHOE.

[62311.]—**Electro-Plating—General Arrangement of Workshops and Construction of Vats.**—A short description of these would greatly oblige—IVANHOE.

[62312.]—**Zoetrope.**—I am anxious to construct a zoetrope or wheel of life for public exhibition, and venture to ask if some kind reader who is versed in the scientific principles of this toy will furnish me with instructions how to proceed ? I should prefer it to be about 3ft. in diam., and made in four sections, so as to be portable. Any hints as to making simple appliance for rotating same will be thankfully received by—UNEMPLOYED.

[62313.]—**Wood Turning.**—I want to turn several small boxes, about 3 by 1 outside and 2¾ by ⅞ inside, in soft close-grained wood. What shaped tool should I use for boring out inside clean (a sketch will help) ? Which will be the best way to chuck the wood after turning out inside so as to turn the outside, as while turning it down thin, would it not be likely to split if driven on a mandrel ?—M.

[62314.]—**Violin.**—Will "Fiddler" or another musician inform me what note the second string of a tenor violin must be tuned to, so that it can be played with others ?—TENOR.

[62315.]—**Cylinder.**—To "T. C., BRISTOL."—I have the casting of an iron cylinder from Mr. Dorrington, of Manchester, 2in. by 3½in.; the steam-ports are cast 3⅛in. apart, and in the full-size drawing of the same cylinder the piston is ¾in. wide. Therefore, you will see that it is impossible for the piston to do a 3½in. stroke without covering up one steam-port or the other entirely. Will this prevent the engine working, or will the weight of the flywheel carry the piston back again past the steam-port which will be covered up, and so let the steam drive it back ?—TRINITY HALL.

[62316.]—**Storage Cell.**—I have an electric boat which works very satisfactorily with three pint Bunsen cells; but as I find the fumes are destroying the internal fittings, I am desirous of replacing with three storage cells, which I would like to make in porcelain, cells inside 4in. high and 3in. by 1⅞in. Please say if I could in these cells construct storage cells that would give the same or longer duration than the present pint Bunsens, and say if it is of advantage to use red-lead. I have access to dynamo for the forming, and after that am perfectly willing to charge by battery if I have some information about the forming. Suppose I make three cells in these pots, what number of ampère hours should I get ? If someone will kindly help I shall be glad to give results, if any of "ours" would be interested. As the dynamo I would "form" from is 110 volts, please say what resistance I should introduce, and what is suitable charging current in ampères ?—ELECTRIC BOAT.

[62317.]—**Rain Water.**—Can any of the readers of the "E. M." kindly inform me of any plan for automatically preventing the first few gallons of each rainfall entering the cistern, as, being surrounded by numerous chimneys, the first washing of the roofs is almost as black as ink, and what is really required is to direct the first washing water into the sewer, and after the roofs are clean, to turn the water into the cistern.—AMOR BOSQUETS.

[62318.]—**Astronometroscope.**—A curious mechanical lantern slide used to be exhibited at the old Polytechnic under the above name, and is now again being used, and exciting great surprise, in certain quarters. Can any of your readers refer me to any work that contains a description of the mechanism by which the singular effects of the slide are produced, or has it ever been described in "E. M." ?—AMOR BOSQUETS.

[62319.]—**Driving Washing Machines.**—My washing is done at home with one of Harper Twelvetree's machines. The work of turning the machine with clothes in is severe for a woman, and is trying principally on account of the quick revolution of handle required, which takes the breath. The washhouse is small, and the space is required at other times. Can any reader kindly suggest the best form of power to employ to drive the machine ? If steam, with full particulars as to size and kind of engine, boiler, &c., and the best method of simply generating the steam. The engine or other means of driving would have to be removed when the work was over. I am afraid a gas-engine is beyond my means. The power required may be taken as equal to a man's work (actual).—ICTHIUM.

ANSWERS TO CORRESPONDENTS.

⁂ All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 27, and unacknowledged elsewhere :—

R. HUGHES.—P. C. Moore.—British Gas Engine Co.—Buck and Hickman.—One in a Fog.—T. T. and A. Garrett.—G. Johnston.—J. Seal.—R. E. M.—W. W.—A. B.—A Novice.—A. Gimson.—A. N. S.—Prismatique.—H. Wake.—E. M. Nelson.—Fal.—Arcturus.—J. T. L.—Ica.—J. K. P.—S. Bottone.—Calculus.—H. G. Madan.—A Fellow of the Royal Astronomical Society.—John W. Newall.

H. (Cannot possibly advise without knowing more about it. You would act wisely by consulting some respectable agent, as you may claim too much or too little.)—J. L. S. (The method has been frequently described, and we answered a week or so back. The plates must be freed from grease by washing with strong solution of soda, and if necessary, scouring with sand. Then immerse in dilute sulphuric acid until the acid bites well, and then transfer to a dish of pure mercury, and rub the latter well over the plate with a wisp of tow until a bright silver-like film is obtained. Set the plate aside to drain, and finally rub off any globules which may form. When the plate after use begins to show a grey granular surface, brush and reamalgamate.)—MAC. (The numbers are mostly out of print; but you can obtain a little work for sixpence of Pewtress and Co., Little Queen-street, W.C., as advertised last week. For discussions on the theory of the Wimshurst machine, see the indices of the last five or six volumes.)—QUEENSLANDER. (How to make a medical coil in No. 1121, p. 52. 2. Watt's "Electro-metallurgy," Crosby Lockwood and Co., Stationers' Hall-court, E.C., 3s., will give you all the information needed; but as to cost of outfit, that depends on what you want to do. Get catalogues from our advertisers.)—N. D. P., Courier. (Pitch, or other compositions in which that forms the principal ingredient. 2. If you pulverised the manganese very fine, you did exactly what you ought not to have done. Use it about the size of peas, sift the dust out, and treat the carbon the same way. The fine powder resists the penetration of the liquid.)—GRAVITATION. (Yes, it would ultimately rest at the centre. It is an old question to be found in several of the text-books, and in a few of the back volumes.)—E. P. M. (By the micrometer, the astrometer, the wedge photometer, &c. See No. 953, p. 384, and the indices of back vols. 2. Of mica, as a rule. See the description in Ganot's "Physics," if you cannot refer to back volumes. Light has no effect unless they are in a vacuum.)—F. S. SC. (Answered to "Germ," last week, p. 186. It entirely depends on the rules of the different universities, and we have not space to give them. See indices.)—M. L. (Probably you can obtain them from Mr. H. K. Lewis, publisher, 136, Gower-street, W.C.) — COPYISTICAL. (Given many times. Soak a pound of glue over night, pour off water, and melt. Add four pounds of glycerine and sufficient whiting to colour. Pour out into trays on a level. Skim the surface with the edge of a card to remove bubbles, and when set and firm it is ready for use. Write on a piece of cream-laid note with a thick solution of aniline violet in alcohol, and transfer to the gelatine pad; then take copies on clean paper.)—FILTER. (Your question about softening water has been answered many times—see p. 108, April 1, for instance. Try boiling first, or adding quicklime; but the success of any remedy depends on the nature of the hardness.)—G. E. (The query was replied to on p. 351, last volume. The ink is aniline with a little glycerine. 2. It is prepared by rubbing the paper over with oil and lampblack or grease and any black pigment, wiping smooth after hanging a day.)—GOLD FISH. (The best cement was given last week in answer to J. Wilkins, p. 186; but see indices of back volumes, or No. 944, p. 183. A variety of cements in Vol. XXXIII. pp. 459, 481, 599. You will have to procure bar zinc for the uprights, and will find a zinc tray-bottom more easy to work than slate.)—H. MARSH. (Because the sun is then on the Equator. 2. The statement about the wind is not true for all regions.)—W. W. (Solution of india-rubber; but there is no method of joining tires safely. The joint must be bound round with a piece of strong linen smeared with the solution and held on with fine string closely wound.)—BOOT FINISHER. (If you will explain what it is you mean we may be able to help you. Is it a black polish you require, and what is the nature of the stains?)—HIBERNIA. (Silver filings and mercury mixed to a paste; but amateurs should not go beyond the simple white gutta-percha.)—STEATITE. (The only radical remedy is to take the lime, &c., out of the water before putting it into the boiler. See indices of back volumes, and p. 108, April 1, Hard Water.)—WELSHMAN. (Composition for covering blackboards in No. 1113, p. 457. Some say that very finely-powdered coke, dusted on a tacky dull varnish makes the best surface. See No. 1002, p. 311.)—ROLEY. (For straightening shafting, see No. 1109, p. 378.)—PERPLEX. (Because there is a greater pressure at one part than another.)—DIFFICULTY. (For tempering springs, see pp. 222, 243, 266, 418, last volume.)—FOYLIENSIS. (It is a special branch requiring the highest skill. We had a series of articles in Vols. XIV. and XV., extracted from the "Carriage-Painters' Manual," by F. B. Gardner, published at New York by S. R. Wells. You may possibly obtain it from Messrs. Trübner, Ludgate-hill, E.C.)—L. W. D. (Ericsson and others thirty and more years ago devised hot-air engines in which vapour was employed; but that is no reason why your device might not be more useful. You will find information in Knight's "Dictionary of Mechanics," Cassell and Co., article Air-engine, and also in the published "Abstracts of the Patent Office." 2. We are not aware of any restrictions as to "chemist," but you must be registered before opening a shop as "chemist and druggist." See No. 1087, p. 433.)—TELEPHONE. (The question is one that should be put to counsel or an expert; but you can refer to the reports of the actions. Both diaphragm and tension regulator are claimed. You say your device does not contain anything that can be "construed into" a diaphragm. If so, you have answered a question which has puzzled many; for according to the decisions, almost anything may be considered a diaphragm.)—D. NICOT. (A full description of the phonograph can be obtained in the patent specification, and with details in No. 683. See also No. 678. 2. Directions for making intensity coils have been given over and over again in nearly every back volume. If you have made your coil as you say with two thicknesses of cartridge-paper glued on between each layer of secondary, and covered with two coats of shellac varnish, you have gone dead in the teeth of all the instructions which have been given in our columns. However, as it is finished, try whether it satisfies you.)—J. D. (As a rule, peat is the best soil, with a little virgin loam. See No. 972, p. 224, and procure one of the little handbooks on the subject, as you do not give sufficient details for any useful advice to be offered.)—SANITUS. (All about the fire-grenades in Vol. XLIII. pp. 14, 36, 63, 86, 109, 127.)—ORANGE. (Methods of silvering glass in the manuals of the reflector issued by opticians, such as Horne, Thornthwaite, and Wood, 416, Strand, W.C.; John Browning, 63, Strand. You will find full directions in back numbers.)—DYNAMO. (We do not know of any published tables of the kind. Makers have their own tables; but they are not likely to publish them.)—W. ROSE, Westcott. (There are many articles on the subject in back volumes; but if you cannot refer to them, procure Johnson's "Complete Treatise on the Art of Retouching," published by Marion and Co., Soho-square, W.)—ONE THING TO GET ON. (The best test for gold is a solution made by mixing 2oz. of nitric acid, 4 drachms of water, and 1 scruple of muriatic acid together, keeping in a stoppered bottle. 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As to the apparent size of the sun, see p. 575, Vol. XLIII., and the indices of back volumes. It is a matter that can be easily determined by experiment. With reference to the elliptic orbits and Laplace's nebular hypothesis, see back volumes and the textbooks. As to the freezing of the river, if it took place at low water, the ice would undoubtedly be lifted up or broken up by the flood tide. The etymology of such words is lost in the mists of antiquity.)—ISIS. (When anything further is published about the matter you will find a note of it in our columns. Meanwhile, see a report of a lecture by Dr. I. Burney Yeo on the new method of treating consumption, &c., by gaseous rectal injections, published in the *Lancet* for April 16 last.)—A SUFFERER. (Consult a respectable medical man, and take his advice. 2. Savory's "Compendium of Domestic Medicine," 5s., or a condensed edition, 1s. 6d., both published by J. and A. Churchill, New Burlington-street, W.)—TAM O'SHANTER. (1. Yes. 2. Yes. 3. 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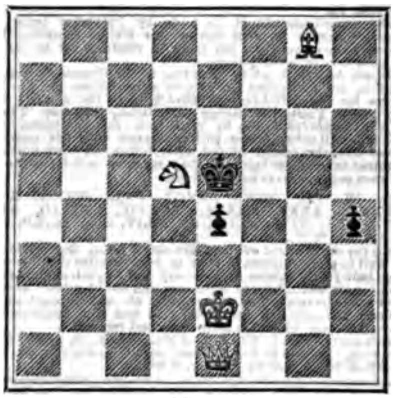
PROBLEM MXLI.—BY REV. E. L. HOPKINS.

Black.



White. [4 + 3

White to play and mate in three moves.

SOLUTION TO 1,039.

White.	*Black.*
1. Kt-Q B 2.	1. K or P moves.
2. Q, R, or Kt mates.	

(Three variations.)

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CORRECT solutions to 1,039 by A. Dean, A. Bolus, T. H. Billington, Cotswold, Harold N. Lancaster, F. Krasser, W. Hewson-Kilbee, A Beginner, Major (too many duals), J. Mackenzie, Black Pawn (very good key move, but spoilt by the duals), H. Hosey-Davis, E. C. M. (Ipswich), A. Flawn, G. A. A. Walker, Snowdrop, Country Boy, and V. S. Pochin; to 1,038 by A. Flawn, G. A. A. Walker (5), H. Hosey-Davis (5), Snowdrop (5), Cotswold, T. H. Billington, A. Bolus (5).

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A. K.—If in 1,039, 1. $\frac{\text{Q-Q 6 (ch)}}{\text{K-Q B 5}}$, 2. $\frac{\text{Q takes P (ch)}}{\text{K-Q 6}}$, and how does White mate next move?

BLACK PAWN.—Your three-mover $\left(\frac{\text{W K}}{\text{K sq.}}, \frac{\text{B K}}{\text{K B 3}}\right)$ will not do, as half of White's first move is *already made*, and this is not stated, or, rather, it is denied, for white is required to mate in three moves, whereas it should be two and a half. Moreover, even were it admissible, it is merely a trick, and not strategy.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MAY 6, 1887.

AN INTERNATIONAL SCREW THREAD.

WHEN the late Sir Joseph Whitworth, many years before he had a title, conceived the idea of establishing a standard screw-thread, he probably thought that ultimately it might become international and universal in the widest sense. It has become the standard in British workshops, but unfortunately not amongst all English-speaking engineers. Somewhere about 30 years ago the Whitworth threads were accepted in the principal machine shops of this country ; but t is less than 20 since the Sellers thread was adopted by the United States Government, though it is now as much the standard in America as the Whitworth thread is here. The Sellers thread is known by the name of its author, as well as the "United States thread," the "Franklin Institute thread," and the "M.C.B. (Master Car Builders) thread." It differs from the Whitworth mainly in having sharp edges instead of rounded, and it is not too much to say that mechanics free from narrow views of business as well as "national vanity" regret this difference in the standard screw-threads of the two great machine-making nations. Some years ago one of the district societies of German engineers sent out a number of circulars to the chief engineering establishments in Europe, asking owners to give their views as to the practicability of introducing a metrical system in place of Whitworth's, whose screw-threads as well as gauges, being the only accurate tools then available, had been readily adopted—at all events for important work. The result of the inquiry—such result as it was, for the majority of those who received circulars did not think it worth while to reply—showed conclusively that the Whitworth system was extensively used, and that it was regarded as a standard even on the Continent. To those accustomed to use the metric system the English inch and its divisions are obnoxious, and for some years attempts have been made by one or more of the German Societies of Engineers to establish a standard based on the metrical system. These attempts took a definite shape about two years ago, when the directorate of the Society of German Engineers, Berlin, thought it desirable to appoint a special commission to inquire into the allegations of one of the district societies—viz., that great disorder prevailed on account of the Whitworth system not being universally adopted in Germany ; that being measured in inches it is inconvenient for metrical measurements, and that the cross section of the thread is difficult of manufacture. A contemporary traversed these statements and pointed out their absurdity ; but went further than the facts warranted by stating that the square-tipped thread, as advocated for the metrical system, had practically failed in the United States, where it had been thoroughly tried by Mr. Sellers. "The present state of affairs in America conclusively shows the system to have been a failure, and all the leading machine-tool makers there are supplying nothing but the V-thread, very similar to Whitworth's." This statement seems to have been the cause of a communication being addressed to the Franklin Institute by the Society of German Engineers, asking what conclusions had been reached by the Institute in connection with a uniform ystem of screw-threads, and in effect whether he statement above quoted was true. The orrespondence which has taken place on the subject occupies several pages in the *Journal* of the Franklin Institute for April, and serves to show how hopeless it is to expect that engineers of rival nationalities will agree to adopt a really "universal" system of screw-threads which would be such a boon to their respective customers. In Goodeve and Shelley's work on the Whitworth machines, the famous screw-thread is succinctly described as follows :—"The angle made by the opposite sides of the thread is 55° in every case ; but the extreme depth which this angle would give is reduced by rounding off the top and bottom, each to the extent of one-sixth. Thus the depth given to the thread is only two-thirds of that which it would have if the sides intersected, being ·64 of the pitch instead of ·96. A constant proportion is thus established between the depth and pitch of the thread. The precaution of rounding off is adopted to prevent the injury which the thread of the screw and that of the taps and dies might sustain from accident." The Sellers thread has an angle of 60°, squared off to the extent of one-eighth of the pitch top and bottom. The following is the rule given by Mr. Sellers himself :—"Divide the pitch, or what is the same thing the sides of the thread, into eight equal parts ; take off one part from the top, and fill in one part in the bottom of the thread ; then the flat top and bottom will equal one-eighth of the pitch, the wearing surface will be three-quarters of the pitch, and the diameter of screw at bottom of the thread will be expressed by the formula $d = D - 1{\cdot}299 / N$, in which D = diameter of the screw, d diameter of root, and N the number of threads per inch." It will occur to most mechanics that there is something to be said for both the rounded edge and the square edge, and it is quite certain that Whitworth did not adopt the round edge, or the angle of 55°, without due thought. Except that it is so easy to draw with accuracy there is no special merit in an angle of 60° for a screw thread ; but the statement complained of was that it had been "found practically impossible to produce a good thread" of the Sellers shape, because the sharp corners on the taps and dies rapidly break away. To set the matter at rest, with the object of satisfying the Society of German Engineers of Berlin, the secretary of the Franklin Institute forwarded a circular letter to the superintendents of the principal railroads and to some of the most important manufacturing firms inquiring whether any difficulty had been experienced in maintaining the form of the standard thread ; whether the straight surfaces were more difficult to maintain than the curved ones of the Whitworth thread, and which form can most easily be constructed and tested for accurate conformity with a standard.

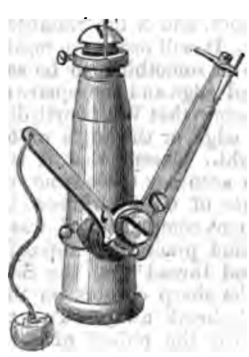
Such replies as were received by the secretary of the Institute show conclusively that the Sellers thread is preferred to the Whitworth in many parts of the United States, even by those who have had experience of the Whitworth in this country. Amongst these replies is a letter from the Pratt and Whitney Company, of Hartford, Connecticut, whose productions are known, we suppose, wherever the mechanical arts are practised. The company having adopted a standard thread according to the best of their judgment would naturally argue that they had adopted the best ; but that is not the point of the question—which is in reality whether or not the Sellers thread is becoming a standard in the United States. On that point the answer of the Pratt and Whitney Company is explicit. They state distinctly that fully 90 per cent. of the orders they receive from railroad companies and manufacturers generally are for the United States Standard thread, and that the others are for the same shape of thread, but for a greater number of threads to the inch. There is no doubt about such a statement as that ; but there may be some room for argument when it is asserted that the form of the Sellers thread is such as to make it the most practical for duplication to gauge, and that by making the outside diameter slightly larger the life of the tap is greatly lengthened. The latter practice is not to be commended, however suitable it may be to the wants of American machine shops, for the whole essence of the matter lies in the absolute accuracy—that is, as absolute as possible—of the gauges and the standard taps and dies. It is satisfactory to learn that the ordinary V-threads and over-size threads are not used to the extent they were some years ago, and that bolts and nuts are practically interchangeable throughout the United States. We may be allowed to accept with caution the statement that a U.S. standard tap will cut ten times as many nuts as a simple V-thread tap without appreciable change of size, whilst doubting whether that result is more easily accomplished than with a Whitworth thread. The manager of the Pratt and Whitney Company says that although the corners of the Sellers thread may wear slightly, that is unimportant if the taps are properly used, and especially so if they are made a trifle larger in outside diameter. A tool that is made a "trifle larger" than it should be is not an accurate tool, and does not come up to the high standard Sir Joseph Whitworth set. It may answer effectually all the purposes of such a tool in practice, but the very fact that such an argument should be used shows that our American cousins are aware that the Whitworth thread is the best as a standard, and that the device they have adopted is only second-rate after all. The answers received from the superintendents or master mechanics of the railroads are much in the same strain. One says they have found no difficulty whatever from wearing, as long as the taps and dies were not used "beyond a proper length of time," which "wearing" would probably be as great in the Whitworth thread, while it is easier to make a straight than a rounding side to a thread, and the former is therefore more likely to be perfect. The writer of that has adopted the commendable practice of procuring new taps and dies when the old ones could no longer be regarded as capable of doing good work, but he is decidedly of opinion that with a flat-top thread the wear of the sides will not reduce the diameter of the thread from out to out, but will simply make it a little thinner at the point. A few of those who have been consulted on the matter treat it in rather a cavalier manner, by saying that the U.S. or Sellers thread is easier to make, and the tools to make it are less expensive ; but others acknowledge that the Whitworth thread is stronger and less liable to fracture the bolt. Amongst the master mechanics who have replied some have obtained evidence from men who have worked in this country, the general result being that the Sellers thread renders it easier to make a good fit, and that it is much more difficult to maintain the curved surface of the Whitworth thread than the straight U.S. standard. It is easy, too, to grind a thread-cutting tool to the straight lines of the Sellers standard. The general opinion is perhaps summed up in the following :—"The angle of the Sellers thread is more easily maintained than the other, because a templet can be accurately made without the use of special tools, as it is easy to construct the angle geometrically [by drawing an equilateral triangle in a circle]. It is also simpler and cheaper to cut the Sellers thread in a lathe. It is a difficult matter to make the nut fit closely on the curved portion of the Whitworth thread, and practically the bearing surface will probably be limited to the straight parts, making it considerably less than in the Sellers system—consequently more liable to be distorted." The secretary of the Franklin Institute, in sending the replies he received to the Society of German Engineers, concludes that the Sellers, or Franklin Institute, standard for pitches and form of thread is accepted and used throughout the United States, to the exclusion of any other—that is, while there are still some shops which have not adopted any standard, there are none which have adopted any other standard than the Sellers. It may be gathered from a reply written in February last that the Society of German Engineers, if it should adopt a standard thread on the metrical system of measurement, will use the Sellers form of thread in preference to that of Whitworth, and if a metrical standard is once introduced, it will by force of circumstances ultimately be used in all machine factories which come under the sway of the mètre.

THE PREPARATION OF PHOSPHORIC ACID.

AN important discovery in connection with the preparation of phosphoric acid seems to have been made by Messrs. Giles and Shearer, who have obtained a patent for their improvements in the manufacture of the acid. Up to the present time all the phosphoric acid of commerce has been produced either by the oxidation of phosphorus, or by treating various phosphates with sulphuric acid or other bodies for the purpose of setting free the phosphoric acid, or by heating phosphate of ammonium. In the former process (that is to say, the oxidation of phosphorus) there is the trouble and expense of preparing the phosphorus, in addition to the considerable labour and outlay which are entailed in thoroughly oxidising it and freeing the resulting acid from arsenic and other impurities which greatly enhance the cost of the phosphoric acid; in the other process the acid, which is prepared from bone ashes, various forms of phosphates of lime or other phosphates, by means of sulphuric acid, or other re-agents, always contains certain impurities, such as magnesia, soda, ammonia, iron, alumina, and the like, which differ in amount and kind according to the source of the phosphate employed and the mode of treatment adopted. These impurities render the acid so made unfit for use where a pure acid is required, as in pharmacy. The patentees, however, have discovered that at an elevated temperature—*i.e.*, from a dull red heat to bright redness—phosphoric acid distils freely in presence of a current of steam or of hydrochloric acid, and that this affords a most effectual means whereby impure phosphoric acid or highly acid phosphates may be freed from all impurities, such as lime, magnesia, iron, or other bases, or their compounds, and also from all foreign volatile and fixed acids. In carrying out the invention they take any suitable phosphatic material, such as phosphate of lime in any form, phosphate of lead or phosphate of alumina, or iron, or the phosphoric slag which is produced in iron or steel making, and having treated any of these materials so as to separate the greater part of the bases and obtain an impure phosphoric or a highly acid phosphate as is understood by chemists, they concentrate the acid or the acid phosphate by evaporation to a syrupy or pasty condition, and then, placing it in a retort, cylinder, oven, or other suitable vessel, they pass over it a current of steam (superheated or not), or a current of hydrochloric acid, preferring, however, to use steam, while at the same time the material in the operating vessel is maintained at an elevated temperature by means of a fire, usually employing a fair, red heat. A partial or perfect vacuum may be created in the condensers to facilitate the distillation. The patentees claim as a part of their invention that it is not absolutely necessary that the phosphoric acid should be previously separated as above described from the bases with which it is combined. In working this modification of the invention, they place in a retort, oven, cylinder, or other vessel the phosphoric material mixed with silica, sand, silicious matter, sulphuric acid, or with any other material that will set the phosphoric acid free, under the joint influence of a high temperature and the presence of steam or hydrochloric acid, and having raised the temperature to the required degree they distil off the phosphoric acid in a current of steam or hydrochloric acid, assisting the operation, if necessary, by forming a partial or perfect vacuum in the condensing arrangement. The vessels employed may be constructed either of platinum, fireclay, or of iron, or may consist of firebrick ovens or towers, and the steam required may be generated in the same vessel as is used for the distillation—*i.e.*, the syrupy or pasty material may be dropped, injected, or sprayed into a highly-heated oven or chamber packed with suitable acid and heat-resisting materials, either alone or mixed with water or steam. Vessels both of platinum and fireclay on the large scale have been employed, but the patentees do not claim any particular form of apparatus. In the circumstances described they have found that phosphoric acid of perfect purity distils over, having a specific gravity varying from 1·060 to 1·080; but they prefer to work so that an acid of about 1·500 specific gravity is obtained. Should any volatile impurities, such as hydrochloric acid, hydrofluoric acid, or sulphuric acid, be present, these bodies distil over before the phosphoric acid, and are caught in a separate condenser, the magnesia, lime, iron, alumina, and all other fixed impurities or residues remaining in the distilling vessels.

GAS-LIGHTING BY ELECTRICITY.

WE illustrate below a new gas-lighting burner which Messrs. King, Mendham, and Co., of the Western Electrical Works, Bristol, have recently introduced. By the aid of these burners, the gas may be automatically lighted throughout a house, no matter of what size, it being only necessary to lay down a system of wires such as are used in electric bell circuits to the gas fittings, and the same battery that works the bells may at the same time be used for the ignition of the gas. The burners are so fitted that by pulling a cord attached to a lever contact is made between the lever and an insulated band round the tip of the burner, a spark being produced by the interposition of a coil, which ignites the gas. These burners are made by Messrs. King, Mendham, and Co. in various forms; but want of space forbids our illustrating more than one form, which will give our readers a very good idea of the principle upon which these burners act. The form illustrated is one which can be fixed to any ordinary gas fitting, the connections to coil and battery being respectively made from the terminal screw shown on the insulated band and the gas pipe. In another form the lever is moved in the act of turning the tap, which, of course, necessitates the tap being within reach of hand. Where such is not the case, the firm make a form in which the lever is moved and the gas turned on by one movement of the pendant chain, a second movement turning off the gas. This form is specially suitable for chandeliers and for billiard-table use. In consequence of the great amount of damage done to a billiard-table cloth by careless dropping of grease from tapers, we have no doubt this system of lighting will be largely availed of. Another form made by this firm is that in which the gas is turned on and lighted by means of a rotating ratchet wheel, which is operated by a distant push; a second push button being used to extinguish the gas. For halls, staircases, corridors, &c., this form is eminently suited, as it enables one to light up the way in front of him, extinguishing the gas after he has passed. As it is practically impossible to turn on the gas without lighting it, there need be no fear of escaping gas. For use in schools, asylums, hospitals, &c., the circuits may be so arranged that an electric bell placed in a particular room would strike when any one burner was lighted. This form may be advantageously used for lighting a number of jets in close proximity to each other, but which are too far away to be within reach of hand. The advantages of this system of automatic gas-lighting are such that they will at once commend themselves to all who are fearful of the risks from careless handling of matches tapers, &c.



NEW USES FOR COAL-TAR.

NOW that the value of coal-tar has considerably declined, managers of gasworks are willing to adopt or to assist in promoting any scheme for its utilisation which appears feasible or has a promise of success. The average production of tar in the manufacture of gas may be taken as 11 gallons per ton of coal carbonised, the figures ranging from 9 gallons for Newcastle coal to 18½ gallons for cannel, and, when used as fuel, about 6 gallons are reckoned equal to a sack (three bushels) of coke, or 20 gallons to carbonise one ton of coal. The greatest objection to the use of tar as fuel in the retort-house is the intense heat at the point of combustion, which rapidly destroys the arch under the middle retort. But improved furnaces have been invented, and a great deal of tar is now consumed at the gasworks for fuel. For some time vague rumours have been flying about in connection with coal-tar as a means of obtaining motive power, and at last a definite statement was made that a power of thirty horses had been obtained by the combustion of two gallons of coal-tar per hour. How that is effected we are not told, except that all the heat developed by the combustion of the fuel is intercepted and made to do work. That story comes from Lancashire; another, not quite so definite, comes from the county of Durham, which is shortly to "produce a startling economic improvement in the matter of fuel combustion and the heating of steam boilers." The invention has been protected, it appears; and that being the case, there would seem to be no necessity for keeping secret the name of the fuel, especially as we are told that the "cubic bulk of fuel that will henceforth be required for marine steam-engines will be reduced by 70 per cent." Of smoke there will be none, and the cost of fuel for a given horse-power will be reduced by "more than one-half." We must await with what patience we may for the details of the above inventions; but meantime we can call attention to the proposals of Mr. Wm. Burns, of Leith, who studied the question some years ago, and has recently taken it up again. The composition of coal-tar varies; but according to an analysis given by Roscoe, which will serve as an example, it contains naphtha 3 per cent., light oils and carbolic acid 1·5, heavy oils, naphthaline, anthracene 35, pitch 50, water and loss 10·5 per cent. It will be obvious to students of chemistry that coal-tar is, therefore, rich in illuminating matters, and, in fact, it is so well known that many attempts have been made to convert the tar into gas, or to get more gas per ton of coals at the expense of the tar. There are, however, considerable difficulties attending attempts to distil tar, the most important of which is that the pipes of the apparatus are so speedily choked. According to Mr. Burns, it is now more than fifty years since he first tried to convert coal-tar into gas in an economical manner, and after many failures he says he has succeeded, by passing superheated steam through the tar in the still at the same time that the latter is subjected to a high temperature externally. The vapours of the steam and tar are collected and mixed in a hot reservoir, and are then transmitted through a red-hot tube packed with charcoal, which completely decomposes the vapours into a permanent gas. One gallon of tar and two gallons of water can by this method be made to yield 700 cubic feet gas of 16-candle power; but by using a rger quantity of steam, a gas of low illumi- ting power can be obtained which has great lue as a heating agent. By distilling average al so as to obtain the largest amount of tar, r. Burns says he can produce 16-candle gas at ost of twopence per thousand feet, the value the coke, ammonia, and pyroligneous acid ying about 75 per cent. of the total expense production, while the plant for making 6,000 cubic feet of gas would cost only about 750. So far as we can gather from the inted account of the process, Mr. Burns has t taken out a patent; but it may be useful extract the following statements, with the nouncement that the inventor of the process s devised apparatus by means of which he n make gas from coal-tar in an economically mmercial manner.

The novelty of the above mode of manufac- ring gas from tar or other liquid hydrocarbons as follows:—

1. The tar or oil is first distilled by a combi- ation of dry external heat and internal perheated steam in a retort of novel con- ruction, which admits of being continuously d and discharged without intermission, hereby the steam and hydrocarbon vapours re thoroughly mixed, and the equal density of he composition of the hydrocarbon vapours is aintained throughout the whole time of the istillation.

2. The hydrocarbon vapours and steam are lecomposed in a separate retort, where the apours are distributed by a perforated pipe hrough and over a large surface of red-hot harcoal and iron, which converts the whole of he vapours into permanent illuminating or eating gas as may be desired.

3. Gas can be manufactured by this method f any illuminating power required up to 60- andles, at less cost than gas can be manu- actured by any other method hitherto adopted. oals of an inferior quality may be distilled at w temperature under high pressure in suitable retorts to produce tar and ammonia, and he tar can then be converted into double the uantity of gas that could be made by making as direct from the coal. One ton of average al by this method would produce 21,000ft. of -candle gas, and one ton of good cannel coal ould make 30,000 cubic feet of gas perfectly ee from sulphur or ammonia compounds.

4. When it is not required to make gas from he tar, the vapours from the distilling retort an be turned into a condenser and converted nto naphtha and oil. When resin or fat is re- uired to be distilled, these substances are put nto close steam-tight vessels above the retort nd melted by steam, and then the melted resin r fat is run into the distilling retort in the anner described for tar or oil.

Wood, peat, and turf can be profitably used r making gas by the foregoing method—one on of peat giving 18,000ft. of gas. Sewage ludge can also be utilised, Mr. Burns having istilled oil from dried sludge at the rate of 5 gallons per ton, giving 60,000 cubic feet 16- andle gas when treated by the method above nentioned. We believe that a patent was obained some years ago for making gas from ewage or the sludge, but for some reason or ther nothing seems to have come of it; ossibly Mr. Burns's may be a better method, nd as he reckons that average sewage will ield 380 gallons of oil per million gallons of ewage, there ought to be a profit, instead of a ss, in dealing with that troublesome refuse. These statements, taken with the rumours bove mentioned, show that inventors are abouring at schemes which may turn out successful; but there have been so many dis- ppointments in years gone by, that it would e unwise to be too sanguine.

ON A NEW PHOTO-MICROGRAPHIC CAMERA.*

SOME, preferring to employ the late Dr. Woodward's method of making the room ight-tight and using no camera at all, will say that uch a contrivance is quite unnecessary. If work s to be carried on in the daytime, Dr. Woodward's method will be found expensive; but for night work little more is required than a light-tight box in which to place your illuminating apparatus. Having tried both methods, I find that the camera is the better and simpler of the two. The microscope is set up, the lens, light, and condenser adjusted as if for ordinary work, the only difference being that the instrument is placed in a horizontal position; the camera is then applied, which operation will be found as easy as changing an eyepiece. Another thing in favour of a camera is that it is portable. In taking a daylight picture, if one side of the house does not suit, the apparatus can be readily moved to the other side. In winter time also, to work in a room without a fire is, to say the least of it, uncomfortable; and delicate work with cold hands becomes impossible. Before describing the apparatus I wish to make a few remarks as to the capabilities of photo-micrography in delineating a magnified image. In pre-apochromatic days I made a series of experiments in photographing critical images with high powers. I chose diatoms as being the most suitable objects to experiment upon.

They possess a primary structure; a secondary structure which, of course, requires a much higher order of resolution; in addition to which a fracture through the secondary structure necessarily requires a resolution of a still higher order. This last is a test, for it tests not only the quality of the optical appliances, but also the mechanical parts of the instrument as well as the skill of the manipulator. It is obviously the best plan to select a very difficult object with the highest power as a test. Too often photo-micrographs of histological, pathological, and other objects taken with lenses having capabilities far beyond those objects, are exhibited as tests, the truth being that they are not tests at all. As an example, the pattern at the base of the cells in the Triceratia has been quoted as a test for good immersion lenses, whereas I have frequently exhibited it with a ⅛ of 35°. The mere visibility of the markings would not be a test for a cheap series ¼; but a fracture through these delicate perforations would be a test for the finest lenses in existence.

In my experiments I succeeded in delineating the second order of resolution, but was unsuccessful in reproducing the last. Nor was I peculiar in this, for on carefully examining all exhibited photo-micrographs, I found they told the same tale —viz., that the images were not sufficiently critical to be capable of delineating a fracture through secondary structure. Hoping as I do that Prof. Abbé's apochromatic principle has, so to speak, taken us out of the wood, I have resumed photo-micrographic studies, and have, in conjunction with Mr. C. L. Curties, designed this camera especially for use with Prof. Abbé's new 3-power projection eyepiece. One further digression before I come to the legitimate scope of this paper—that is, I must again condemn the too-prevalent idea that a resolution of the transverse striæ of A. pellucida with oblique light is a test of a high order: it tests neither the optical nor the mechanical parts of the instrument. The most that can be said for it is, that it is a rough measure of the aperture of the objective employed—a fact which might be determined with accuracy by an apertometer. In projecting this object on the screen no particular difficulty will be experienced with the focussing adjustment; but how different is it when you project a critical picture illuminated by a large-angled central cone, for it then becomes a matter of considerable difficulty to focus the object with one of the slowest fine adjustments of the best construction. Besides all this, there are no more striæ on the A. pellucida than there are on the N. rhomboides; I fail to see what possible good can arise from continually misrepresenting diatom structure. The last phase this mania for striæ has taken is the resolution of longitudinal striæ on the A. pellucida. In all the photo-micrographs I have seen, they appear coarser than the transverse. In a very fine specimen before me, where the valve is 8in. long, the longitudinal striæ are about 1½ times as coarse as the transverse. If this is so, then, according to the Abbé diffraction theory, the diffraction spectrum of the longitudinal striæ will not be so much bent from the dioptric beam as that of the transverse.

Let us examine the object with a lens of 1·4 N.A. First take the transverse striæ and illuminate them by a pencil of the greatest possible obliquity. Remove the eyepiece and examine the spectrum: it will be found that the "red" is well in the grip of the objective. We are assuming, of course, that a specimen of average fineness is under examination. Now, without altering the illumination in the least, rotate the valve through 90°, so that the oblique pencil falls across the longitudinal striæ. On removing the eyepiece, no spectrum will be visible. This proves that there are no longitudinal striæ even as coarse as the transverse. Much more, therefore, are there none coarser, for if there were, their spectrum would be farther in, not farther out.

This camera consists first of a base-board, which is of sufficient length to take the camera when fully extended, the microscope, and the lamp. The axis of the camera is fixed at the same height above the board as the optic axis of the microscope employed, when placed in a horizontal position, this particular one being adjusted to the "Nelson model" microscope. The camera itself consists of two cardboard tubes, which will be found strong and light, the one sliding into the other like the tube of a telescope; the joint between the two tubes is made light-tight by a velvet flap, which is fastened down by an indiarubber band. The joint between the microscope and camera has the usual light-excluding tubes. This camera is so arranged that when it is closed it will give with the three-power projection eyepiece a magnification equal to about five times the initial magnifying power of the objective used, which is equivalent to the power obtained with an A eyepiece; but when fully extended it gives ten times the initial magnifying power of the lens, or the equivalent of a C eyepiece. The outer cardboard tube is fastened to an upright piece of wood, which can be clamped to the base-board by thumb-screws at any points of its extension. The focussing screen, which is of plain glass with some lines ruled on it, slides in grooves at the back of this upright piece of wood. This is removed when the double back with the sensitive plate is put in position. The double back is the well-known patent metal one which is cheap and thoroughly efficient. This back is not a fourth of the cost of the wooden ones, and is free from the objectionable sticking of the slide due to the warping of the wood. It will be found convenient to have half a dozen of these backs, and then a whole box of plates can be disposed of at once. Light-tight boxes are therefore not needed. It is a good plan to keep each double back in a black calico bag of double thickness with a flap secured by an elastic band. A rod runs down the right-hand side of the camera, a string passes round this, and over a pulley on the other side of the board, taking a round turn over the head of the fine-adjustment screw. This string is kept taut by a piece of elastic. The feet of the microscope fit into chocks fastened on the base-board.

The method of working the instrument is as follows:—1. Close the tubes of the camera and slide it back as far as it will go. 2. Adjust the microscope in the usual manner, using an ordinary eyepiece. 3. Replace the ordinary eyepiece by the projection eyepiece, taking care to remove the eyepiece cap when using wide-angled lenses. 4. Extend the eyepiece focussing arrangement as far as it will go. 5. Slide up the camera, placing its end carefully into the light-excluding cap, so as not to disturb the microscope. 6. Focus the object on the screen. Let me, in conclusion, especially recommend the Aplanatic lens No. 127 in Zeiss' catalogue, power 6, as a focussing glass. I have previously drawn your attention to the very high excellence and utility of lenses on this formula for ordinary purposes. The whole of this apparatus —viz., camera, microscope, and lamp—is produced at a cost less than is usually paid for a camera alone.

It is not a makeshift which is only capable of doing fairly good work, but it is proved by practical experience to be equal to the highest class of work. The Campbell fine adjustment will be found peculiarly serviceable for photo-micrographic work as it is slow and free from "spring," which is the bane of every geared-down fine adjustment. The camera is fitted for quarter-plates.

RYDER'S AUTOMATIC MICROTOME.

THIS new instrument has been devised by Prof. John A. Ryder, of the Biological Department of the University of Pennsylvania, in order to facilitate the preparation of sections for large classes, and also for the rapid preparation of series of sections in ribbons in embryological work, in which the element of time becomes a serious consideration. The device is small and compact and is also automatic—that is, the same movement which cuts the section also brings the block into position for cutting the next successive section and so on continuously, of any desired uniform thickness; the cutting takes place as fast as it is possible to move a vibrating lever up and down through a distance of 3in. with the right hand. Nearly all other automatic microtomes are costly, unwieldy, large, and heavy, or else very complicated and liable to get out of order. The only exception in part to this rule is the rocking microtome, made in Cambridge, England; but it cuts in an arc, so that the sections are segments of a hollow cylinder, and not parts of a perfect plane; besides, the rocking or vibrating arm admits of only a very limited movement, so that the instrument is suitable only for cutting sections of objects of very limited dimensions; nor is the position of the block adjustable. Moreover, in none of the automatic microtomes now in use is it possible to place the knife at right angles or any other desired angle to the direction in which the block to be cut is moved—a great desideratum in botanical or other

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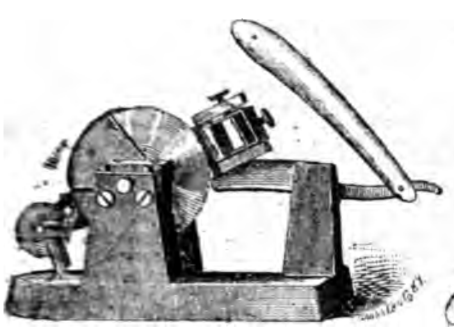
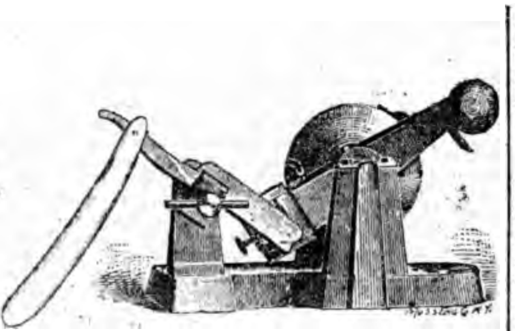
* Read before the Quekett Microscopical Club on pril 22, 1887, by Mr. E. M. NELSON.





work in which an inclined knife is necessary. In order to supply an instrument serviceable especially to teachers, as well as to all classes of students, botanists, pathologists, histologists, and zoologists, the designer has attempted to bring together all the desirable features of previously invented instruments, in as simple, convenient, and compact a form as possible, without sacrificing rapidity and efficiency of action.

The working parts are an oscillating lever, which is provided with a clamp at one end into which paraffin holders are adjusted, and at the other with a simple handle. This lever rests upon trunnions on either side, and these in turn rest in triangular notches at the top of the two pillars between which the lever oscillates. At the cutting end of the lever a spring pulls the lever down and effects the sectioning and also the adjustment for the next section. The lever is pushed over and adjusted for the successive sections by a hollow screw, through which passes the trunnion on the side away from the knife. This screw is fixed to a toothed wheel, 3in. in diameter, which revolves close by the side of the oscillating lever. The toothed wheel and screw is actuated by a pawl fixed to the side of the lever near the handle. The number of teeth which this pawl can pass in a single vibration downward is controlled by a fixed stop screwed into the under side of the oscillating lever near the handle; the end of this stop striking on the top of the bed-plate thus brings the lever to rest at a constant point in its downward excursion. An adjustable sector by the side of the toothed wheel throws the pawl out of gear after a given radius of the wheel has been turned through an arc embracing the desired number of teeth. This adjustment is also effected before the block, containing the object to be cut, reaches the edge of the knife. The adjustment for the next section is therefore effected while the surface of the block is not in contact with the under side of the knife, so that no flattening or scraping effect is produced on the surface of the block in its upward passage past the knife.

The movement of the vibrating lever being arrested at each down stroke at one point and the pawl which catches into the notches in the toothed wheel being released at any desired point by the action of the adjustable sector, it is possible to adjust the apparatus with great accuracy for cutting sections of any desired thickness. If a given radius of the wheel is moved through the arc embraced by a single tooth, sections are cut having a thickness of only $\frac{1}{10000}$ of an inch, or ·0025mm.—a thickness which is only practically possible with paraffin imbedding and a very keen razor. If more teeth are taken by the pawl, any thickness of section is possible up to about $\frac{1}{400}$ of an inch, or ·0625mm. (The screw which adjusts the block for cutting has exactly fifty threads to the inch, and there are two hundred teeth on the periphery of the toothed wheel. The value of a single tooth is, therefore, $\frac{1}{50} \times \frac{1}{200} = \frac{1}{10000}$in.)

A freezing attachment which has lately been appended to the apparatus shows that frozen sections can be made with as great rapidity and as thin as those cut from objects imbedded in the paraffin block, and very nearly, if not quite, as thin. The freezing attachment is as simple and efficient as the self adjusting and cutting devices of the instrument. Other auxiliary apparatus makes it possible to cut celloidin sections. This is effected by means of alcohol conducted by a tube from a reservoir to the knife, over which the fluid will run and drain into a tray below in such a way as not to come in contact with any other parts of the machine. This tray fits into a recess in the end of the bed plate of the instrument just below the knife, and into this tray the celloidin sections may be allowed to drop as fast as cut.

The paraffin holders are square and ¾in. in diameter, so that a block of that size may very readily be sectioned. For the botanist, one of these holders is provided with a movable side and screw for clamping objects, so that rather tough stems may be firmly held between blocks of cork, while the more delicate vegetable tissues, or such as must be embedded in fresh carrot, soaked in gum and hardened in alcohol, may also be firmly held for sectioning by the same device, provided the pieces of carrot are first trimmed into the right shape. The same style of holder is equally applicable for holding the corks—if properly trimmed—upon which tissues are embedded in celloidin or in gum. This style of holder also enables one to embed very long objects entire in paraffin—such as earthworms—and to cut them as a single piece, provided the surrounding paraffin is carefully trimmed so as to have two opposite sides parallel. An object 6in. long and ¾in. in diameter embedded in this way may be cut into an absolutely continuous series of sections without losing any essential portions. This is accomplished by slipping the block through the quadrangular clamp for the distance of ½in. every time ½in. of the object has been cut off in the form of sections. One-half inch is the length of block which can be cut at one time without readjusting the feed-screw which moves the block and vibrating lever over towards the knife, the whole being kept firmly in place against the face of the hollow screw by a strong spring which presses against the end of the trunnion on the outside of the iron pillar on that side of the instrument where the knife is fastened, so that all the sections are of exactly the same thickness from first to last. Cutting up large objects in the manner above described is not possible with any other form of microtome yet constructed.

Almost any section-knife—wide or narrow bladed—will fit into and be firmly held by the knife-clamp, which is, however, intended more especially to hold an ordinary razor. The best razors for cutting sections have been found to be those of the best make only, such as Wade and Butcher, or Joseph Rodgers and Sons, of Sheffield. Only such razors as hold an edge well should be used.

For ribbon-cutting by the paraffin method the block containing the object, after it is trimmed and soldered to the paraffin with which the holder is filled, by means of a heated wire, is covered with a thin coat of soft paraffin or "paraffin-gum," and of which "chewing-gum" is made. (Chewing-gum may be rendered available for this purpose if it is melted at a temperature somewhat above boiling, when the sugar which it contains will separate as caramel, leaving the pure paraffin-gum, which may be drained off and used as directed, if the manipulator should find it difficult to get the paraffin-gum of commerce). This enables one to cut ribbons of any desired length, since the softer paraffin at the edges of the successive sections sticks them together by their margins as fast as they are cut. The ribbons may be allowed to fall upon a slip of paper, which may be drawn out, as fast as the sections are cut, from under the bed-plate of the instrument, beneath which there is a space left for this purpose between the three toes or tripod upon which whole apparatus rests. The edge of the knife also remains in the same plane, no matter at what angle the cutting edge is placed with reference to the direction in which the block to be cut is moved, just as in the best forms of the sledge microtome.

The advantages which this new instrument offers are, briefly, comparatively small cost, great efficiency, rapidity, and accuracy. One hundred sections per minute may very readily be cut with it. Its simplicity of construction, with few wearing parts, and slight liability to get out of order in the hands of inexperienced persons, will also commend it to the teacher and investigator. Experience has already shown that those once using it can scarcely ever be again induced to use the most efficient sledge or automatic microtomes of different design if they can have access to this instrument. This device is made by Mr. Zentmayer, whose name is a sufficient guarantee of the workmanship employed in its construction.—*American Naturalist.*

A GOOD RECORD FOR A TURNING TOOL.*

I HAVE on my table a diamond point lathe tool which has busied me for the past few minutes in the way of getting its dimensions, clearance angles, height of point, inclination of cutting edge, &c. Will you kindly permit me to describe this tool, as a little later I have something to write in relation to the record the tool has made, and consider this a case where it will do no harm to know beforehand why the tool should have accomplished what it has?

The tool is from 1¼in. × ½in. American tool steel. It weighs 1¼lb.; cost of steel 30 cents. As it rests on its edge on the table I find on measuring up to the point is 1¼in. Up to the heel of the cutting edge is 1$\frac{5}{16}$in.—that is, the point of the tool is depressed below the horizontal $\frac{1}{16}$in. in the width of the cutting edge, which is ½in. wide. Trying the protractor bevel on the clearance angles from the horizontal line I find the reading 75°. Straddling the cutting edge—the wedge which is driven under the chip—I find the reading on the protractor to be 45°. This sums up thus: Clearance angle 15° out of vertical; cutting angle—shear from cutting edge back and downward, 30° out of horizontal. This angle of shear in grinding produces at the top of the ½in. square blade a face of ⅜in. × ½in. I believe this description to be accurate. This tool was set admirably. The mark of the set screw, which held it in the tool-post, is just 3in. back from the cutting point. The front of the supporting collar was only 1¼in. back from the point. It was solid, as it had no blocking under it, but came just the right height without that villainous blocking out of level, which makes some tools a nuisance, the angles of which are only suited to a horizontal position of their bodies. The man who ordered the tool made knew the lathe, knew the job for which the tool was to be used, and the tool dresser who made it could comprehend the instructions he had, and was willing to govern himself accordingly. What of it? I will tell you. I found this tool at work roughing out a lot of shafts 3¼in. diameter by 22in. long. Weight in rough 60lb. The tool was working so well—the great curling chips were piled under the lathe and twirling away from the tool in a way which all machinists admire—that I stopped to watch the splendid work this tool was doing, and as I took in the faultless shape of the tool for the lathe in which it was being used, the perfection of grinding and setting, saw the great chips roll off, and the smoke from the tool reaching half-way up to the ceiling, I began to investigate. The shafts were machinery steel. For 6⅜in. at one end, and 4⅝in. at the other, they were turned down to 2½in. This was done at two chips; ⅜in. reduction the first chip, ⅛in. the second; 7in. of the remaining length was turned to 3⅛in.; the remaining 4¼in. was turned to 3$\frac{7}{16}$in. I weighed a shaft after the turning—23lb. had been removed. I timed the revolution and found the surface speed on the 3¼in. down to 2⅝in. cuts was 18ft. per minute. The feed was 40 to the inch. "How often do you grind?" I asked the latheman. "Run nearly all day without grinding sometimes," was the answer. "How many do you turn in a day?" I asked. He answered, "Six."

I was anxious to see so light a lathe tool, at a speed and chip which made the smoke rise, run ten hours without grinding. I had recently seen a planer tool stand to plane steel ten hours without taking out, but with a lathe tool there was no chance to rest and cool off. With all my experimenting and theorising on the possibilities in cutting steel, here was a chance for verification, or contradiction, of assertions I had made, which captured and delighted me.

But it was not all a matter of shape or setting. The steel from which the tool was made was superb. The old notion that "anything was good enough for lathe tools" had not applied in this case; and, another thing, this tool had not been hardened at a heat which made it necessary to draw it to a purple, or brown, or straw, or any other colour. No. It was hardened at so low a heat that the scale was not disturbed in the least. The temper was not drawn at all. Not even was it "just started, to take off the strain." "Won't break, can't break it," said the man. "If it was going to break, that first chip on a little light tool like that would fetch it. I tell you it is a good tool." It is. I watched its working, timed it, brought home chips from it, and have the tool and its record. It stood without grinding, without removing from the tool-post, or being sharpened in any way, to turn 18 such shafts as I have described, turning off 414lb. of steel chips. The actual working time was 28½ hours. How does this strike the readers of that yarn about "whittling a steel key with the blade of a pocket knife"? If such tools are available, can be had for the outlay required to buy a first-class cast steel, and the careful proper treatment it should have in forging and hardening, and then, with the tools put in the machinists' hands, intelligent, interested grinding and setting will show such results in whittling steel as above recorded, why should there not be as much of interest manifested in a recital of the facts, as there has been in the widely copied article about "a cold chisel made from cheap tire steel," which, by hardening and tempering by some secret process, would chip hard material which resisted all efforts to cut it with best cast-steel tools? Why should the reading public have served up as marvels the facts that chilled iron has been drilled through the agency of some newly discovered secret process of tempering applied to the drill, when it is a fact that in the different shops in the country where chilled rolls are turned enough of the hard stuff is turned into chips daily to stall a locomotive on dead level, if it could all be gathered from a day's cutting and used as the loadings of a freight train?

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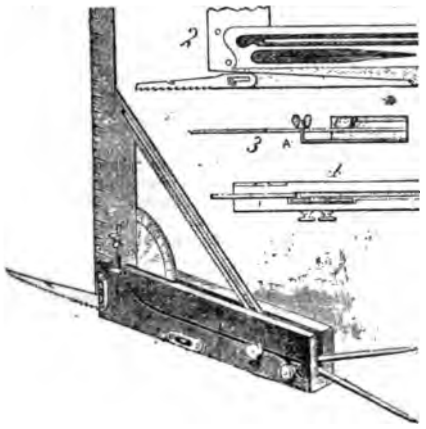
* Extracted from a paper by Mr. S. W. GOODYEAR in the *American Machinist.*

Why should the public be expected to swallow in gaping wonder the astounding information that a carpenter's chisel, by being tempered by a wonderful, newly-discovered secret process, has cut iron as though it was so much wood? And that malleable iron shears have been converted into finest steel by another process is more of the "stuff" which is going the rounds of the Press. Let's analyse this matter of turning off 414lb. of steel at one grinding of the tool. Almost a cubic foot of steel converted to chips, $\frac{10}{12}$ of a cubic foot, say, for convenience. Equivalent to cutting off a chip ¼in. deep on a surface of 40 square feet, or ⅛ deep on 80 square feet, or $\frac{1}{16}$ on 160 square and with a cut $\frac{1}{32}$ deep, 320 square feet, $\frac{1}{32}$in. chip. That is what is taken off on a side in turning shafting, and under the modern method the $\frac{1}{16}$in. reduction in diameter made in turning shafting is divided among three tools—*i.e.*, a roughing tool, one making a second cut, and a square-nosed finishing tool. How many feet in length of 2½in. shafting turned to 2$\frac{7}{16}$in. would be represented by this 320 square feet, $\frac{1}{32}$ thick, which it appears our tool which is under consideration turned off? Would be about 470ft. in length, would it not? It seems to me that I heard a shafting turner bragging about a tool standing to do its share of the cutting on 80ft. of such shaft, and another man said his crack tool, to which his mind reverts as the incomparable one which he has never seen matched, turned 60ft., while still another man runs the record up to 120ft. It is a little like stories about catching big fish, is it not? And it is possible that my story about a tool which did the equivalent of turning about 470ft. in length of 2½in. shafting unaided, and unground, from the time the turning commenced, will be beaten out of sight when the returns are all in. But in the meantime I shall think that for a diamond point from 1¼in. × ¾in. steel, with much of its work done at a depth of cut covering the entire depth of cut of which the blade was capable, this, which I have described, is worthy of notice.

COMBINATION TOOL FOR SQUARING, LEVELLING, &c.

THE engraving represents a tool which has been recently patented by Mr. David W. Warnock, of Lexington, Ky. The tool may be used for squaring, levelling, plumbing, centring cylinders, laying off angles, starting a saw kerf for cutting a keyhole, and for cutting lace leathers for belting. In one edge of the body is a groove, held in one end of which is a square blade which is cut away at an angle of 45° upon its inner edge, to form a bevelled shoulder for receiving and supporting the end of a slotted bar, when in the position shown in Fig. 1. This bar is fitted in the slot, and is provided with a pivotal pin projecting through a second slot formed in the side of the body. This pin retains the bar in the body, while admitting of adjusting it in position for use or folding it into the body when not in use. The end of the second slot, near the blade, is curved towards the blade, and the opposite end is branched. In the main groove is placed a thin pair of compasses with a pivotal pin projecting through the side slot. When it is desired to use the slotted bar, the compasses are drawn forward into the branch of the side slot, and the pin of the bar is moved forward to the extremity of the slot behind the branch, when the compasses may be pushed back entirely within the body. When the bar is folded over upon the shoulder, a left mitre can be obtained; and when it is pushed back in the slot to the angle of the body and blade, and then inclined outward at an angle of 45°, a right mitre can be obtained. Both right and left mitres can be obtained without reversing or turning the square over. In the body is a cavity, into which the protractor may be turned when not in use. Fitting in a slot in the outer edge of the body is a keyhole saw, the inner end of which is slotted to receive a pin, as shown in Fig. 2. To facilitate the opening of the saw, its back is provided with a nick for receiving the thumb nail for lifting it out of its slot. In one side of the body, near the middle, and at one end, are secured spirit-level bulbs, which are used for levelling and plumbing in the usual way. In a transverse groove in one side of the body is a steel bar, A, Fig. 3, which is bent at right angles at its extremity toward the blade, and is formed into a knife having a shank projecting through a slot in the blade, to receive a nut for clamping the knife in any desired position in the slot. This knife is designed for cutting lace strings for belting, and is made adjustable, to admit of cutting laces of different widths. When not in use, the knife is moved into a notch in the edge of the body.



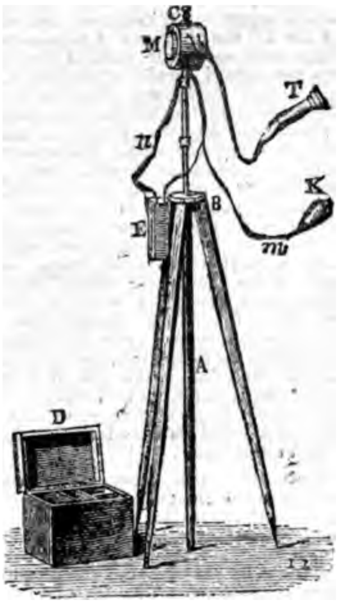
HOW TO MAKE A POCKET ACCUMULATOR.

THE following method of making a pocket accumulator is given in the *Magazine* of the Finsbury Technical College over the initials "R. L. D.":—

There are several kinds of pocket accumulators in existence. There is the thick one, whose box is made of ebonite, the thin one made with lead casing, and the thin one made of ebonite. Of these the last is the most convenient and portable. The ebonite box, with the accompanying top, may be obtained very cheaply. The boxes are made with a partition down the middle to form two cells. The first step is either to shellac varnish or cover with elastic glue the edges of the partition, to make it watertight; the next is to make the plates. The simplest plan is to get a plate of lead about $\frac{1}{12}$in. thick, and cut it up into six strips just broad enough (say 1in.) to go into the cells, three in each, side by side; the usual length for these strips, about 3in., depending on circumstances. Each of these strips should be made with a lug at one end to project outside the cell. The top of ebonite is then divided into two, and each half carefully fitted into the inside of each cell. Each half then has three holes cut in it for the lugs to come through, and a hole through which to pour the acid into the cells. The six strips are then placed in position, three in each cell, with two indiarubber bands passed round the middle strip of each cell; the band should go round vertically, not horizontally. This will be sufficient to insulate them from each other. A band may be placed round all three, if preferred, to steady them, but is not necessary. The tops are then put in and glued in carefully, taking great care that no hole is left where leakage might occur, either from one cell into the other, or from the cells to outside. There are then six lugs of lead projecting out from this, three in one half and three in the other. The two outer lugs of one cell are then joined to the inner lug of the other cell; the inner lug of the first cell is fixed into a binding screw, which is then vertically fixed into that end of the top, and the two outer lugs of the second are fixed to another binding screw, which is then fixed in a similar manner to the former in the other half of the top. A small glass tube about ¾in. long is then placed in each of the two remaining holes. A layer of glue is then put all over this, so that the only parts projecting are the binding screws and the tops of the two glass tubes. The binding screw, which is connected with the centre plate of the first cell, is then marked +, and the other −, as the centre plates in each cell will be the + plates. Acid is then run into the cells, the proportion of acid to water being one in six. The cells are then charged, discharged, and reversed a large number of times till fit for use. When used in the pocket, the glass tubes should be closed with guttapercha stoppers. The accumulator may be used before the plates are fully formed; but the forming process should continue till the plates have a capacity of about two ampère hours. The E.M.F. of these cells is four volts. It is advisable to make a case of some sort for the accumulator, in case there should be any slight leakage of acid, which would otherwise have disastrous consequences on the wearer's clothes. Of course these cells will not stand much rough treatment, but must be used carefully. The total cost, when made in the way described, is very small, only amounting to a few shillings.

THE HYDROPHONE.

MR. A. PARES, of Altona (Germany), has devised an extremely ingenious apparatus for detecting leakage in water mains, and the accompanying figure gives an illustration of it. A is a rod made of a substance that conducts sound well. This rod is held in a vertical position by a tripod, and to its upper extremity is attached a metallic box containing a microphone, M. The apparatus is completed by a regenerative dry pile, E, a telephone receiver, T, and a pear-shaped contact-maker, K, that permits of leaving the pile circuit open, and of closing it only at the moment of observation. On moving the rod A over the water-pipe, any leak can be distinctly heard by the ear. It appears that the sensitiveness of the apparatus is such that the slightest leak in the pipes inside of a house can be ascertained from the street. When the observation is made in a place where there is much noise, it is well to use two telephone receivers, or, if but one be used, to close one ear by means of a small device which Mr. Pares calls an antiphone, and which forms one of the adjuncts of the apparatus. The microphone is so constructed that it can be fixed directly to a water conduit.—*La Lumière Electrique.*



THE THERMOPILE AND SECONDARY BATTERIES AS A CONVENIENT MEANS OF PRODUCING ELECTRICITY FOR MEDICAL AND SURGICAL BATTERIES.*

ELECTRICITY has never played so important a part in the routine of daily practice and consulting-room work as its undoubted usefulness would seem to indicate that it should. In comparing it, for instance, with the stethoscope and thermometer, we find that, while these are in the hands of every physician and surgeon, electricity is hardly met with at work, save in the chambers of a few specialists and in a few well-equipped hospitals.

I wish to direct the attention of the profession to a method by which electricity in all its forms can be readily and easily obtained at all times, by arrangements that are easily and conveniently managed, that are little liable to get out of order, that can be procured at a moderate initial expense, and cost little or nothing afterwards, that are convenient for transport, and are in all respects attended with the minimum of inconvenience. I do not claim that the arrangement I advocate the adoption of is all we could wish it to be; but believe it is a very great step indeed in advance of the plans hitherto proposed, and is likely to satisfy a large number whose employment of electricity in practice is at present hampered or prevented by the drawbacks that have been mentioned. The plan is not my own. It was suggested to me last year by Mr. J. W. Swan, the well-known inventor of the incandescent lamp that bears his name. He pointed out to me that the employment thermopile as a generator of electrici probably be of considerable service to our profession, and he was good enough himself in the matter and work out manner I could not myself have accomplished, the practical steps towards effecting this. I explained to him our wants, and he devised the means of meeting them. The thermopile, which forms the starting point of the arrangement, is composed of four groups of German-silver and zinc-antimony elements, each group containing twenty pairs in the form of a wheel 6½in. in diameter, in which the elements are the spokes. The four corona-groups are placed on a wooden stand, about 16in. square, and are connected together in series—i.e., the positive pole of one group is attached to the negative of the next. Each group has in its centre a gas Bunsen burner, the burners all supplied by a common pipe, but with taps so placed that they may be used separately if required: and when the burners are lit, the difference of temperature between the outer and inner ends of the pairs of elements generates a current of electricity, feeble indeed, but very convenient, since its feebleness can be compensated for, and its convenience, requiring as it does only the turning on and lighting of the gas, is unquestionable. These thermopiles are made by Rebicek, of Prague. They give an electromotive force of about one-tenth of a volt per pair of elements—that is, four volts for the four groups, equal, say, to seven or eight Daniell's and three or four Grove's cells, power sufficient to illuminate a small incandescent lamp. A slight alteration in the thermopile would adapt it for being used with spirits of wine, or even with paraffin. Several of these thermopiles can be arranged in series, with a gain in electromotive force corresponding to the increase in the number of elements added, but at the cost of an increase in initial expense, and, from their bulk, a lessening of convenience. Were they to come into general use, their bulk could be considerably reduced by some slight alterations.

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* Extracted from a paper by ALEX. OGSTO fessor of Surgery, University of Aberdeen, in

The thermopile alone, however, is insufficient for the purposes of the practitioner. To render it useful, it requires to be supplemented by the secondary battery, or accumulator, as it is sometimes called. With this addition in a suitable form, portability being the chief point, the apparatus is complete. The secondary batteries which Mr. Swan designed for me for this purpose, consist of two portable vulcanite boxes, each 3in. square and 8in. high. Each box contains two cells arranged on the principle of Planté, with elements of lead and peroxide of lead, in dilute sulphuric acid of one to ten in strength. Each is closed by an indiarubber washer and a lid clamped on by a screw, to prevent their spilling when carried, a ring-handle being attached for this purpose. They can, like ordinary galvanic cells, be used separately or in conjunction. Each weighs, when filled and charged, 6lb. 1oz. Mr. Swan writes concerning them:—"The object in dividing the batteries is that there may be no unnecessary weight to carry where the power of one battery (two cells) is sufficient, and it will be sufficient for surgical lamps for eye and throat examination. For electrical cautery the combination of the two batteries is needed. The thermopile has just power enough to charge one battery at a time when the gas is not very fully turned on—that is, when the flame just burns above the talc disc. Under these conditions the thermopile will send ½ or 0·6 of an ampere through one of the batteries, and that is what is proper for a battery of this size. While charging, the cover should be removed, and several folds of blotting-paper laid on the mouth of the battery to intercept the bubbles of gas that rise from the liquid. It is necessary to make up for this loss of liquid by adding to that in the cells sufficient to cover the plates. The battery should not be allowed to become completely discharged, and, after using, it should, as soon as possible, be fully recharged and left so. The only part of the battery likely to get out of order is the connection between the positive plate and the outside terminal, but it is very easy to repair, and I think probably little or nothing beyond that will require to be done to the batteries for a long time. Several folds of blotting paper round the joint of the lid and case, or a waterproof bag to contain the whole, will prevent droplets of acid staining the clothes of the person carrying it."

I have, during the past two months, subjected the arrangement to the severest tests of practice, having used it for nearly every purpose save that of extracting steel by the electro magnet, and have every reason to be satisfied. The batteries yield a sufficient constant current, can be attached to the induction coil for faradisation, answer well for electrolysis, and are very convenient for illuminating the mouth and examining for translucency in cystic tumours. They are very efficient for the galvanic cautery, easily heating, when fully charged, 5in. or 6in. of stout platinum wire white hot, and fusing thinner pieces. When employed for electric illumination in the work room, the conductors from one battery are connected with a two candle power Swan lamp placed in the hollow end of a piece of bamboo, which shades the eyes of the observer from the light, and, acting as a handle, enables it to be directed towards the parts to be illuminated [illegible] the mouth. When both batteries are attached I can light up my consulting-room by means of a five-candle lamp that is suspended by a bracket from the wall. In testing the translucency of [illegible] tumours, the two-candle lamp [illegible] handle is pressed against one side of the [illegible], and, the swelling being steadied by the hand, the other side of the tumour is observed. In cases of hydrocele of the tunica vaginalis, and in one case of congenital cystic hygroma of the neck, the translucency was well brought out, and it is much more convenient than the candle or wax taper, especially in children, whose incautious movements cause danger of scorching them. In the use of the endoscope the greatest inconvenience is felt from the heat of the lamps used in connection with them, and from the necessity of keeping them upright. This inconvenience is a very great drawback indeed to its employment in examination of the œsophagus, the rectum, and especially the urethra, where it is occasionally of the greatest service. The introduction of a two-candle power Swan lamp into the instrument creates quite a revolution in this respect, and converts the endoscope from a very cumbersome into a most manageable aid to diagnosis. When required for faradisation the conductors are simply attached to the coil standing in the consulting-room. Both batteries have to be attached to the conductors for electrolysis, electric cautery, or the use of the constant current. In galvano-puncture I have not yet had an opportunity of using them, but in electrolysis they answer well, one needle being attached to each conductor. For electro-cautery or the galvanic écraseur the instrument is attached to the conductors and the circuit completed at the moment desired by the button being closed. I was pleased with its action in cauterising the pharynx, and in burning a small canal that had to be closed after an extensive operation for cleft of hard and soft palates. In using the constant current a sponge electrode is affixed to each terminal of the pair of conductors. The method of attachment most convenient is that of a pin slipping into a tube or socket, which is quickly connected or undone, or, when needles are used, joining them to the conductors by a thin bit of silvered copper wire.

During the two months in which I have employed the above arrangement, it has been in almost daily use, and its efficiency has been tested in every way: yet the secondary batteries have only thrice required to be charged by lighting the thermopile for a few hours. The convenience of the whole, and its superiority to any of the methods hitherto suggested, are so very striking, that I unhesitatingly recommend it to the notice of my professional brethren in the very strongest terms.

OXALIC ACID FOR THE SEPARATION OF VARIOUS METALS.*

IF oxalic acid is added to the solutions of different common metals—neutral or faintly acid—there are produced in the majority of such solutions precipitates of insoluble or sparingly soluble oxalates. In a few cases only there takes place no separation of insoluble oxalates, and the solutions remain clear. This latter case occurs in the solutions of the alkali metals and those of the higher compounds of some metals rich in electro-negative constituents, in which hydrated alkalies throw down hydrates corresponding to the sesqui- and per-oxides, and in which such hydrates form compoudds with a metallic acid. A precipitation of insoluble oxalates does not occur in the solutions of neutral salts of the alkaline metals, and in the solutions of chrome, aluminum, iron, manganese, uranium, and tin oxides, as well as of chromic, manganic, and antimonic acids, and of the acids of arsenic. This behaviour of the oxalates affords means not only of distinguishing the various stages of oxidation of the above acids, but also of separation, qualitatively and quantitatively, of the metals in question in their higher compounds from a great number of other metals. Setting aside gold and platinum, we find that among the metals of group VI. stannous oxide and antimony teroxide are separated from their solutions by oxalic acid, while no precipitation ensues in the solutions of stannic oxide, antimonic acid, and of the arsenic acids. All the metals of group V. are precipitated by oxalic acid.

The oxalates of lead, bismuth, silver, copper, and mercury, both in their maximum and minimum compounds, are almost insoluble. Cadmium oxalate is sparingly soluble. Copper, and indeed all other metals, should be thrown down only from hot liquids, preferably by a boiling solution of oxalic acid or by adding to the boiling solution a sufficiency of finely-pulverised oxalic acid, as the precipitates in boiling solutions subside more rapidly. After the liquid has become clear it is filtered by decantation, so that the least possible quantity of the precipitate is brought upon the filter. The two portions of precipitate (that on the filter and that on the beaker) are then dried, placed in a porcelain crucible, and heated, very cautiously at first, and finally more strongly after the addition of a little nitric acid. Small quantities of copper oxide can be easily converted into oxide. Large quantities are inconvenient on account of the gases evolved during the decomposition of the oxalates, which may occasion loss by projection. The silver salt enters into decomposition at 110°C., and detonates if heated more strongly. The mercuric salt is decomposed at 163° somewhat violently into mercurous salt and carbonic acid. Instead of decomposing oxalic acid in its salts by heat alone, it may be destroyed by heating with strong sulphuric or phosphoric acid, with permanganic acid, chromic acid, or with chlorine in an alkaline solution.

As for the metals of group IV., oxalic acid throws down nickelous, cobaltous, manganous, ferrous, and uranous oxides, and also zinc oxide, from their neutral or moderately acid solutions as sparingly soluble oxalates. In this group, consequently, ferrous, manganous, and uranous oxides may be separated, by means of oxalic acid, from the corresponding higher oxides. The faintly rose-coloured cobalt oxalate and the dull green nickel oxalate much resemble the copper salt in the fineness of the precipitates. Both are very sparingly soluble. Rather more soluble is the lemon yellow, very stable ferric oxalate, and the manganous salt, which is almost white and settles readily.

The zinc salt is most readily and completely separated by evaporating its solutions mixed with a slight excess of oxalic acid. This behaviour of the zinc salt must be kept in mind in quantitative analyses. The complete separation of all the precipitates produced by oxalic acid is much promoted by the time allowed. The metals of group IV. require more than those of group V. If to the solutions supersaturated with oxalic acid there is added a solution of ammonium chloride or nitrate, the separation of the insoluble oxalates is much promoted.

A rapid and complete separation of all these salts is effected by evaporating down the solution with a slight excess of oxalic acid, and taking up the soluble matters in a little water. A volatilisation of volatile chlorides under these circumstances does not take place if oxalic acid is present in excess, even in case of arsenious compounds. Dilute sulphuric and nitric acids do not appreciably increase the solubility of oxalates which are insoluble in pure water and in dilute oxalic acid. Hydrochloric acid, even if dilute, has a decidedly solvent action. Similar is the action of strong oxalic acid upon various insoluble oxalates. Many of the insoluble oxalates combine with the alkaline oxalates to form soluble double salts. Exceptions are the strontium, barium, calcium, silver, lead, and mercurious salt. The lead and the mercuric salt dissolve in hot solutions of alkaline oxalates, but separate out again on cooling or dilution. The barium, magnesium, and mercuric salts are soluble in ammonium chloride. The non-volatility of the soluble oxalates is of importance, as evaporation is the quickest, simplest, and most certain method of separating the soluble compounds quantitatively from the insoluble. In such solutions the oxalic acid must be present in slight excess. If the evaporated residue is treated with water, the soluble oxalates are dissolved without decomposition, and may then be separated from the insoluble by filtration.

Ammonia produces no precipitates in the solutions of antimonic and antimonious acids, while precipitates of oxides or of basic salts are formed in the oxalic solutions of stannic, ferric, uranium, chromium, and aluminum oxides. Alkaline phosphates and borates, which, like ammonia, precipitate all these solutions in the absence of oxalic acid, occasion no deposits in its presence. This behaviour of tin nnd antimony solutions with ammonia affords a simple meaps for the separation of the two metals. Even in solutions containing both, the tin is thrown down free from antimony if the solution contains sufficient oxalic acid or ammonium oxalate, or if the precipitated tin oxide is dissolved in hydrochloric acid, mixed with oxalic acid, and reprecipitated with ammonia.

If we have to examine an alloy of tin, or antimony, or of both, with lead, copper, zinc, or iron, the comminuted sample is dissolved in a small excess of aqua regia, oxalic acid is added to the boiling solution so long as a precipitate is produced, the insoluble oxalates are allowed to settle on cooling, or the solution along with the precipitate is evaporated to dryness on the water-bath and taken up again in a little water. The separation of the precipitate from the liquid is best effected by decantation through a double filter, bringing upon the filter as little as possible of the precipitate. In quantitative operations the precipitate and the filter are freed from soluble portions by means of a dilute solution of oxalic acid, and both are then dried and cautiously ignited. In the solution are found the tin, iron, and antimony f its conversion into antimonic acid has been complete, and the arsenic as arsenious or arsenic acid. As various oxalates are not absolutely insoluble in water and dilute oxalic acid, traces of them may be found in the solution containing the tin, antimony, and iron, and must be considered in accurate quantitative operations.

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* By C. LUCKOW, in *Zeitschrift für Analyt. Chemie.*

In the treatment of the ores, alloys, &c., with aqua regia, it is well, in case antimony is present n large quantity, to mix the solution, before adding the oxalic acid, with chlorine until a distinct and permanent odour of chlorine is perceptible, in order o make sure that all antimony is present as antimonic acid. In presence of zinc it is safest either o evaporate down the solution (after addition of oxalic acid) upon the water bath, or to allow the ame oxalic solution, mixed with ammonium chloride or nitrate, to stand for some hours.

In order not to introduce an excess of acid, 0·1 grm. of the ore or alloy requires 1c.c. aqua egia made up of 3 to 4 vols. hydrochloric acid, p. gr. 1·2, and 1 vol. nitric acid of the same sp. gr., nd that this 0·1 grm. requires twice the weight of rystalline oxallic acid $(COOH)_2$ + aq. in order to onvert all the dissolved metals into oxalates. If paringly soluble chlorides or sulphates separate ut in the solution, they may be transformed into he corresponding oxalates by boiling with a slight xcess of oxalic acid.

If alloys containing tin are treated with nitric cid, the supernatant liquid evaporated to expel itric acid, the residue or its insoluble portion moistened with a little hydrochloric acid, digested with a strong solution of oxalic acid until the ydrochloric acid is expelled, oxide is dissolved, while any metals present forming insoluble oxalates pass into the precipitate. Antimonic acid prepared with strong nitric acid does not possess his property; but the meta-antimonic acid ormed by the action of water on antimony perchloride. Solutions of antimonic acid mixed with xalic acid remain, therefore, clear on dilution with water. It is possible that this different behaviour of tin oxide and antimonic acid may lead to a separation of the two metals.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE seventh meeting of the session was held on the 13th ult. at King's College, W.C., the President (the Rev. Dr. Dallinger, F.R.S.) in the chair.

A letter from Mr. B. W. Thomas, of Chicago, with reference to the 13 slides of diatomaceæ, &c., presented to the Society (some of which were exhibited under microscopes in the room), was read. Mr. Thomas suggested the necessity of having standard Maltwood finders.

Mr. Beck said there had been spurious imitations of Maltwood's finders, so that it was impossible to guarantee the quality of all that were in existence. All the genuine ones, however, agreed with one another to within $\frac{1}{1000}$in. Mr. Maltwood originally asked them to carry out his plan, and they had a glass plate engraved, and all the finders they had sent out had been photographed from this. No doubt some enterprising American had endeavoured to make Maltwood's finders so as to offer them for a few pence less than the genuine ones. All the genuine Maltwood finders were made to the same standard, and there was no practical difficulty in insuring their correctness.

Photographs of living rotifera by Mr. J. B. Robinson were exhibited; also photographs of snow crystals taken at Davos Platz by Mr. A. W. Waters, showing some remarkable forms.

Mr. T. C. White exhibited a series of photomicrographs which he had recently taken, showing the result of the method of cutting off some of he superfluous light by means of a sliding diaphragm, so as to be able to admit just enough to bring out the detail and nothing more. The specimens shown were printed on Eastman's bromide paper, instead of silver paper, which he found brought out the character of the detail very much better.

The President was sure it would be interesting to all to note the improvement shown in these productions by Mr. White. The photomicrographs were certainly remarkably clear, and showed a distinct advance upon anything he had seen before.

Mr. J. R. Cheshire said that the small bottle which he held in his hand contained an object unmounted, which was very rarely seen, because extremely difficult to discover even by experts in the t of bee culture. It was generally well known that in the bee-hive all the eggs were usually laid by the queen, whose body contained about 300 various tubes, and who, under favourable conditions, was capable of laying even more than 3,000 eggs in the course of 24 hours. After the accidental loss or intentional removal of the queen, the bees take some of the eggs remaining in the hive, and by a special feeding of the resulting larvæ are able to produce fresh queens. If, however, it should happen that in a hive which has lost its queen there are no eggs available for this purpose, it is found that some of the workers under some special circumstances, which could not be very clearly explained, became capable of laying eggs, but that such eggs produced drones only. These bees were known as fertile workers, and though there could be no doubt as to their frequent existence, they were very difficult to catch, owing to the fact of their being exactly the same in appearance as the ordinary workers. During the whole of his experience he had never but in three cases been able to secure specimens, and, besides these, only one or two isolated cases of verifying them had occurred in England. In the bottle to which he had referred were two of these fertile workers, having the ovaries drawn out of the bodies and attached to their stings and abdominal plates, so as to show that they really were workers. There was a remarkable peculiarity to be observed in connection with the ovarian tubes of these insects; every ordinary worker possessed an undeveloped ovary which it was very difficult both to detect and to dissect; but when under the influence of some stimulus the worker became fertile, a number of points began to appear in the tubes which afterwards became developed, and it would seem that the eggs were developed in alternation, an examination of the ovarian tubes showing them to contain developed eggs alternating with others in an undeveloped condition (as drawn on the black board), and of which some very curious instances were seen in the specimens before the meeting. He hoped to be able to mount them, and if successful in doing so, he should have great pleasure in showing them at their next meeting.

Mr. Tebb asked if there was any difference in appearance between the ordinary workers and those which Mr. Cheshire had just been describing?

Mr. Cheshire said that externally there was no distinguishable difference between them, though it was possible they might weigh a little more; dissection made the difference clear at once. They could only be detected when in the hive by the attentions which were paid to them by the other bees. A curious fact in connection with the queen was that although she had much smaller intestines than a worker, she was yet capable of producing nearly four times her own weight of eggs in the course of a day; and it would naturally seem very remarkable how so much nitrogenous matter could be produced by one whose organs of digestion and assimilation were so inferior in proportionate size, being actually less than those of a worker. But the fact was the queen did not herself digest her own food, but was fed upon a highly nutritive fluid from a gland in the head of the worker, in whose body the process of digestion had been carried on, and who conveyed the product to the queen by a special apparatus connected with the tongue. In the body of the fertile worker it was worth noting that no pollen was found such as formed the food of the ordinary bee, and this showed the fertile worker to be fed, like a queen, by the other bees.

Mr. Karop inquired how it was that Mr. Cheshire knew that the eggs developed alternately in the way he had stated, seeing that the opportunities for observation were so very rare?

Mr. Cheshire said it was only from what he found by examination of the ovarian tubes, and seeing that now and then there were gaps such as he had drawn, that he had ventured to give this as a suggestion. He rather intended the remark as a seeker after further information.

Prof. Bell asked if there was any reason to be assigned why one worker should be preferred to another in becoming fertile? Were there many such, or only a few in the hive which underwent this change?

Mr. Cheshire said it had been thought by some that these workers had been brought up in cells adjoining that of the queen, and might, therefore, have to some extent been nourished by some of the special food given to the larva of the queen; but since fertile workers had been found in hives which had never produced queens this idea was hardly tenable. He thought it might be due to some special stimulus exerted by the bees under a strong desire to obtain eggs, though it was difficult to say of what nature the stimulus actually was.

Prof. Bell suggested that this bore some analogy to male lactation, as when a hare was shot some time ago in America suckling its young, and was afterwards found to be a male. The point of his inquiry, however, was how these workers became in the first instance induced to lay eggs—whether there were any stimulating circumstances which promoted their development? There appeared to be no doubt that attention was paid to them afterwards; but was there nothing which went before?

Mr. Cheshire said this was a question upon which he was seeking information. He was quite unable at present to answer it; but since all workers were at first fed in the larval state in the same manner as those intended for queens, and that the queens had this diet through all their larval development, it was highly probable that some of the worker larvæ were so fed for a longer period than others. Such would be especially favourable subjects for conversion into fertile workers.

The President said the point appeared to be whether the attention given to these workers was a cause or only an effect of the alteration in their condition.

Mr. Cheshire could only say that there was something about the queen which had some special fascination for the workers. They would come upon a knife which had been used to dissect a queen, or on the hand of a person who had taken up a queen. He had seen a rose-leaf upon which a queen had been placed visited in an inquiring manner by bees for many days afterwards, and the same thing occurred in the case of the fertile worker. Her body, although she had never copulated, attracted bees most singularly after she had been completely dissected.

Prof. Bell asked whether there could be any doubt as to the fact that these bees were really workers?

Mr. Cheshire said there could be none whatever, the queens were distinctly different in every part of their anatomy, so that there was no possibility of making a mistake.

Mr. Crisp called attention to the earliest known compound microscope, one by Campani, of Rome, made at some time prior to 1665, as was evidenced by the absence of a field lens to the eyepiece.

Zeiss's new form of adjustable nose-piece was exhibited, in which Dr. Zeiss had carried out an idea which had not occurred to anyone during the epidemic of such nose-pieces which broke out a few years ago. The objective was made to slide on and off the nose-piece in an inclined plane, which insured its not touching the object when being changed. It could also be centred.

Mr. P. H. Gosse's paper "On Twelve New Species of Rotifera" was read by Prof. Bell.

The President said that the council had felt from time to time some responsibility as to the matters to be brought before the meetings, as well as objects of interest for exhibition, and their feeling was that it would be very desirable if there could be more talking and more exhibiting on the other side of the table. If some of the Fellows would (as Mr. Cheshire had done that evening) give some description of objects of interest or of recent observation, it would greatly add to the usefulness of their meetings.

Mr. Badcock said that, adopting the suggestion just made by the President, he might mention that he knew where to find something which at the present time was rather rare. In Victoria Park there was a pond where *Dendrosoma radians* and *Floscularia* could be found in enormous abundance, also *Brachionus* in several varieties; *Epistylus* in several species, with many other kinds of pond life, including *Polyzoa*, just now hatching out from the egg. The pond was one of the most extraordinary for the number of things which were to be found in it that he had ever known. If any Fellows of the Society interested in the matter would call upon him, he should be happy to point it out.

A Tributary of the Congo.—A report has been furnished by Dr. Junker to the *Mouvement Géographique* on the district of the Inellé. The Inellé is a tributary of the Congo, and rises in the mountains near the Albert Lake. A great portion of its course, hitherto unknown, has been explored by Dr. Junker. Being navigable for some distance, the Inellé affords a new water-way towards the district of the Upper Nile. The country through which it flows is very fertile, and the whole district gives the impression of an earthly paradise. The population is very dense all along the banks of the river, in some parts amounting to 250 inhabitants per square mile. The principal tribes in the basin of the Upper Inellé are the cannibal tribes of the Niams-Niams and the Mombouttons. They differ little in figure, colour, and customs from the people of the Upper Congo. Polygamy is the fashion, and the chiefs have 100 wives. The district is little visited by Europeans. On the shores and large inhabited islands of the Inellé there are immense stores of ivory. Emin Bey has collected at Wadelai stores of ivory from all the provinces, the value of which will more than cover the expense of the expedition sent out to his rescue. Dr. Junker's explorations are of great scientific value. It is now known that the great river Inellé is connected with the Congo by the Obangi, and a long and splendid water-way is thu opened up between Leopoldville, on the Stanl Pool, and a point very near the Nile. A railw only 280 kilomètres long by the side of the falls the Lower Congo would unite the west coast a the central districts of Africa, and goods fro Banana and Boma could be carried to the Upp Inellé in the course of five or six weeks.

SCIENTIFIC NEWS.

THERE is still a possibility of picking up Barnard's comet C, 1887, in good instruments. His second comet of this year is not likely to be seen again.

Dr. Valentiner, of the Grand Ducal Observatory, Carlsruhe, states, in the *Astronomische Nachrichten*, that his assistant, Dr. E. von Rebeur-Paschwitz, observed Uranus to be distinctly elliptical in the 6in. refractor on April 3. The following evening Dr. Valentiner satisfied himself that the disc of the planet was unmistakably elliptical. He asks astronomers possessed of powerful telescopes to devote some attention to the subject.

The death is announced of Mr. Charles Warner, of Brighton, a well-known antiquarian, who thoroughly explored his native county of Dorset, and published several works on its archæology and antiquities. Mr. Warner was eighty-five years of age.

The death is also announced of Dr. Nathaniel Lieberkühn, professor of anatomy at Marburg, aged sixty-five.

The following fifteen candidates have been selected by the Council of the Royal Society to be recommended for election into the society on the 9th of June:—Mr. J. Y. Buchanan, Dr. J. T. Cash, Sir J. N. Douglass, Prof. J. A. Ewing, Prof. G. Forbes, Dr. W. R. Gowers, Prof. A. B. W. Kennedy, Dr. G. King, Sir J. Kirk, Prof. O. J. Lodge, Prof. J. Milne, the Rev. O. Pickard-Cambridge, Mr. G. J. Snelus, Lord Walsingham, and Mr. W. Whitaker.

At the annual meeting of the Royal Institution the report of the committee of visitors for the year 1886 was read and adopted. The real and funded property now amounts to above £83,000, entirely derived from the contributions and donations of the members. Forty-eight new members paid their admission fees in 1886. Sixty-three lectures and 19 evening discourses were delivered in 1886. The books and pamphlets presented in 1886 amounted to about 288 volumes, making, with 443 volumes purchased, a total of 731 volumes added to the library in the year. The following gentlemen were unanimously elected as officers for the ensuing year:—President, the Duke of Northumberland, K.G.; treasurer, Mr. Henry Pollock; secretary, Sir Frederick Bramwell, F.R.S. Managers:—Mr. Joseph Brown, Q.C., Sir J. Crichton Browne, F.R.S., the Earl of Crawford and Balcarres, F.R.S., Mr. Frank Crisp, Mr. Warren de la Rue, F.R.S., Mr. Henry Doulton, Dr. J. H. Gladstone, F.R.S., Sir William Gull, F.R.S., Dr. W. Huggins, F.R.S., Mr. A. B. Kempe, F.R.S., Mr. G. Matthey, F.R.S., Earl Percy, Sir F. Pollock, Mr. W. H. Preece, F.R.S., and Mr. E. Woods. Visitors:—Mr. F. F. Arbuthnot, Mr. S. Bidwell, F.R.S., Mr. J. Birkett, Mr. M. Carteighe, Dean Church, Mr. E. Cutler, Mr. J. Farmer, Mr. C. Hawksley, Prof. D. E. Hughes, F.R.S., Mr. J. W. Miers, Mr. F. Purdy, Mr. L. M. Rate, Prof. W. C. Roberts-Austen, F.R.S., Mr. G. J. Romanes, F.R.S., and Mr. J. Wimshurst.

The council of the Royal Geographical Society have decided to award the Founder's Medal to Lieut.-Colonel T. H. Holdich for the important services he has rendered in geographical science by the zeal and devotion with which he has carried out the survey of Afghanistan; and the Patron's Medal to the Rev. George Grenfell, for the extensive explorations he has carried out during his 13 years' residence in West Africa, first in the Cameroons country and afterwards in the region of the Congo. The Murchison grant will be given to Mr. George Bourne, who, as second in command of the Landsborough expedition, crossed Australia in 1861; the Back premium to Sarat Chandra Das for his researches in Tibet; and the Gill memorial to Mr. J. F. Needham for his exploration of the valley of the Lohit Brahmaputra. The new honorary corresponding members are —his Royal Highness Krom Mun Damrong Rajah Nukharp, Director-General of Surveys and Minister of Public Instruction, Siam, Dr. Alfred Kirchhoff, Professor of Geography in Halle University, and Dr. E. Naumann, late Director of the Geographical and Topographical Survey of Japan.

At Oxford University the appointment of a Reader in Geography is strongly resented by those who take an interest in history. It appears that the delegates, after refusing the offer of the Royal Geographical Society, have abolished the only university appointment open to history lecturers and awarded it to geography.

The fifty-eighth anniversary meeting of the Zoological Society was held last week. The report of the council stated that the number of Fellows on the 1st of January was 3,146, showing a decrease of 47. The total receipts for 1886 had amounted to £25,787, showing a decrease of £22 as compared with the previous year. The balance brought from 1885 was £972, making a total of £26,759 available for the expenditure of 1886. The ordinary expenditure for 1886 had been £24,438. The total expenditure for the year amounted to £24,568. The society's library now contained about 15,000 separate volumes. The visitors to the society's gardens during the year 1886 had been altogether 639,674, as against 659,896 in 1885. Mr. F. E. Beddard, prosector to the society, had been appointed Davis lecturer, and had commenced a course of ten lectures on the "Classification of Vertebrate Animals." The number of animals in the society's collection on the 31st of December last was 2,609, of which 777 were mammals, 1,429 birds, and 403 reptiles. About 30 species of mammals, 20 of birds, and three of reptiles had been bred in the society's gardens during the summer of 1886. The council and officers for the year were then elected: Sir J. Fayrer, K.C.S.I., F.R.S., Mr. J. P. Gassiot, Col. James A. Grant, C.B., C.S.I., F.R.S., Prof. A. Newton, F.R.S., and Mr. J. Travers Smith were elected into the council in place of the retiring members; and Prof. W. H. Flower, F.R.S., re-elected president; Mr. C. Drummond treasurer, and Mr. P. L. Sclater, F.R.S., secretary.

A class is being formed, to include beginners and advanced students, for a study of the geology of the London district on Saturday afternoons, under the conductorship of Prof. H. G. Seeley, F.R.S., of King's College. The hon. sec. is Mr. May, 16, Bethune-road, Stoke Newington, N.

At King's College during the summer, a course of instruction in bacteriology will be given, in order that a practical knowledge of the more important micro-organisms may be spread, and of the methods of detecting their presence. The class meets on the 16th inst. under Mr. Crookshank, who has returned from a recent visit to the laboratories of Berlin, Rome, and Turin.

A column has been erected at Monte Pincio, in Rome, in memory of Galileo's imprisonment in the neighbouring palace of the Medicis. It bears the following epigraph:—"The neighbouring palace, once the property of the Medicis, was the prison of Galileo Galilei, guilty of having seen that the earth moves round the sun.—S.P.Q R., LDCCCLXXXVII."

At the Royal Victoria Hall and Coffee Tavern on May 10, Dr. J. A. Fleming will lecture on the "Ice Rivers of Switzerland," and on the following Tuesday Mr. Lant Carpenter will lecture on the "Electric Telegraph and its Jubilee."

At the recent general meeting of the North of England Institute of Mining and Mechanical Engineers, under the presidency of Sir I. Lowthian Bell, Mr. S. B. Coxon read a paper on an improved electric safety-lamp with Schanschieff's primary single-liquid battery. The lamp, complete, was, he said, so simple that the top could be taken off and the battery emptied and charged by any person, although he might be without any knowledge of electricity. When once charged, the lamp could be kept for any length of time with the elements above the solution, and be ready for use in a moment by simply turning the elements into the solution. Advantages claimed for the lamp were that the E.M.F. was perfectly constant; that the internal resistance was very small, only ·03 ohm; that it gave a perfectly steady current, and no polarisation was possible; that it was quiescent when the current was open, and that it was cheap and durable.

According to the New York *Electrical Review*, a private exhibition was given in Washington recently, to a few invited persons, of a type-writer machine calculated to transmit writing by telegraph, and by means of a duplicate machine at the other end of the wire the same would be transcribed at one and the same time that the sender was operating, the shifting of the carriage of the type-writers at the end of a line being automatic. A public test of the machine will be made within two months' time, between Washington and Philadelphia. If the new invention proves a success, the plan contemplated is to sell the machines to subscribers, who, by the system of a central exchange, the same as prevails with the telephone, can call up another subscriber, and, whether the person addressed be at his machine or not, a message can be sent him, which he can read at his machine when he returns. It is calculated, also, that no third person can tap the wires or take a message which is being sent. The inventor is an old Philadelphia telegraph operator named McLaughlin. Patents have been taken out in this and a number of foreign countries.

It is stated that Mr. F. J. Clamer, of Philadelphia, has discovered and perfected a new process for coating iron with an adherent layer of lead, which is no more expensive than ordinary galvanising. If the coat of lead proves firmly adherent in practice, the new process will be widely used.

The fastest torpedo boat is one constructed for the Spanish navy by Messrs. Thorneycroft, which, on a recent trial in the Lower Hope, below Gravesend, gave the remarkable mean speed of 26·11 knots, or over 30 miles an hour. The boat has twin screws, is 147ft. 6in. long, 14ft. 6in. beam, and 4ft. 9in. draught.

Mr. C. A. Bell has taken out another patent for transmitting and recording speech and other sounds in which he makes 92 claims. The number is 2,268 of 1886. A glass tube is fastened on a vibratory support or soundboard, and pure water is passed through it, the jet playing on the diaphragm of a transmitting telephone. On talking to the soundboard, the sound-waves throw the jet into vibrations, which are thus transferred to the telephone diaphragm and transmitted as electrical undulations.

Some thousands of *Salmo fario* and *S. Levenensis* have been safely transmitted over many miles and consigned to the waters in Trafford Park. Not a fish was lost.

A method of clarifying water has been devised by Prof. Dobroslavine, of St. Petersburg. He uses first a solution of perchloride of iron, and follows that with a solution of carbonate of soda. The quantities are said to be three grains of the perchloride of iron and four grains of the soda crystals per gallon of water.

A deputation consisting of officers and members of the Amalgamated Society of Railway Servants has been appointed to attend the opening of the Paris Railway Exhibition on the 15th inst., with instructions to examine brakes and all railway safety appliances, and to report thereon.

Browning of Steel and Iron.—A process having this end in view has been recently patented in Germany by Mr. A. De Meritens. The goods to be browned form the anode of the bath, which consists of ordinary or distilled water. The cathode is formed by the vessel which contains the water, if it is made of iron; otherwise a plate of iron, copper, or carbon is placed in the bath. The water is kept at from 160° F. to 180° F., and the tension of the current must be sufficiently great to decompose the water. The oxygen which thus is given off at the anode forms in an hour or two a layer of the black oxide of iron (a combination of ferrous and ferric oxide), which is said to polish up very well. Steel is said to give the best results; in the case of cast and wrought iron, the oxide of iron formed separates us a powder; and it is necessary to use distilled water in order to obtain a layer which will adhere to the goods.

THE hon. secretary of the Stratford-on-Avon Sparrow Club reports that during the past year over 19,000 birds have been killed. The club pays 3d. per dozen for heads of all sparrows destroyed, and over £23 has been paid in this way during the year. The common sparrow is held to be destructive to farmers' crops, and the club was formed for the purpose of keeping down the number of these birds. About 20,000 a year is the average number destroyed in the neighbourhood of Stratford-on-Avon.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆◆◆

THE JOURNAL OF THE ROYAL MICROSCOPICAL SOCIETY — CAN STARS BE SEEN IN THE DAY-TIME FROM THE BOTTOM OF A WELL? — THE SUPERNATURAL DARKNESS ON THE FIRST GOOD FRIDAY—ASTRONOMY AND MATHEMATICS—LARGE FIELD EYEPIECE GEGENSCHEIN—SPECIFIC GRAVITY. THE SEXTANT AND THE SUN—LUNAR CLEFTS—PAROCHIAL LAW—TELESCOPE—LEGAL: DO AS YOU ARE TOLLED — THE GREAT LICK EQUATOREAL.

[27196.]—AFTER letter 27115 (p. 178) was in type—to wit, on April 19th—I actually received the index number of the *Journal* of the Royal Microscopical Society for 1886! I do earnestly hope and trust that its compiler or compilers are not suffering from the over-exertion incidental on so extraordinarily punctual an appearance. On the cover of the December number of the *Journal* we were informed that the title-page and index of the volume it concluded would be issued in February; and, occupying a similar position in the February part was the announcement that "the Index Number is delayed from exceptional and unavoidable causes; but will be issued shortly." If over four months is "shortly," I wonder what period would be described in King's College parlance as "protractedly"? [Since the above lines were written (and were presumably in print) I have seen letter 27188 (p. 201). I should perhaps best consult my own dignity if I treated with silent contempt the covert insinuation that I was not speaking the truth in letter 26868 (Vol. XLIV. p. 560); but as there are people who may possibly be deluded by the impudent denial of my statement made by your correspondent, I must reiterate here that I quoted verbatim (*loc. cit.*) the words employed to me by the young man in charge of the Society's rooms on the day when I called there in February to make my inquiry. He was alone there, Mr. West being absent. Whether it is part of the policy of the Council of the Royal Microscopical Society to employ "irreverent wags" to represent them and answer civil and legitimate questions in the manner in which mine was replied to, might be a curious subject for inquiry. As "One Who Knows" is fond of hypothetical explanations, I may perhaps suggest that, in the absence of the assistant secretary, and the deputy assistant secretary, "some person . . . . unknown" had emulated the clown in the pantomime, when he knocks the respectable tradesman down, and takes temporary charge of his business!]

Mr. Lewis Swift (letter 27116), p. 173, writes, as it appears to me, a trifle too dictatorially upon the question of the visibility of brilliant stars in the daytime from the bottom of wells, mine-shafts, and tall chimneys, and seems to labour under the curious hallucination that because *he* has "been lowered into a well 40ft. deep" and failed to perceive any stars of the first magnitude (as likely as not because none such happened to be in transit over its mouth), therefore no one else similarly situated can have ever seen any! Now Sir John Herschel was a man of such world-wide and unassailable reputation that it seems almost like an impertinence to undertake to defend any statement deliberately made by him; but I must remind Mr. Swift that our great English astronomer does not merely state that bright stars may be seen "from the bottoms of deep, narrow pits," but goes on to add that he has himself "heard it stated by a celebrated optician, that the earliest circumstance which drew his attention to astronomy was the regular appearance, at a certain hour, for several successive days, of a considerable star, through the shaft of a chimney." Now, here is an assertion as to a matter of fact; and one would be really curious to know whether Mr. Swift would borrow from the vocabulary of Dillon, Healy, and Co. to describe Sir John Herschel, or the optician who was his informant. Of course it is the luminosity of the atmosphere which interferes with the perception of stars in daylight; but it is mainly the large expanse of it. Doubtless dozens who will read these lines have seen Venus in brilliant sunshine a month or so after her greatest eastern elongation from the sun. A paper tube will enable anyone with average sight to pick her up under these circumstances.

The letter of "Amateur" (27152) on p. 180, has put me on a fresh track in connection with the Supernatural Darkness on the First Good Friday. In the light of the information he gives, let us see what foundation there is for the stuff talked by the Darlington clergyman on the 18th ult. Now, to begin with, Dionysius was an Athenian, and not an Egyptian at all; and the two sources alone from which we gather any information whatever concerning him are Acts xvii. 34, and that queer hash, the "Lexicon" of Suidas (dating probably from the end of the eleventh or the beginning of the twelfth century). In it Suidas who says that Dionysius studied first in Athens, and subsequently at Heliopolis in Egypt, and that while in the latter city he witnessed that remarkable "eclipse of the sun," concerning which he, addressing his friend, Apollophanes, gave utterance to the words quoted in Latin (on p. 629 of my edition) of "Ainsworth's Dictionary"; but which appear in Suidas in Greek, and with a change in the latter clause of the sentence, thus, "*ἢ τὸ θείον πάσχει, ἢ τῳ πασχόντι συμπάσχει.*" Here, it is obvious, is the source of the quotation by the vicar of St. John's, Darlington. Probably Suidas himself derived his information from the "Epistle to Polycarp," by the Pseudo-Dionysius, a forgery of the fifth century. It may gratify Mr. Gardner (letter 27112, p. 156), to learn how extremely trustworthy are alike the science and historical accuracy of his spiritual pastor.

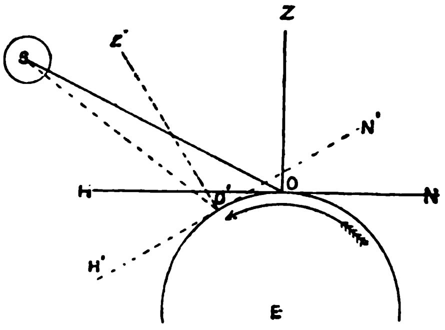
In answer to reply 62067, "T. S. S." having mastered the rudiments of the Calculus ("Differential Calculus for Beginners," by Knox, and Hemming's book, published by Macmillan, are very good), may go on to Cheyne's "Elementary Treatise on the Planetary Theory" (same publishers), and Godfray's "Elementary Treatise on the Lunar Theory." Abbatt's little book, referred to in my former letter, contains a good deal that is worth studying, and, of course, the immortal "Principia" of Newton (at any rate the first three sections of it) will not be neglected. A quantity of information, both with reference to spherical and gravitational astronomy, will be found in an American book, "A Treatise on Astronomy," by W. A. Norton. When your correspondent has conquered the works to which I have referred, he may attack the "Mécanique Celeste" of La Place. It is needless to add that there is a mass of matter relating to gravitational astronomy in the form of detached essays in the *Proceedings* of the Royal, Royal Astronomical, and of foreign learned Societies.

From what "Corona" says in query 62244, on p. 185, it appears as though he must have been employing 4-lens terrestrial eyepieces for astronomical observation—an odd arrangement, to say the least of it. I, myself, possess an ordinary Huyghenian eyepiece, magnifying 42 diameters, which gives a field of over 1° in diameter; and by the adoption of a low-power eyepiece of the aplanatic form my querist ought to obtain the angular subtense of field he requires. He may, perhaps, know that the Kellner, or Orthoscopic eyepiece consists of a double-convex crossed lens for the field-glass (with its most convex side towards the object-glass) and a meniscus of great convexity but small concavity for the eyeglass, without the usual stop between them. This gives a very large field as compared with the common Huyghenian form. The aplanatic eyepiece only differs from the one which I have just described in the eye-lens, the field lens remaining as in the Kellner. In the aplanatic, the eye-lens consists of a double-convex crown glass and a plano-concave flint. This achromatises the large, flat field of the eyepiece, and makes observation more pleasant. It is the very thing for the observation of comets and star clusters, such objects as H vi. 33 and 34 exhibiting a perfectly glorious spectacle. Comparing the simple Huyghenian, or negative, with the Ramsden or positive eyepiece, the latter has the flatter field of the two; but this slight drawback is counterbalanced by the advantages presented by the older form. There is nothing like it for all-round astronomical work.

I should recommend "T. S. S." (query 62248, p. 185) to consult a paper by Mr. Backhouse, "On the Aspect of the Zodiacal Light Opposite the Sun," on p. 46 of Vol. XXXVI. of the *Monthly Notices* of the R.A.S. (it is in the number for November, 1875). I cannot find the passage he quotes in the only edition (the first) of Newcomb's "Popular Astronomy" in my own library.

In reply to query 62260 (p. 185), the late Prof. Miller, from an elaborate series of experiments, determined the weight of a cubic foot of water at a temperature of 62° F., and with a barometric pressure of 30in., to be 62·321lb., agreeing with that found by Sir George Shuckburgh at the end of the last century; and this is legalised by statute. It must, however, be remarked that this ratio does not *precisely* agree with that adopted in France; nor, for that matter, with those adopted by Austria, Russia, and Sweden; but as these all differ very slightly, *inter se*, there is no reason to suspect the English determination, confirmed by Act of Parliament, of inaccuracy, and it is the one which should always be employed in this country.

The ideas of Mr. Hampden (letter 27179, p. 200) on the subject of the use of the sextant are—to put it as mildly as possible—remarkably vague. Of course it would be absolutely impossible to determine an angle of between 8″ and 9″ with it at the extremities of a base of 4,000 miles in diameter, and no one but a lunatic would attempt to employ the instrument for any such purpose. What it is used for (in connection with the sun) is to determine the altitude of that luminary above the rational horizon of the observer at any given instant; and the more rapidly the earth rotates on her axis—and consequently the more rapidly the sun's altitude appears to change, the greater the value of the observations. A figure may make this intelligible. Here E is the centre of the earth, O an observer on its surface (say, at the Equator), Z is his zenith, and S the sun, HN the horizon. Then what the observer does is to measure the angle SOH at a particular second as shown by his chronometer. The rotation of the earth in the direction of the arrow in the diagram will presently bring his zenith to Z′; when (as the sun may be regarded for our present purpose as stationary) the sun's seeming altitude will be SO′H′. The orbital speed of the earth in no way affects the measurement, as it is seemingly transferred to the sun, whose apparent motion among the stars is so thoroughly well known that his exact position is discoverable at any given instant.



In connection with reply 62181 (p. 205), I would ask "Tau" if he has reflected on the *dimensions* of the lunar rills or clefts: whether he knows what their width must be to be visible at all; and whether he is aware that some of them are 200 or 300 miles long? The mass of the Moon is only about 0·15 that of the Earth, hence a body, which would fall 16·1ft. in one second at the surface of the latter, would only fall 2·48ft. during the same interval on our Satellite.

Mr. Kerr (query 62270, p. 207) will find a large amount of information in a popular form in Holdsworth's "Handy Book of Parish Law," published by Routledge.

"Derby" (query 62285, p. 208) had better not waste his money in an attempt to convert a 1¼in. terrestrial telescope into an astronomical one. With reference to the remainder of his questions, the focus of an eyepiece is the focal length of its combined lenses. The advantage of having two lenses in the Huyghenian eyepiece is that it gives a "field," which has scarcely a recognisable existence with a single lens, and that definition is good practically up to the edge of it.

If "One Gated" (query 62291, page 208) will only go and look at the table of Tolls painted up at the Turnpike Gate to which he refers, he will find that a toll is payable upon *every* vehicle having so many wheels, &c. Clearly then his man was liable to pay both for his waggon and for the cart fastened behind it; and I am strongly of opinion that—assuming that six months has not yet elapsed—he could still be proceeded against under 3 Geo. IV. c. 126, s. 41 for evading the toll.

I learn from California that it is expected that the Great Lick Telescope is expected to be mounted and in working order early in September.

A Fellow of the Royal Astronomical Society.

WHITE PATCH ON THE MOON.

[27197.]—ON the evening of May 1st, not having an opportunity of seeing this lunation before, I noticed, south-east of the Great Pass of the Alps, a white patch that I never saw before. It is not so small as to be easily overlooked, and think it may be seen with 2in. or 3in. of aperture. It did not appear to be haze, because some small craters within it were as distinct, I thought, as others outside of it. Perhaps some of "ours" may have seen it, and will tell me if it is anything new, and, if so, their opinion of it. I do not think I could have overlooked it before, as it is situated on a part of the moon in which I am much interested, and the definition was not as good as I have seen it many times before with the same telescope—a 12in. silver-on-glass.

Bank Top, Darlington. **W. H. Harris.**

AQUEOUS VAPOUR AND STEAM.

[27198.]—SINCE "E. L. G." (27189) considers that I have been well answered, I suppose I must be very dense, for I cannot even now understand how it is that iron hot enough to decompose water will yet not do so if free oxygen be present.

No doubt if H_2O be decomposed in air the liberated hydrogen will combine with oxygen; but that is not the question, which is, whether or not the water is decomposed, and not what becomes of the products. Potassium thrown on water will decompose it, and the hydrogen will combine with oxygen of air; but "F. C. S." will not say that because no free hydrogen is present the water has not been decomposed.

I do not see how the case of the boiler applies. "F. C. S." is, I presume, comparing the energy of the steam to the affinity of the heated iron for oxygen. Of course, if the boiler be gradually fired, the steam will escape at the 10lb. valves, and not at the 50lb. valve, because, if the 10lb. valves are large compared to the firing, the pressure will never reach 50lb. But suppose that all the 10lb. valves are weighted to 100lb., and that when pressure has reached, say, 96lb., 90lb. each be taken from 100 valves and 50lb. from the remaining one, does "F. C. S." say that no steam will escape from the valve now weighted at 50lb., because the other valves are weighted at 10lb. only?

I say that steam will issue from all the valves; but, of course, in the case of the 50lb. valve, only for a short time, because escape of steam will reduce pressure to below 50lb. But suppose, again, that at moment of reducing weight of valves the firing be augmented to such an extent that loss of steam pressure be compensated for. I say that now steam will continue to escape from 50lb. valve as well as from others, because the energy of the steam is more than sufficient to lift it.

If we now consider the iron, which, be it remembered, has sufficient energy to decompose water, it will, according to "F. C. S.," on coming into contact with a molecule of water, not decompose it, but pass it on, and take instead a molecule of free oxygen. I can imagine a sentient being doing so; but I cannot imagine a steam-hammer refusing to crack a marble because a nut happens to be present. I can understand that iron might decompose vapour if the tension of that vapour is great, say 15in. Hg; but not when the tension is 2-10in., as it is in the case of ordinary air; but what we have been told is, that the cause of the non-decomposition is the presence of free oxygen, and not because of the low tension of vapour.

Suppose, once more, that air is composed of nitrogen only, and the amount of aqueous vapour remaining the same, would iron now decompose the vapour? If "F. C. S." is "of the same opinion still," I shall feel much obliged if he will refer me to experiments illustrating the point. There is another matter not touched upon—viz., the difference between the oxides formed in each case.

"E. L. G." (27189) contends that the term steam includes clouds, and that clouds consist of bubbles; hence, since bubbles are composed of water, steam is in some cases water! He also says that a steam cloud need not contain any aqueous vapour. But since water, whether bubbles or droplets, gives off vapour at all temperatures, it would seem that a steam cloud could not exist apart from aqueous vapour. **Kensingtonian.**

ON THE LAWS, REACTIONS, AND CONSTRUCTION OF SOME FORMS OF PRIMARY BATTERIES.

[27199.]—IN letter 27194 I made an omission. Before the words near the end "Hence it will be seen," please insert the following, "Consumes a certain (equivalent) quantity of oxygen from the oxidant."

The next point to be considered in batteries is chemical—namely, the reactions in the cell by which the electricity is generated. In by far the greater number of cells zinc is the positive element, and so we will take a cell with a zinc positive as typical. The reactions of each cell will be described more particularly when the cell itself is treated of, so I shall take the positive of zinc in dilute sulphuric acid, and the negative plate of copper or silver in the same.

Now the zinc is first superficially oxidised by the water in the dilute acid, and this oxide is *immediately dissolved by the* acid, forming zinc sulphate, and leaving a fresh surface of zinc exposed, which in its turn undergoes decomposition. This action, if chemically pure zinc is used, only takes place when the circuit is completed. Now, since the zinc robs the water of its oxygen, hydrogen is of necessity set free, the reactions being as follows:—

$$Zn + OH_2 + SO_2Ho_2 = ZnO + SO_2Ho_2 + H_2$$
$$ZnO + SO_2Ho_2 + H_2 = SO_2Zno'' + OH_2 + H_2$$

This H_2 is set free at the negative plate, where it rises to the surface in bubbles, but unfortunately a portion of it clings to the negative plate forming a thin film of hydrogen over it, thereby increasing the resistance of the cell, as hydrogen, being a gas, is a bad conductor, and, worse still, setting up a back electromotive force, as hydrogen is positive to zinc.

This action is called "polarisation." It is overcome by what is called a "depolariser," which is some substance containing oxygen, a portion of which oxygen is sufficiently loosely combined with the substance to enable the hydrogen to break the bonds uniting it to the substance and cause it to combine with it to form water.

It is evident, then, that in any cell there are a series of chemical changes going on, and, as a natural consequence, the resistance of the cell is gradually increased. This naturally tends to lower the E.M.F. in the outer circuit.

Again, as the substances become used up—i.e., as the free acid is converted into zinc sulphate, and the depolariser loses its oxygen—the solution approaches saturation, and the action proceeds more slowly; and owing to the depolariser losing oxygen the hydrogen eventually is not taken up as fast as it is generated, and so polarisation, partial or complete, sets in. These are some of the causes why batteries fall in E.M.F. after being some time in use.

Other causes are the porous cells getting clogged with crystals, which diminish their porosity, and so increase their resistance, and very often also owing to the connections becoming dirty, owing either to fumes given off by the cell, or to the salts creeping up, as they will do.

To return to the chemical question. We have seen that the zinc is converted into sulphate, and that an equivalent of hydrogen is set free, which polarises the cell. We have now to consider the means employed to remove this hydrogen as fast as it is formed.

In the Smee cell this is done mechanically, as will be afterwards described; but in most forms it is done chemically. We will take a Daniell cell as an example, and also a Grove cell, to show the different reactions.

In a Daniell cell the zinc is converted into sulphate, as described, and hydrogen set free. Now this hydrogen is, as already stated, carried over to the negative plate, which is of copper in this instance. This copper is contained in a vessel containing a saturated solution of sulphate of copper (SO_2CuO''). The zinc is usually contained in a porous pot wiih the copper outside. The reactions are—

$$H_2 + SO_2CuO'' = SO_2Ho_2 + Cu.$$

In other words, the H having a stronger affinity (being more positive to it) for oxygen than copper, splits up the copper sulphate into sulphuric acid and metallic copper, which is deposited on the plate; thus the hydrogen is removed, and the copper plate is kept always clean and fresh. To keep the solution always fresh and saturated, crystals of copper sulphate are suspended in the solution, which gradually dissolve.

Grove's cell consists of zinc in dilute sulphuric acid, and platinum in concentrated nitric acid. The reactions here are as before for the zinc. The hydrogen set free combines with the oxygen of the nitric acid, and nitrous fumes are set free.

In each case a certain quantity of zinc dissolved sets free a certain equivalent quantity of hydrogen, and this hydrogen abstracts a certain equivalent quantity of oxygen, and all these actions and reactions produce a certain quantity of electricity, which quantity of electricity is the equivalent of the quantity of heat which would be generated by the different *combinations* produced in the cell minus the heat absorbed by the different *decompositions* which take place. Hence a chemist, by knowing the quantity of zinc required to produce a certain quantity of current, can calculate all the quantities of acid, hydrogen, oxygen, &c., either set free or used up in generating that current.

Electrician.

[27200.]—IN last week's number, "Electrician" promised us a series of letters treating with the above subject, and gave his explanation of Ohm's law as a beginning. It is to be hoped, both for the sake of "Electrician" and the readers of the "E. M.," that the remainder of his letters will contain a little more scientific accuracy, or they will not be of much value.

After giving us Ohm's law as $C = \frac{E}{R + r}$ he goes on to say, "Hence it is plain that E.M.F., current, and resistance are so mutually dependent on one another that any change in one affects all." Perhaps "Electrician" will prove the truth of this last paragraph. I can understand that any alteration of E will affect C; but how will it affect R?

Then, in speaking of running one or more lamps from a battery, we are told that if we switch on two lamps in the place of one, "we halve the external resistance, and ought to double the current; but we don't." The reason given as to why we don't is remarkable. It is "as more current is passing through the cell the internal resistance rises, and a greater portion of the total E.M.F. of the cell is consumed in overcoming this resistance, and so less is available for use outside the cell." Now let us see if this is true.

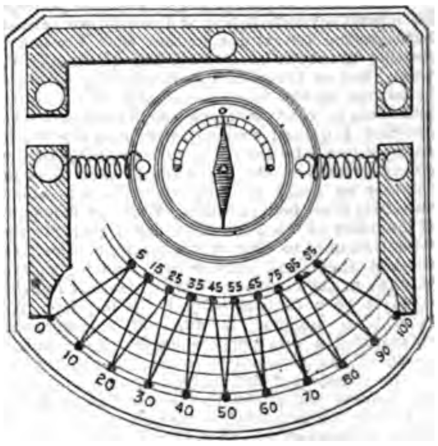
Let the total E.M.F. of the cell be 2 volts, the internal resistance be ·5 ohm, and the external resistance (one lamp) be 2 ohms. Then, by Ohm's law, $C = \frac{2}{2 + {\cdot}5}$. From which C = ·8 ampère. Now, if we switch on another lamp, we may take the external resistance to be halved; then we have $C = \frac{2}{1 + {\cdot}5}$ or C = 1·3 ampère, which is not double the current we had with only one lamp in circuit.

So we find that it is not because the internal resistance of the cell rises that we get less than double the current, but because there is any internal resistance at all. If we could get a battery without any internal resistance, then the current would increase in direct proportion to the number of lamps.

I trust "Electrician" will not fail to give us the full series of the letters he promises, for I am hoping to find in them a full description of the wonderful battery of which he has lately been telling us so much (or so little). **M. S.**

NEW FORM OF WHEATSTONE BRIDGE.

[27201.]—AS the construction of electrical apparatus has lately occupied the attention of readers of the "E. M.," perhaps a sketch of a novel form of Wheatstone bridge would not be out of place in your columns. The form of bridge usually made by students, which has been figured in your pages, is open to the objection that in order to be fairly efficient it must be some 20in. or 30in. long. Prof. Guthrie directs the board to be 2ft. long by 4in. broad. Now, the same length of wire which would require a board 2ft. long when stretched in the usual way, can by a simple device be stretched on a board 6in. long by 2in. broad. It is only necessary to take the wire backwards and forwards in a zigzag fashion, as shown in sketch, and then a much longer wire can be used if required without inconvenience. The instrument I have made is contained on a board 8in. square, so that I can place a galvanometer on the same, and so make the apparatus complete. It might be anticipated that a difficulty would occur in measuring the length of the wire where it passes round each pin. I get over this by using stout brass pins with good heads, and drive them down until the wire is nipped at each side; the part which passes round the pins can then be neglected in subdividing. **A. N. S.**



PRIMARY BATTERIES.

[27202.]—MY attention was attracted by one paragraph in the letter under the above title published in your last issue, which I think might with advantage be further explained by your correspondent.

He says: "If we have a battery running one lamp well, and switch on another lamp, we halve the external resistance, and ought to double the current; but we don't, because as more current is passing through the cell, the internal resistance rises, and a greater portion of the total E.M.F. of e cell is consumed in overcoming this resistance, d so less is available for use outside the cell. onsequently we obtain two lamps in circuit, either of which gives as much light as the one did fore."

The law of Ohm states that "the strength of the rrent varies directly as the E.M.F., and inversely the *total* resistance of the circuit"; and the itching on of the second lamp (similar, I preume, to the first) mentioned by "Electrician," ould, without further explanation, be regarded an additional resistance, the total external restance thus becoming twice as great, instead of ing halved.

The matter is, however, explained by the law for nding the total resistance (R), presented by a ivided circuit in which the current branches off to two or more parts which afterwards rejoin; n arrangement known as "multiple" or "parallel" rc, as distinguished from a circuit in "series."

By this law $R = \frac{r_1 r_2}{r_1 + r_2}$, r_1 r_2 representing the ndividual resistances—in the present case the two mps.

I understand this is the arrangement your correpondent means, and if so, his statement may be roved by this law.

I should like to know why more current passing hrough the cell causes the internal resistance to ise. Is it only on account of the additional hemical action? **A. N.**

MICROSCOPICAL.

[27203.]—MY time having been occupied by ther matters, I regret that I have been obliged to eave several queries, some of them addressed to me, unanswered.

Microscopical, 61904 (optical tube length).—If a "Beginner" measures the distance from the diaphragm in his eyepiece to the back lens of his objective he will obtain a result sufficiently accurate for all practical purposes, with powers from ⅓in. and upwards. The optical tube length will, however, be a little shorter with lower powers. See paper on this subject by Mr. Frank Crisp, Sec. R.M.S. in "E.M." Jan. 11, 1884, No. 981, p. 406.

Seibert's No. 7 water immersion, 61979 (Tests for Penetration and Definition).—This is an important subject, about which a great amount of misconception exists. Let us first get at the meaning of the words. According to Goring, Pritchard, and Brewster in 1837, "Quekett," 2nd edition, 1852, "Jabez Hogg," 2nd edition, 1855, penetration or "separating power" = resolving power; definition = freedom from spherical and chromatic aberrations. So also "Micrographic Dictionary," 3rd edition, 1875, with this exception, that according to it, separating power = magnifying power. In "Carpenter," 5th edition, 1875, penetration = focal depth; so also in Beale, 5th edition, 1880. Probably the term "penetration" came to mean resolution from the phraseology used in connection with Herschel's monster telescope "penetrating" into space and resolving very minute stars which were thought to be immensely farther off than the more conspicuous ones.

The word "penetration" is now used solely with reference to depth of focus.

The qualities of an object-glass are 6 in number.

1. Magnifying power.
2. Resolving power.
3. Penetrating power.
4. Illuminating power.
5. Flatness of field.
6. Defining power.

1. No test is required for this, as it can be directly measured. Imagine anyone saying that a scale of Morpho Menelaus was a good test of magnifying power!

2. Resolving power is simply numerical aperture, or N.A. This can also be directly measured, therefore no test is necessary.

3. Penetrating power is the reciprocal of resolving power, or $\frac{1}{N.A.}$ No test is necessary.

4. Illuminating power is $(N.A.)^2$, or N.A. multiplied by itself; no test necessary.

5. Flatness of field. Tests for low powers, a micro-photograph; for medium powers, a stage micrometer; for high powers, a slide of minute acteria or micrococci, dried on cover and stained. his is not so important as is usually supposed, pecially in high powers.

6. Defining power depends, as we have seen, on e freedom of the lens from spherical and chroatic aberrations. Of these two, the spherical is e all-important one.

Of the method of testing lenses for this point, I ave treated already at length in these columns; erefore, will merely say that it is performed by iewing a suitable object illuminated by solid ght cones of light, the object being placed in the ex of the cone. Cones of small angles should st be used, and then enlarged until the object gins to get pale, milky, or foggy. On removing the eyepiece and looking down the tube at the back lens of the objective, it will be seen what portion of the lens is filled with light, thereby determining at what point in the aperture of the objective, the spherical aberration begins to operate, the best lens being that which will stand the most light. Flooding an object with too much light is only another name for spherical aberration in the object-glass. A good objective is one which cannot be flooded. Suitable tests for spherical aberration:—

Very low powers, 3, 2, 1½in., wing of Agrion pulchellum ♂ (dragon fly).

Nycteribia Hopei (parasite of Indian flying fox) squeezed flat in balsam.

Low powers, 1, ⅔in., proboscis of blow-fly squeezed flat.

Medium powers ½, 1/10, low-angled ¼in., minute hairs on proboscis of blow-fly; hair of pencil tail (Polyxenus lagaries), diatoms on a dark ground.

Medium powers, wide angled, ¼, ⅓, ⅛in., P. formosum and N. lyra in balsam or styrax, bacteria and micrococci stained.

High powers, wide angled immersions, the secondary structure of diatoms, especially the fracture through them.

Navicula rhomboides in balsam or styrax, bacteria and micrococci stained.

Chromatic aberration is not so important as the spherical, because some very fine object-glasses have a good deal of outstanding colour.

Tests for low powers: Thin section of deal, the coarse structure. Medium powers: The discs in ditto. High powers: Podura scale and P. formosum. So it will be seen that there is only one point of paramount importance in an objective to be tested, and that is its spherical aberration. The other qualities can be measured.

The measured values of my Seibert, No. 7, are —Initial magnifying power, 160 diam., N.A. 1·08; illuminating power, 1·16; penetrating power ·92.

While on this very important topic, let me point out the fallacy of the American system of testing lenses. The following is an example of what one frequently sees in their journals. So-and-So's immersion 1-14, 1·3 N.A., resolves No. 27 on somebody's test plate. This test merely shows that the lens is possessed of a certain aperture, and that its marginal zone is sufficiently well corrected to combine the dioptric beam and the first diffraction spectrum which pass through it—a condition by no means difficult to fulfil. There is not much difficulty in making a lens which shall have two points in its marginal zone with a common focus; but a great difficulty lies in the way of making a lens which shall have a point in its centre, and one in its marginal zone with a common focus. One of these glasses, with only a corrected margin, was in my possession the other day. It was handed to me as a unique specimen of American manufacture; it was called a ¼ of 1·3 N.A. On measurement I found its initial power was 60 diam.; it was, therefore, a full ⅛. By increasing the power 50 per cent., the difficulty of construction is greatly diminished; the measured aperture was 1·325 N.A. This glass gave a very good picture of the striæ on A. pellucida illuminated by oblique light, which showed that the dioptric beam which passed through one side of the marginal zone was brought to the same focus as the first diffraction spectrum which passed through the opposite side of the zone.

But when a much coarser diatom was examined, the illumination remaining the same, there was an immense falling off in the quality of the definition, for while the dioptric beam was in the same position on the marginal zone of the objective, the first diffraction spectrum passed through the centre of the lens. The spherical aberration of this lens being uncorrected, the focus of the central portion of the lens was not coincident with that of the margin; therefore, the first diffraction spectrum was not combined with the dioptric beam, thereby accounting for the confusion in the resultant image. With the solid cone test the lens, of course, utterly broke down. My object in this is to point out that such a lens is useless for work even with oblique—light when the structure varies much from that of A. pellucida in fineness.

What can be the use of a lens merely for the purpose of manufacturing false images on irresolvable diatoms, I am at a loss to understand. Arguing by analogy, I have no doubt that the A. pellucida consists of a minutely perforated membrane, having the perforations closer together transversely than they are longitudinally, which causes the so-called transverse striæ to be coarser than the longitudinal. But no one has ever seen this. A diatom cannot be said to have been resolved unless the perforations have been seen. In fact, it is not properly resolved unless a fracture passing through the perforations can be shown. I term Triceratium fimbriatium and Isthmia nervosa resolved diatoms because a fracture passing through their secondary structure can be seen. But A. pellucida is in the same state of resolution to-day that Navicula angulata (P. angulatum) was 40 years ago. The microscopical crux of those days was the exhibition of the striæ; now, however, we can see the fracture passing through the perforations.

Microscopic Stages (62092).—A good mechanical stage is very beneficial in high-class work. A bad mechanical stage is worse than useless. A good mechanical stage requires not only to be well planned but very carefully and thoroughly made. Most mechanical stages are defective in design and scamped in workmanship. Object carriers of all kinds are bad; but spring clips are the worst of all. A rotating stage is the least important part of a microscope, except for polarising and petrological work. If you have no clips or object carrier, you need not use your mechanical action for rapid cursory views.

Immersion Condensers (62093).—Oil immersion condensres can be used with dry objectives.

Bacteriology (62094). Reichert's 7*a* is a ¼ of 114°, and costs £2. I do not know of an oil immersion 1/12 for £4.

April 29. **Edward M. Nelson.**

ROCK-CRYSTAL SPHERES.

[27204.]—"R. J. M." (27098) is in the right when he supposes that these can be made—indeed, are made—by both American and European workmen. Given the stone, there is no more in it than making glass spheres. I have myself worked optically perfect spheres in glass, and should not feel any great difficulty in working up rock crystal. I ground lenses and prisms of rock crystal 20 years ago. The extreme hardness of the material certainly makes the *working* costly. I should suppose the high value at which some of the larger balls are estimated is due to the scarcity of such masses free from *shakes* and other imperfections, more than to any occult skill needed in working up. After an inspection of the immense collection of Oriental lapidary work forming part of the presents made to the Prince of Wales, I came to the conclusion that English, American, and Continental lapidaries can "lick" Orientals all to pieces at stone-cutting. **Prismatique.**

OPTICAL PHENOMENON.

[27205.]—MR. W. H. SHRUBSOLE (27102) I think will find the apparent opening and closing up of the images, as seen by rotating the "piece of silvered glass" in the same plane, is due to the fact that a "piece of silvered glass," such as is used for ordinary looking-glasses, &c., is invariably *wedged* in one direction. A moment's thought will at once give Mr. S. the clue to the easily solved problem. A piece of absolutely *parallel* silvered glass, such as is used for the index or horizon reflectors of a sextant, I do not think will show the closing and opening out—indeed, the fact of such a phenomenon (?) existing would prove the glass imperfectly worked. I may add that absolutely parallel glass is one of the *most* difficult of the many difficult pieces of work that go to make up the total skill of a working optician.

Prismatique.

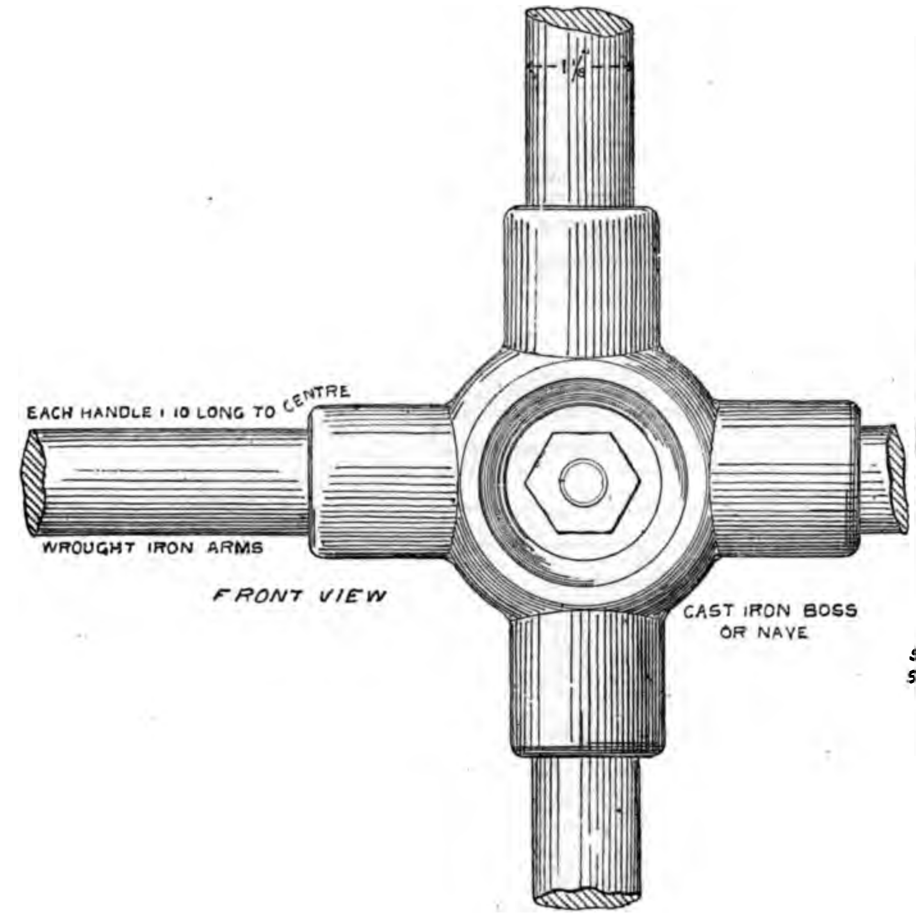
[27206.]—A FURTHER feature in connection with this phenomenon (letter 27102) is worth notice: it is that the light emanating from the images reaches the eye in a more or less polarised condition.

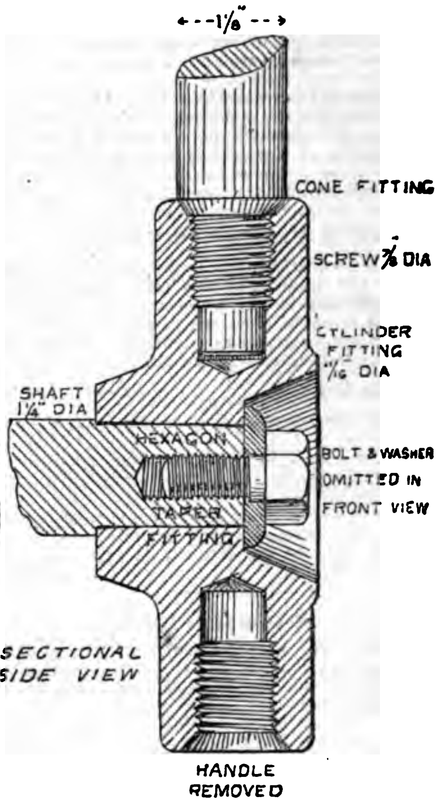
When a Nicol prism is used and a plate of selenite interposed, the images present the usual complementary colours, and go through the ordinary changes when either the mirror, selenite, or prism is rotated. **W. H. H.**

LATHE MATTERS.

[27207.]—REFERRING to letter 27133, I hope "F. A. M." will not think me hypercritical if I take exception to his second paragraph, where he says that "the centring of the chuck would be determined *entirely* by the plain surfaces, the screw having nothing to do with it but only holding the parts together. This would do away with the necessity for that extreme accuracy," &c.

I think if "F. A. M." looks at the matter again, he will perceive that as in a view of a right-handed screw the thread rises from left to right on the side nearest to the observer, and the reverse way on the side furthest from him, and similarly that the inclinations are reversed on the right and left sides, he will see that the thread even of a buttress section, or "resistance" form, as it seem fashion to call it, has still something to do the centring. And while on the subject, I say that without having tried any experim am strongly of opinion that the "butt resistance thread is not so strong as an o V-thread. It may be an appropriate sort o to use in the breech-plug of a gun, and, a worth has so used it, I may be supposed a for suggesting that I don't see its great advan even for that purpose. I mean, in the cou day or two, to try a buttress thread ag ordinary Whitworth V, and will imm





withdraw my opinion expressed above if I find my anticipations not verified. By the way, whilst on the subject of screws, what a very peculiar sketch of a double-threaded screw is given on page 166, Fig. 35. It is, in fact, so much like a single-threaded screw as commonly but erroneously drawn, that I fail to see the difference, notwithstanding the *a b a b*, &c.

I send a sketch of the manner in which I have screwed the cross-arms of my last planing machine into the cast-iron boss, and for its particular purpose I do not think it can be improved upon. Even for a lathe chuck it might do if properly fitted; but, as I have always contended, neither this nor any other will do if the screw is not well cut. I have been looking at some of the letters about chuck-fitting, but I cannot light on the ones in which so-called "D tools" or "half-round bits" are relied upon for forming the proposed cylindrical fitting of a chuck on its mandrel. The proposers of such a plan seem to forget two things, one being that before you attempt to bore with a D tool you have to prepare the hole for its reception to about the depth of, say, ⅜in. or more, according to the degree of front bevel of the tool, in order to give a fair bearing; and, secondly, that when you have done that you never find the tool itself do otherwise than leave a very perceptible indication of the commencement of its own cut, and between the two you get a very imperfect imitation of a cylindrical hole. Then as regards taps for making the screws in chucks. People fancy that if you have a succession of taps of increasing diameters, you can produce good threads in chucks. Well, I have had a good deal to do with the matter, and I am satisfied that nothing of the kind is the case. The internal screws must be cut in a screwing lathe with a tool of a single point, or embracing about a thread and a half, leaving little or nothing for the finishing tap to do. A cone-fitting as advocated a few weeks ago, with the ordinary screw in front of the cone, would not be nearly so good as the cylindrical fitting with a flat shoulder in rear, if you could only get it at a price that would not be quite prohibitory. At the same time, I am completely opposed to the adoption of the cylindrical fitting on mechanical grounds only. If interchangeable chucks are required, in the same way as interchangeable parts of microscopes, the same fitting must be adopted in the former case as in the latter—viz., true screws, and flat shoulders to screw against. These are essential, and all the rest superfluous.

J. K. P.

[27208.]—In Dr. Edmunds's and Mr. Gray's letters of April 1 and 15 "E. M.," there is a special screw-thread, which they refer to as the resistance or buttress thread, to which I should like to call the attention of your readers, independently of the purpose for which they advocate its use.

As early as 1862, Mr. E. T. Loseby, now of Leicester, took out a patent, No. 3454, in the printed specification of which the following passage occurs at page 5: "The threads of the screw which are found to be most advantageous are of an original or novel form; the sides resisting the thrust are cut at right angles to the axis of the screw on one side, and at an oblique angle on the other, making the threads similar in form to those of a ratchet, and combining the advantage of a square-threaded screw with that of its being easily made in discs or screw plates."

From this it will be seen that he had invented this form of thread 25 years ago, and I may further say that he had left samples of this thread at the Society of Arts, Adelphi, on 6th August of the previous year and explained their special advantages, and some correspondence ensued about the new thread, without, however—so far as I know—the invention having been brought prominently forward.

It would be interesting to find out by what stages this thread has now come to have its qualities appreciated after lying 25 years unrecognised. As an engineer, I think it would be also interesting and instructive to know what is the opinion of your correspondents as to the capacity of this form of screw thread to general engineering purposes. It appears to possess all the qualities of the standard Whitworth V-thread, with the additional advantage of precluding the possibility of jamming with the nut and its consequent rapid wear, when, as in joints which have to be frequently broken and remade, the nut has to be repeatedly taken off and put on. In fact, for purposes where the screw and nut are not required to take a pressure in both directions, as, say, in the screw of a slide-rest, it possesses all the requirements for a *universal thread*, especially as it can readily be cut with dies in an ordinary screwing machine. And I now propose to elicit from your correspondents any arguments that may be advanced for or against its being set up as a universal thread for engineering purposes.

I have seen some screws which were cut with the thread at the same time as the specimens sent to the Society of Arts, which were, in fact, duplicates of them, and in these the acting face of the thread forms a right angle with the axis, and the back of the thread an angle of 45°. **A. J. Gimson.**

54, Highfield-street, Leicester.

[27209.]—I have read with interest the various new ways of cutting screws by specially designed apparatus; but I fail somewhat to see the necessity for their introduction. They might, perhaps, be handy in a large factory where a man cuts nothing but screws all day long; but for the amateur and ordinary mechanic, surely the usual screw tools are enough. I am many removes from a good turner, but screw-cutting by hand was one of the first things I learnt, and, like swimming, once acquired it is never lost. Turning seems to get more and more elaborate. Friends of mine are constantly buying expensive extras before they can make their own chucks, or turn out with ordinary tools such fancy articles as are sold made of vegetable ivory—I mean specially those highly ornamented. How many amateurs could make a simple ivory thimble by hand, drilling the holes regularly without a division plate? Again, I notice a correspondent asks how to make twist drills, because he breaks so many; and another correspondent asks for an apparatus to sharpen them with. Why not learn to work without breaking them, and why not practise to sharpen them on a grindstone? It is perfectly easy with proper tuition and a week's practice. I don't mean to say that they should never break; but I have used a set nearly down to stumps, with only one breakage. I am quite sure that a series of articles on plain turning would be welcomed by a great number of your readers, including **A Novice.**

[27210.]—My screw-cutting arrangement was designed for the use of manufacturers, regardless of the special requirements of the amateur. It was stipulated that no change wheels or gear of any kind was to be used.

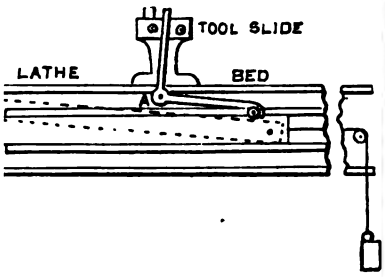
In reply to "F. A. M.," I may say that with the dimensions I have given I believe the arrangement would be strong enough to cut threads in chucks of 8 or 10 to the inch, as the shifting bearing can be brought close to the tool arm, so that in this case the bar will stand a very hard thrust or pull without yielding.

"O. J. L." would have it that the question is decided that a curve can be formed on Niblett's "swash-plate" that will give a correct spiral for any screw to be cut. Not yet. I will put it another way: Instead of using a fancied curve to produce a screw, we will take the converse, and let the screw mark out the curve. Set a truly-cut hob, say, of 20 to the inch, between the lathe centres, let one arm of the guide-bar run in the thread of this hob, while a tracer on the other arm forms an outline for half a revolution of the "swash plate." However slowly the gear may cause this to rotate, the curve traced must be a true spiral; it is, in fact, a part of the thread of a guide-screw of coarse pitch. Now replace the hob by another of 10 threads per inch; tilt the "swash-plate" for this range in the half-turn, and you have at once nothing else but a drunken thread, represented by ve of the "swash-plate," and which could t a deformed thread for the 10-thread pitch. cer for the 10-thread cannot be made to run path formed by the 20. Any turners' ap- e could demonstrate this by tracing a true on the edge of a disc, and then by tilting ike the thread a drunken one. Anyone not see this plain fact, but placing a blind on figures, had need to put on mathematical les in order to grope out a desired result imperfect text. **F. H. Wenham.**

THE SCREWING APPARATUS.

1.]—MR. WENHAM, in letter 27136, p. 178, to the adjustable inclined plane "fusee- " principle as being practicable but cum- and much in the way. Perhaps I may be to say that this principle is actually carried he screwing apparatus, described on p. 104, being apparently cumbrous or obtrusive. ig slide stands close to and parallel with one lathe-standards, and is little more than a ddition to the latter in front.

ll be quite easy to place the slide horizon- ther in front of or behind the lathe-bed, as d in the subjoined rough sketch, the tool

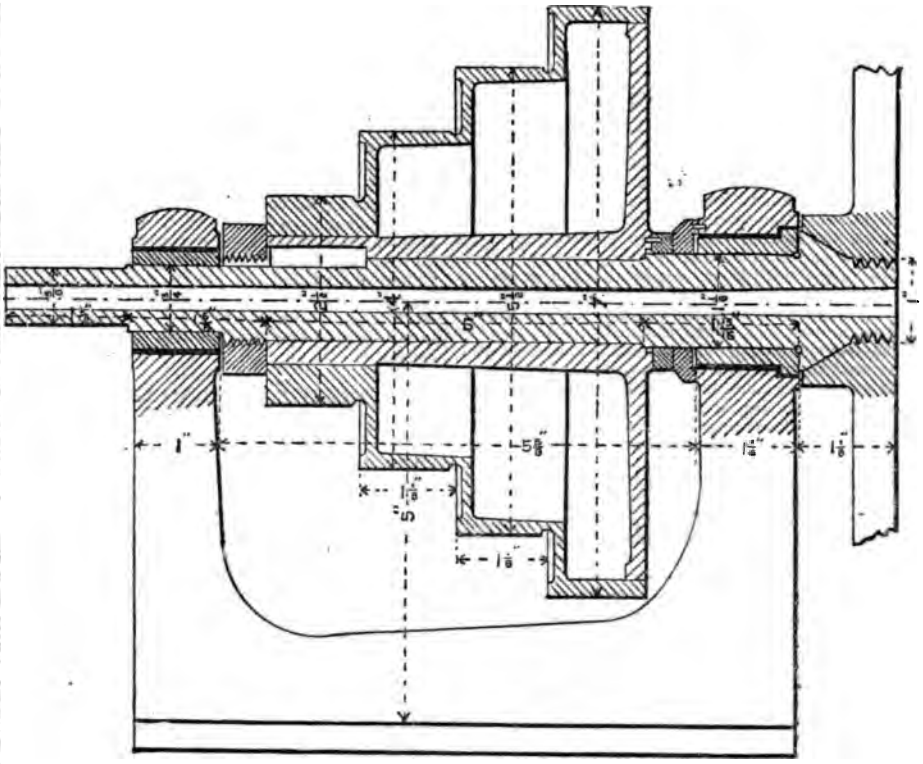


ing worked by a cranked lever, A. The this lever will, of course, move in a circular d thus a slight inaccuracy would be intro- but in the fine threads cut this would be appreciable. **H. G. Madan.**

FIVE-INCH LATHE HEAD.

2.]—I SEND you, by book-post, a tracing of lathe head, in section, so as to show con- on. I find that to keep it as simple and t as possible, it works out slightly different t I had in my mind when I wrote the letter inted 15th ult. It will be seen that both arings are parallel, and have no adjustment. erience is that parallel bearings are best h, medium, or low speeds, and, if properly ioned, made of hardened steel, a good fit, ecially, truly round, they will last for many f fair work. When worn, they can be good as new at small cost. Of course, no s will last, if allowed to run hot and dry. arranged to take end thrust on the front . By making the adjustment for end play wo sides of *one* bearing, there is less chance ation of adjustment by difference of tempe- han if a long length of spindle intervene n the collars. The belt cone is prevented rning by a feather, and is kept to its place play of spindle in bearings prevented by nut in front of back bearing. I have used ust plates, as there is no doubt but that n more lightly than coned shoulders. s a $\frac{5}{16}$in. hole through spindle, the front end oned for a centre. The tail end of spindle finished according to the work the lathe is d for. If the lathe were for my own use, I make the front bearing longer—certainly ng, probably 2in.; but for foot power, and s of work likely to be done with it, 1¼in. be sufficient (in hard steel), and it would ewhat lighter. It will be seen that I have lat steps instead of V's. I cannot under- hy the gut band has survived so long for lathes. For small accessory apparatus it essity, but for the main spindle driving I ot. A flat belt has more driving power, is sily joined, runs more smoothly, and varies length from atmospheric changes than a d. The pulleys, also, can be made quite as I have shown four speeds; but for a foot think three are ample: the foot can vary ed so largely, that a small cone for the peed possible, a large one for the slowest ossible, and a middle one for general work, hat are really wanted. I would then make s 1¼in. wide, instead of 1⅛in., and the re- space could be used for a worm wheel for tion of spindle.

not a very diligent reader of the ENGLISH NIC; but whenever I take it up, I am almost ind an article on some new way of cutting Now, as methods of *originating* screws, emes are many of them very clever and



interesting. But, for cutting screws in everyday work, why not be satisfied with change wheels? They give a definite, positive, and accurate cut, with a minimum of adjustment. If the spindle end projects beyond the back bearing, and if the lathe has a slide-rest, then the connection can be made at small cost. The following threads—10, 12, 14, 15, 16, 18, 20, 22, 24, 25, 26, 28, 30, 32, 34, 35, 36, 40, 45, 50, and 60, can be cut. If the slide-rest, as is usual, has a screw of 10 per inch, with a set of 12 change-wheels—viz., 15, 20, 25, 40, 50, 55, 60, 65, 70, 80, 85, 90. The cost of these is 11s. 3d. —say 1s. 6d. each for castings for the bracket for extension rod and swinging arm, and 2s. 6d. for the sundry screws, bits of iron for studs, &c., and I don't think the whole is a very extravagant total. I am assuming, of course, that the lathe owner does his own work, as he seems generally supposed to do. The work required is all straightforward, and when done, gives a reliable screw-cutting arrangement—not a makeshift.

I shall be pleased to answer any questions, or give any assistance I can.

Arnold-road, Bow, E. **Jno. W. Newall.**

TWIST-DRILL MAKING.—TO "COUNTRY PARSON."—TRIGONOMETRY.—TO "E. L. G."

[27213.]—HAD I at first noticed that £10 to £15 would not have been thought by you too much to pay for drill-making apparatus, I would not have troubled you with my unpretentious fixture, which would not have cost so many shillings. You need, however, have no fear: you would *require* a separate twisted guide for each drill. *One* would, as far as the twist is concerned, serve for all, as the difference in the pitch of the spiral of drills is very slight, hardly appreciable from $\frac{3}{16}$in. size to ⅜in. I have no means of testing the difference; but whatever there may be in the sizes from ⅛in. to $\frac{1}{16}$in., or smaller still, C. Parson will find no practical difference or injury will result from his using the same twisted guide, if he needs to do so, for all sizes from ⅛in. to ¼in.

As to *twisting* the guide, it is a much simpler and easier operation than might be supposed. What I would do myself would be to take a piece of ⅜in. square steel, say, 6in. or so long, put in fire, and heat evenly; take to vice, and grip about 1in. in the jaws, with a tap wrench on the other end give the necessary twist; straighten if it needs it. Then take to lathe, and having centred, turn down the end which has been held in the vice, and cut a screw-thread on it to suit the thread on your little two-jaw self-centring chuck, removed for the occasion from your little American hand-drill. You now only need to fit twisted square shank in its square guide hole on any suitable frame, which may be made to fit into socket of T-rest, and you have for a few hours' work a very simple and not ineffective arrangement, which I think "C. P." would find would turn out as good work as some of the more orthodox and costly methods recommended to him.

In re the rival screw-cutting devices, would "E. L. G." kindly look into the calculations given by Mr. Pocklington, letter 27138, p. 178? No doubt, as it is endorsed by two such authorities as it is in to-day's number, we ought not to hesitate to accept their word for its correctness, as no doubt they have been able to follow out the proof—which is more than I have—as more than plane trigonometry seems needed. But without doubting Mr. Pocklington, confirmation from a mathematician such as "E. L. G." would not weaken Mr. Niblett's case. **Fredk. Carre.**

NIBLETT'S SCREWING APPARATUS.

[27214.]—I HAVE received, since I last wrote, a private communication inclosing a boxwood cylinder with a series of threads cut by a single-point tool. In this I do not detect any variation whatever in the spacing of the threads. That the invention is a sound one, both in theory and practice is, I think, satisfactorily established. In spite of adverse criticisms in various styles, I am very glad that I took upon myself the work of introducing this novelty, of which the entire credit is due to Mr. Niblett himself. I have now no fear that this will become in the future a recognised addition to the lathe.

Orders have come into Mr. Niblett's hands, and have resulted in a number of valuable testimonials from those who have tried and proved the value of this screw-cutting guide. But I wish to state that I do not, and did not, speak against Mr. Wenham's arrangement. I stated that it was the best I had seen of its kind, and that its defects—or what struck me as defects—were due solely to the bar system, and absolutely inseparable from it. That it is practicable and efficient, I have no doubt whatever, and I think these discussions should not arouse jealousies, but should stimulate us to the study of various kinds of mechanical movements which may be capable of similar practical application. Inventors need, it is true, a hippopotamus hide warranted proof against the shafts of ridicule; but it would be very regrettable if the fear of such shafts should prevent them from publishing in these columns their ideas and suggestions. Given something to be done, and in the present case that something is screw-cutting, some plan may be hit upon to enable it to be done better, and by even simpler means than either Niblett's, Wenham's, or the traversing mandrel. At present, as it seems to me, these are the three standard methods, each having, perhaps, some drawback and some special advantage over the other two.

All three are perfectly practical, and I think about equally efficient; I have not included the screw-cutting lathe proper, because it stands qu apart, and is not suited to the kind of work - posed. We have the sliding bar, the traver mandrel, and now the swash-plate, and I con the inventor of the latter as much entitled to as any other clever man who introduces a valuable machine. If our readers, therefor really enthusiasts in mechanics, they can fail to appreciate, as I do myself, both the tion and the inventor. Very probably, im ment of detail may be possible; but the plate will henceforth take its stand as a recognised method of giving uniform traverse suitable for screw-cutting. **O. J. L.**

IGUANA SKIN.

[27215.]—I HAVE never met with this useful product in Europe. At Delhi, and other populous Indian cities, this tough, scaly material is used for shoes, generally dyed green. The ugly reptile (like a miniature crocodile) is plentiful in most parts of Hindostan, usually inhabiting hollow trees, descending for food to poultry yards, fish ponds, and green swamps; they grow to 5ft. or 6ft. long, though the average size is 3ft. or 4ft. A pair of those shoes are said to last a lifetime. The flesh is considered to be superior to any kind of fish, so say the omnivorous Burmese, and an English sportsman, long resident in that country, assured me he had acquired a taste for it. I found this skin very durable covering for the scabbard of a heavy scimetar, a hunting knife sheath, and other paraphernalia, being very tough and defended by small protuberant scales. The Oriental gipsies, too, delight in eating the creature, and all I killed were nicely skinned by these people, in return for the feast. In South America it is also considered a dainty. I have a skin by me, though over ten years have passed since I killed the owner.

Eos.

THE SUPERNATURAL DARKNESS ON THE FIRST GOOD FRIDAY.

[27216.]—THE reference by Tertullian to "annals" is of doubtful value, and may merely refer to ancient writings, such as Phlegon's. Controversialists are apt to find decisive evidence and particular statements where others see nothing of value or vague statements. The "annals" do not exist, and the heathen replies have been lost or destroyed, so we cannot estimate their value.

Our everyday experience proves that opposing parties state that some fact or necessary inference is admitted by their opponents which destroys their case, yet the other side deny it *in toto*; we cannot, therefore, admit unsupported statements of miraculous occurrences. We even decline to believe many well-attested ones—such as that the Holy House at Loretta flew across the sea to its present resting-place.

Phlegon's fragment, preserved by Eusebius, "determines merely the Olympiad, scarcely the year, and in no case the season or day of this darkness." Phlegon is not a very good authority; next to nothing is known of his life, except that he lived in the time of Hadrian, about the middle of the 2nd century A.D. He appears to have been rather credulous, as, amongst other oddities, he speaks of a child who was able to converse with others before it was two months old, and says the women of Paleæa became mothers at six years of age. Origen also says of him that "he makes a mistake in the person, naming Peter instead of Jesus."

Dr. Adam Clarke, in his comment on Matthew xxvii. 5, summed up the objections to his evidence thus:—

1. All the authors who quote Phlegon differ, and often very materially, in what they say they found in him.
2. He says nothing about Judæa; what he says is, that in such an Olympiad (some say the 102, others the 202), there was an eclipse in *Bithynia* and an *earthquake* at Nice.
3. He does not say the earthquake happened at the time of the eclipse.
4. He does not intimate that this darkness was extraordinary, or that the eclipse happened at the full of the moon, or that it lasted three hours.

The silence of St. John is a serious matter, as his Gospel was written in a highly civilised heathen city, where such an event as the unusual darkening of the sun would be well known, *if true*, and where such evidence would be of enormous value for converting those who doubted the Christian story. Yet John does not refer to it in any way. Neither is it referred to by him or by any other writer in the Epistles: it only occurs in the Synoptic Gospels.

This omission is usually defended, as by "E. L. G.," by saying that St. John only *supplemented* the Synoptic Gospels, and wrote nothing unnecessarily. This answer is doubtful generally, and is wholly inapplicable to the present case, as this particular evidence would have special force in such a city if true, but be wholly destructive if false; the omission of it is strong evidence that John did not expect those he wrote amongst to believe it even if he did. But John's account is not a supplement to the others, but contradicts them. If it were supplementary, he would naturally have cleared up difficulties already existing, instead of which, he ignores them and states the case in a different and contradictory way. Thus:—Mark says Jesus was crucified at the third hour (9 a.m.) and that the darkness began on the sixth hour Matthew and Luke say Jesus was crucified at the sixth hour (noon) and that the darkness commenced *then*. *Whereas John says* that Pilate sat in judgment on Jesus "about the sixth hour," at which time, according to Luke, He was three hours on the cross, and says nothing about the darkness. This is not supplementary evidence, but a different statement.

The authorised translation of the Bible uses the word "land" in connection with the darkness—as if it desired to convey the notion that the darkness was local. The revisers do the same in the text, but give the correct reading "earth" in the margin. This leaning of the translators is interesting, and is an instructive commentary on the fact that, although the original states that this darkness was all over the face of the earth, yet no proper confirmatory evidence has yet been obtained, though for ages multitudes of clever men have sought it eagerly, and those who rely on it have ultimately to fall back on the brief notices in the three first gospels.

Memnon.

SUPERNATURAL DARKNESS—MAGNETIC UNIT.

[27217.]—TO those who examine the question free from bias, the verdict respecting the supernatural darkness at the Crucifixion must be "not proven." The event is alleged to have occurred during the lifetime of Seneca, and of the Elder Pliny, neither of whom make any mention of it, although each of them recorded unusual phenomena in nature. It is not recorded in Josephus, who, indeed, never mentions Christ at all; for the passage in book XVIII. chapter 3 of his work is universally admitted to be a pious forgery. It is not quoted by Chrysostom, Justin Martyr, nor Clemens Alexandrinus; and Photius expressly states that Josephus, being a Jew, has not taken the least notice of Christ. "Save us from our friends" will be the thought of many of our readers on seeing letter 27192, page 202. If Mr. Hampden, coming straight from Wimbledom Common, were to tell me that McVittie had won the "Queen's," I would immediately come to the conclusion that at any rate the great Scottish marksman had failed to gain the blue ribbon of rifle shooting. A man who seriously believes that the earth is flat, and that Sir Isaac Newton was either a knave or an imbecile, is ——; and I congratulate the supernatural party on their champion.

The writer of the passage quoted by your correspondent, "J. B. G." (letter 27195), is evidently ignorant that in the C. G. S. system a complete set of magnetic units have been formulated. They are very fully set forth in Everett's admirable book on "Units and Physical Constants."

Newcastle-on-Tyne. **Wm. John Grey, F.C.S.**

A WARNING.

[27218.]—A FEW years ago the bright beams of "Sunlight" were shed over the pages of "Ours." No subject too lofty, no querist too mean—all were invited to bask in his rays. Honour was replaced by fraud, until finding that legal inquirers were unpleasantly importunate, the above bright beams became suddenly eclipsed, and many, like blossoms put forward in too early spring, suffered sorrowfully for their credulity.

But lo! our brilliant friend, casting longing glances as he thinks over former profits, resolves to once more try his skill. This time "unconquered," and I had almost said unrecognised, except by few—money, goods, confidences, flowed in as before. Again a change of air was required: his efforts for his *friends* had tried him much. A slight recuperative seclusion is taken. Readers of "Ours," who aforetime have been so profitable to him, think he has forgotten "them." No, he has once again returned to "them," to work again for "them," to be feed by "them," and also to be regretted by "them." Dear Mr. Editor, no one need suffer if **Forewarned.**

THE SEXTANT AND ITS USES.

[27219.]—ALTHOUGH I cannot call myself an "impartial" reader, I must say I cannot see the force of Mr. John Hampden's argument. He draws lines perpendicular to a chord of the supposed spherical earth, and from the points where these lines meet the circumference, he draws lines to the sun, and then asks how any sextant or quadrant can measure the angles so formed. He is most certainly under a "misapprehension," for no navigator ever yet attempted to measure such an angle. If he will draw tangents at A and B, and at the other points on the circumference to represent the horizon at such place, he may perhaps (though I do not think it probable) gain some idea of the angles actually measured in practice. A diagram such as he has drawn really means nothing, and is calculated to mislead ignorant people who know not—or at least, cannot understand—whether the earth is round or flat. With reference to his "difficult" question about the difference of temperature in the Torrid and Frigid zones, it is, of course, vain to point out to him that the difference is solely due to the sun's altitude above the horizon. If (as is probable) he denies this fact, may I ask him how *he* accounts for the difference of temperature? Certainly it cannot be due to any difference in the sun's *distance*, as his apparent diameter is practically the *same*. But possibly there may be some people living who fail to see that under no circumstances can 2 + 2 = 5.

Common Sense.

SOME EXPRESS RUNS.—III.

[27220.]—OWING to a printer's error, a thing commendably rare in the "E.M.," the booked arrival time at Manchester of the Midland express is given as 2.25 instead of 2.35 in my letter (27165) last week.

Of several journeys between Glasgow and Edinburgh last September, the following is the best:—

M.	Ch.		h.	m.	s.	Speed.
		Glasgow	4	1	40	—
			4	3	40*	—
3	19	Bishopbriggs	4	11	56	—
12	68	Dullatur	4	23	20	50·5
21	63	Falkirk	4	32	55	56·9
29	54	Linlithgow	4	41	13	56·4
35	21	Winchburgh	4	47	30	53·4
43	61	Corstorphine	4	58	0	48·5
45	70	Edinburgh (Haymarket)	5	1	30	—

REMARKS.—*Due Glasgow 4.0, Edinburgh 5.2. Stops at east end of platform for the rope to be attached. Gradient to Cowlairs 1 in 40 rising.

The engine on this occasion was 525, and the load eight coaches. I made one journey to Glasgow (Eglinton-street) by the Caledonian in 56½ minutes, but on two other occasions 15 minutes were lost each time, owing to the bad state of repair of the engines.

April 30. **Kappa.**

BRAKES.

[27221.]—I AM very glad to find that Mr. Stretton now admits (27167) that the brake tried in 1880 was the Sanders; he is, however, quite mistaken as to my "making a great point about the *name* of a brake," it is not the *name* I care about, but the *substance*.

It is not true that the "Sanders form of apparatus is supplied by the Vacuum Company"; for, as a matter of fact, I believe I am correct in saying that it has been purchased by the Westinghouse Company, which is, I presume, what "Rover" (27168) refers to when he says it has "come to grief."

I am quite aware of the fact that "12lb. of atmospheric pressure acting upon an 18in. piston has the same power to-day as it had in 1880." But, Sir, the same writer, referring in 1884 to the question of the power exerted by the vacuum brake, in reply to a statement showing the vacuum to exert as great a pressure as the Westinghouse, used these words: "This theory is either 'a pretty-looking trap' intended to deceive those who do not understand the subject, or it proves that its author has not yet mastered the first and most simple principles of mechanics. Every brake, from the ordinary lever on the coal waggon to the best continuous system, is of *equal power* when 'full on.' The question, therefore, is not simply one of power, but of the time required to bring that power into efficient action."

So that, Mr. Editor, you see that the proof produced by Mr. Stretton to warrant his use of the 1880 trials falls to the ground on his own showing. And, again, not very long ago he told the delegates at Leicester that the vacuum automatic brake with the *latest improvements* was *quick in action*, and now he tells us that it is the same "form of apparatus as in 1880, notwithstanding the information given by him in 1886 to the readers of "Safe Railway Working" in describing the vacuum automatic brake, when he uses the words "a brake has been *perfected* which appears to comply with the celebrated conditions of the B. of T."

Now, an important feature in the vacuum-brak is its van-valves, and these *quicken* the action o the brake considerably; but they were no part o the Sanders apparatus. **Geo. Kiernan,**

166, Duke-street, Brooks'-bar, Manchester,
April 30.

ENGINE-DRIVERS' EYESIGHT.

[27222.]—ON page 98 I directed attention to th subject of engine-drivers' eyesight, and to th number of men reduced from their duties as e press drivers, or entirely removed from the fo plate, on account of their failing to give the nam of certain shades of wool and to count dots, as r quired by the *theoretical* test. The injustice beca so serious that the Amalgamated Society w absolutely obliged to take steps to protect members, and most valuable and complete, i formation was obtained from physicians, offici

tical men, which tended to prove that the
d test is not the proper one for engine

mentioned in my former letter, the society
the test to be *practical*, and consist of
o see signals both by day and night at the
y distances.
se some men fail to know the names of
shades of wool it must not be thought that
e colour-blind; they are only colour-
. As a matter of fact, it may be mentioned
ne men who have failed to name the
have since received instructions from some
rls in Berlin-wool shops and from painters,
now able to pass the theoretical test with-
culty.
e other hand, a man may be perfectly able
ots on the card, and sort the forty shades
and yet be quite unsafe to be upon an
as he may be unable to see signals at the
l distances. To prove this, I may quote a
point in which a driver who passed the
cal tests, and was therefore said to be per-
express work, knew himself that he could
the signals, and he, fearing an accident,
to be removed from a main-line engine to a
g engine. Now, in this instance, the
cal test proved to be absurd, and if this
l been subjected to a proper practical test
ctive sight would at once have been found
ppose he had not had the good sense to give
n-line work, he would, having passed the
cal test, have continued as an express
and perhaps have caused a serious accident,
n committed for manslaughter.
nday, the 24th April, a number of engine-
and firemen belonging to the North-
. Railway who failed to pass the dot and
sts were re-examined at Darlington. This
test suggested by the society was employed,
n were put to the *practical* test of seeing
: and nothing can prove the absurdity of
oretical test more clearly than that these
n who failed with "dots and wool" were
o be able to see signals at 1,000, 754, and
ds. I trust these men, who had been re-
from their engines, will now be reinstated
former positions. Another very important
is the time when the test should be made.
a driver to be tested before he goes on duty,
he has been at work ten or twelve hours?
ave occurred in which a man could see the
d pass after twelve hours of duty, but when
sted at the end of seventeen hours work, he
Of course, the effect of wind, dust, and
ly overwork, must at the end of a very
rm of duty seriously impair the sight of a
On several lines in this country the
l test with signals and lights is considered,
practice is found to be, highly efficient, and
it may become general, in place of the un-
tory and purely theoretical tests to which
n so much object.

Clement E. Stretton.
nsulting Engineer Amalgamated Society
of Railway Sevants.
ancras Hotel, London, N., May 2.

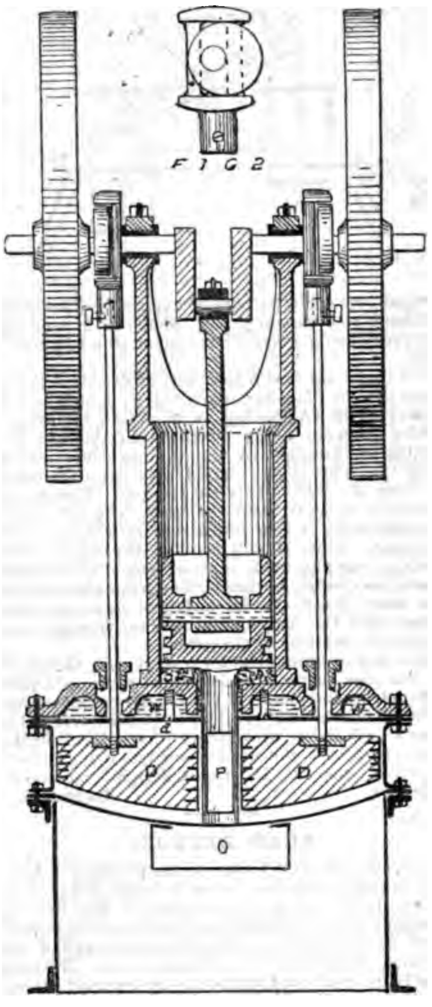
BREAKING OF DRIVING-AXLES.

3.]—THE Board of Trade returns for the
86 show that the proportion of iron and
iving-axles broken in running is practically
e as since the year 1881. The steel axles
ain the least number of cases; but the iron
an the greater mileage before breaking.
86: 184 cases; 123 were made of iron, 61
ade of steel. Average mileage of 117 iron
86,517 miles; average mileage of 61 steel
12,362 miles.
igures again prove that the average life of
g-axle is known, and point to the necessity
oving axles after they have run a certain
r of miles, instead of allowing them to run
y break on the journey and cause an accident.

Clement E. Stretton,
nsulting Engineer Amalgamated Society of
Railway Servants.
City-road, London, E.C., May 2.

SIGN FOR HOT-AIR ENGINE.

24.]—SOME time ago I promised to send
g of ½ man-power hot-air engine. I should
lfilled my promise before, only I have been
menting with another design, expecting to
re power from a smaller engine; but up to
esent I have not obtained a satisfactory
so I have sent drawing of a design I have
view some time, hoping it will meet with as
favour as the drawing of my model engine
sent last year. The drawing I now send is
to scale, and is ¼ full size of ½-man power
. The cylinder, piston, top plate of water
, eccentrics, and flywheels are castings. The
rical part of heater should be made of sheet
20 gauge, flanged over top and bottom, and
brazed; or if riveted, the rivets must be
sunk and filed off smooth inside. The top plate of heater should be iron ⅛in. thick, and screwed up to top of water jacket as shown at *a*, using asbestos or indiarubber between the joints, the bottom of heater iron $\frac{3}{32}$in. thick; but copper would be better, and should be of the shape shown in drawing. The base or firebox of engine is sheet iron riveted to rings of angle iron. The opening shown at O is for the chimney to be connected to. At the bottom of cylinder a plate of metal is placed with a tube let into the centre for the passage of air from and to the cylinder and heater. This tube must rest on the bottom of heater, and have two pieces cut away, one from each side as shown at P, and must be so cut that the displacer, D, just covers the holes made when it is at half-stroke.



This tube and the plate in cylinder must be insulated from the water jacket, W, with asbestos fibre as shown in drawing. The displacer might be made of alternate layers of rings of asbestos millboard and rings of thin sheet metal, with iron plate top and bottom connected with five iron screws. The cylinder must be truly bored, and the piston packed with rings, and work easy and air tight. A small tap should be fixed in the off cylinder as near the bottom as possible; this is to let the air escape when it is required to stop the engine. Fig. 2 is a side view of eccentric arrangement. To set the engine to work, a fire must be lighted under heater, and cold water circulated through water jacket, W, through openings not shown in the drawing. All joints should be made with asbestos. I think the drawing will explain the rest. **J. Seal.**

67, Carthew-road, Hammersmith, W.

THAT PRESSURES ARE DYNAMIC EFFECTS.

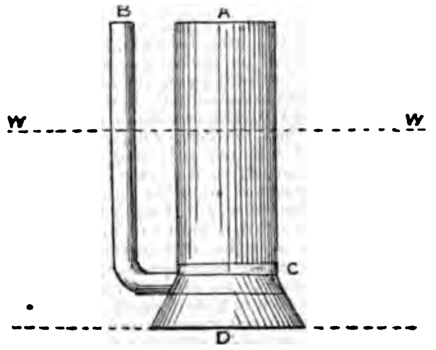
[27225.]—AS no one appears to have given particular notice to the latter part of letter 27060, I venture to trouble you with a few remarks, especially as parts of it are founded on a fallacy which, if not corrected, may do harm to your younger readers. I quite agree that elasticity is a necessary condition of matter; else, if Newton's laws are true, we should have some terrible jars and smashes.

Mr. Wakelin shows us in an admirable and simple manner how to measure the dynamic equivalent of the pressure of a weight at rest. He then goes on to ask: "If a package is being lifted by a crane, will it, if the cord be cut, continue to rise for a short distance, no matter how slowly it is being hoisted?"

This in effect is his question, and he says there is a certain speed at which it will not rise further if so cut, but immediately begin to descend. Now, I say he is wrong, and will try to show that he is so. In finding the dynamic equivalent (a very good term) of the pressure of 20lb., why does Mr. Wakelin let the 1lb. weight fall from a "certain height"? It is in order to attain a certain velocity, which, multiplied by its weight, equals 20lb. Similarly, if the package hoisted by the crane equal 20lb., it will not move upwards till a power of more than 20lb. is applied to the crane cord; neglecting friction, this excess of power will be stored in the package as energy capable of being given out as work, and if the cord now be cut, this work will be expended in raising the package till the power is exhausted, and not till then will it stop and begin to fall. The momentum of the package at the certain speed alluded to above, at which Mr. W. says the package, if disengaged, will not rise further, but begin to fall, he calls the "dynamic equivalent of the pressure of the weight of the package." Well, if the package have any momentum, its impact, being the product of its weight multiplied by its velocity, must exceed its weight alone; therefore, the only condition under which its momentum (?) will not exceed its weight is when at rest—that is, when it has no momentum. Of course, as its momentum is bound to exceed its weight at every speed, the package *will* rise after being instantaneously disengaged, no matter how slowly it may be raised. **Hy. Wake.**

A FRENCH BATH-HEATER.

[27226.]—I THINK that 30 years have elapsed since this extraordinary article was suddenly brought to my notice. I had ordered a hot bath at a French hotel; when I entered the bathing-room I only found a fine large receptacle of clear cold water. I rang the bell, and told the waiter I wanted a *hot* immersion, not a cold one. He replied the fire was not quite ready for use. This statement made me imagine that I should have to wait long for the boiler to do its work, but was startled a few minutes later on by the apparition of a curious stove brought in and placed in the water of the bath. It was half-full of incandescent charcoal glowing delightfully by aid of the air-blast, rushing down the side pipe figured B. The stove A was made of light sheet-iron, rivsted and brazed, with a heavy bottom at D; a perforated plate inside at C supports the live coals, and helps the air-pipe B to act; W W, water level. By placing an inverted pot of metal under the stove, it can be raised higher, so as to warm a larger volume of water if necessary; but this retards the process, as might be expected. Wherever charcoal can be procured, as in Canada and India, this apparatus is of value. The fuel must be *smokeless*—"that's the rub." **Eos.**



LIBRARY STATISTICS.

[27227.]—YOU printed a fortnight back an interesting paragraph, based on the forthcoming Report of the Bureau of Education of the United States, giving the statistics of public libraries in America. We compare, as a nation, most unfavourably with our cousins across the Atlantic, both in the matter of libraries and also in Government documents relating to these institutions. America has, as you truly say, 5,338 libraries, of which about 450 rank as free public libraries. The gross number of volumes in these 5,338 libraries is 20,622,076. Some of the American libraries I have visited, and can bear testimony to the universal appreciation and use of these institutions. In the second edition of my little book on "Free Public Libraries," published to-day, I am able to record only 146 places which have adopted the Public Libraries Act in Great Britain and Ireland, and the gross number of volumes in the existing free libraries is not by any means considerable. In Berlin there are 22 free libraries, in Paris about

50, and London can boast of six in existence, and five parishes, which have recently adopted the Act, will bring the number up to eleven, established under the Public Libraries Act. How long are we English to bear this reproach of being so far behind America, Germany, and France in the number of these educational institutions? With regard to Government documents on the subject, the Bureau of Education at Washington have issued two large volumes having together some 1,200 pages, and a third volume of statistics. The publications of our own Government consist of a Blue-book published in 1850, and two or three returns of free libraries published at different intervals, each confined to a very few pages, and these are so inaccurate and incomplete that they are utterly worthless for practical purposes. This free library movement, however, is a work for the people themselves, and all friends of education and of the people should interest themselves in the extension of these useful institutions. I shall be happy to send a small supply of literature to any-one interested in the subject applying to me.

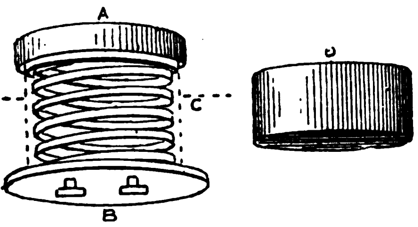
Thomas Greenwood.

Lordship Park, Stoke Newington,
London, N., April 19.

A COMPRESS PAD.

[27228.]—In my erratic life I have seen something of wounds caused by gun, spear, and bow, and minor accidents in domestic life due to carelessness in the manipulation of knives and bottles, so I was led to think of some instantaneous mechanical appliance, always within reach, which should stop hæmorrhage till the arrival of surgical aid. In the good old times of muzzle-loaders a yard or two of stout tape was served out to officers of companies, the surgeons previously instructing the combatant officers how to use it. The tape being tied round the wounded limb, a ramrod was the article preferred to tighten the ligature until opportunity arrived for dressing the injury. Here is a very simple and portable little instrument, which the sportsman and tourist can make and carry in his pocket. It had the honour of being admired and praised, and a patent suggested, by an army surgeon, a gold medallist, of Dublin. A is a disc of pure rubber punched out of the solid; C a spiral spring of stiff brass wire, $\frac{1}{8}$in., four or five coils; B a stiff leather disc rather larger in diameter than A; D a cylinder of light, stiff leather to inclose the spiral, when spring is compressed. To mount the component parts, two circular plates of thin sheet copper are each to have a small central hole pierced, the ends of coil inserted, and then firmly soldered. Next attach the leather B to the plate with bicycle cement (pitch and guttapercha), make two suitable holes for the brass studs, and screw them through the leather into the plate; then pass the cylinder D over the other end of coil (A should fit loosely); cement the rubber cushion to the metal plate; put the work into a clamp till quite secure. You can have indiarubber web circular bands, with metal eyes of two or three sizes for limbs, or a leather strap and buckle, with eyes in pairs all along the length, or you can use whipcord looped round the studs, and tied on opposite side. The rubber cushion, backed by the strong spring, adapts itself to the soft human body, the cylinder D keeping the spring straight and its elasticity equal; it should not be more than two-thirds the length of spring, as the latter will close up into it. I covered the hide leather at B and the cylinder D with morocco, adding considerably to its neatness. This compress has proved particularly adapted to special cases of rupture. Nearly every artisan in England can make one for himself, being so simple.

Eos.



THE LIMELIGHT.

[27229.]—Would not Mr. Lewis Wright, and other workers with the optical lantern, find the arrangement in the figure preferable to the ordinary one?

B, the ordinary blowpipe for the mixed gases; N, a long nut attached to the vertical tube which slides over the pin supporting the whole apparatus; L, a cylinder of hard lime, fitting a brass socket with a clamping spring, the brass socket being attached to and co-axial with a long screw worked by a milled head, S. By this simple arrangement the radiant point would be limited in size to the cross-section of the lime cylinder, which might be $\frac{3}{8}$in., and the lime might be turned and, at the same time, advanced as it was consumed.

The following arrangement has also struck me, by which the mixed gases in the proper combining proportions could be burned under equal pressure, without the necessity for more than one gas (oxygen) being stored either in an iron bottle or a bag.

FIG. 1.

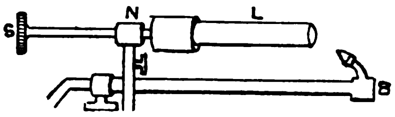
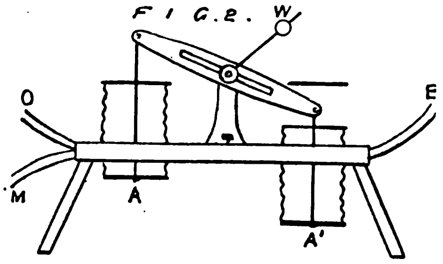


FIG. 2.



In Fig. 2 are shown two pairs of double bellows, some 2in. in diameter, mounted on a base board, one of them (A) acting as an engine, the oxygen under pressure being admitted to the top and bottom alternately by the tumble-over valve-gear W. This engine drives by a beam the other bellows A', which acts as a pump. This pump draws in coal-gas from the main, and delivers it into the tube B, *into which tube also the engine* A *exhausts*. Thus B will conduct the mixed gases through one pipe to the safety-burner. (This must really be a safety burner.) The point about which the beam rocks can be adjusted so as to make either end the longer, to secure the proper combining proportions of the gases.

To secure immunity from explosion the gases should pass through packed brass wires, and then through ground pumice. (I have shown this safety-tube horizontal in Fig. 1.) The tumble-over valve gear would secure the absence of any break in the pressure whilst the dead point was being passed. I should much like Mr. Lewis Wright's opinion on this idea.

Calculus.

SLAG REFUSE.

[27230.]—When I entered the premises I have now occupied for five years I found an immense accumulation of slag, produced by the heating furnaces of the plant-houses and dwelling-house. How to clear away such ugly stuff puzzled me awhile. At present I wish I had more. Nothing like it for roads and pathways in swampy places, beating down with rammer, then the heavy roller, with ashes and fine gravel on top. I have raised the level of ground in a large muddy poultry yard by several inches in this fashion, besides improving my garden walks; the surfacing with beach shingle has given them a good finish. In view of a particular experiment, I had a quantity of this unsightly refuse spread out and exposed to wind and weather for a year or two, to rid it of sulphurous acid, the fumes of which were very perceptible. It so happened that the ground where the slag was deposited was a weed-bed of dandelions and docks. To my surprise, these and many other rank species of wild plants grew to large proportions. My primary object being the enlargement of a rockery, I now laid out the basis of the same to some feet above the ground level in irregular height, covering the slag with tree stumps and sandstone slabs, pouring many barrow-loads of stones, large and small, into the interstices, ending with a constant supply, during rainy weather, of garden soil, peat, and sand. All this was washed in and replenished from time to time, and then planted with suitable creepers and flowering plants. Where water carriage is available, I think this stuff would be the proper thing for filling up the dangerous holes and roadside pits so plentiful near some of our towns. Another use: to keep out rats from burrowing under the foundations of outbuildings. I would line trenches with the same, contiguous to the walls, for I have found that rats and mice avoid this sharp material.

Eos.

The spring meeting of the Institution of Mechanical Engineers will take place on Monday, the 16th, and Tuesday, the 17th, of May, under the presidency of Mr. E. H. Carbutt.

REPLIES TO QUER

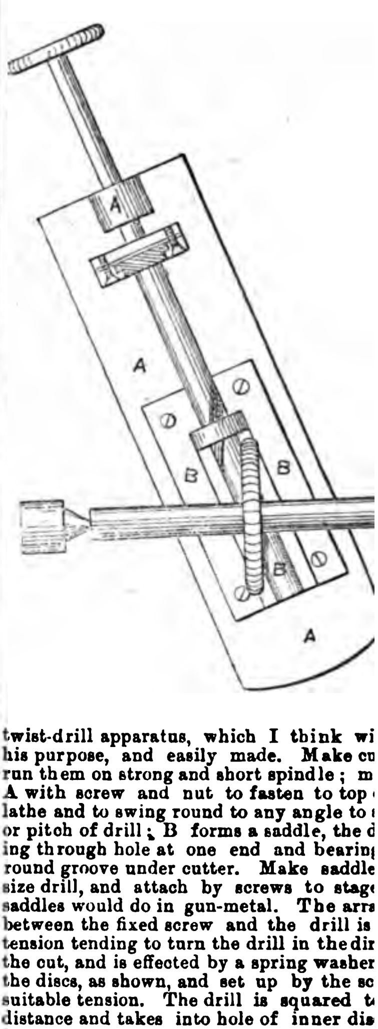
◆◆◆

*** *In their answers, Correspondents a*
fully requested to mention, in each instan
and number of the query asked.

[61654.]—"**Sidney's Arcadia.**"—To
son Gunner."—The cheapest editio
above work is published by Messrs. Low
believe the last edition was published in
will get discount off this.—Cœpio.

[61716.]—**Lighting by Primary Bat**
I must certainly give "Iota" credit fo
perience in primary batteries, although
could say I had only spent £100 on th
battery only needs about twenty minutes'
once a fortnight, I do not think it can
very troublesome. I am glad he has suc
charging accumulators, which shows, as I
it is practicable and has some advanta
cost of Schanschieff's battery is as follo
zinc, say, 3d. for 1H.P. hour; 1¾ gallo
8s. 9d.; total, 9s. Mercury sold would ret
4s. to 4s. 6d., leaving cost for 1H.P. h
4s. 3d. If "Iota" is ever in Herne Bay,
pleased to show him my batteries at wo
will, I think, modify his opinion.—Elec

[61839.]—**Twist-Drill Apparatus.**
quest of "Country Parson" I send a



twist-drill apparatus, which I think wi
his purpose, and easily made. Make cu
run them on strong and short spindle; m
A with screw and nut to fasten to top
lathe and to swing round to any angle to
or pitch of drill; B forms a saddle, the d
ing through hole at one end and bearin
round groove under cutter. Make saddle
size drill, and attach by screws to stag
saddles would do in gun-metal. The arr
between the fixed screw and the drill is
tension tending to turn the drill in the dir
the cut, and is effected by a spring washer
the discs, as shown, and set up by the sc
suitable tension. The drill is squared t
distance and takes into hole of inner dis
in section). If the above is not clear,
happy to write again.—R. T. J.

[61839.] — **Twist Drills.** — In rep
"Country Parson," if cheapness is c
essential, the method described by me
for making twist drills is the best, as it c
£2 for a cutter-frame, and a set of fou
costs about 30s., and would probably d
drills required. The "third" method
detail is: I bought a lathe-milling attachm
Mr. G. Allsop, whose machine was des
"Ours" less than twelve months ago. I
made 3in. spiral centres, suited to the
wheels of my lathe. (Spiral centres, I
plain, are a pair of small lathe-heads o
bed, with division plate, and adjustable b
I altered the milling-machine so as to f
longitudinally; this I did by a worm and
then connected the longitudinal traverse
milling attachment to the back gear of sp
by an endless cord, kept tight by pulley a

aking them act together. I can cut a
n. long on material up to 5in. diameter,
ch of from one turn per half-inch, to one
8in., which is enough for me at present.
ly cut the full depth of flute at one cut
ngle the cutter within reasonable limits.
advisable, however, to angle the cutting-
ich beyond the parallelity of the groove.
ill cutters are not entirely round in section,
being about three times the radius of the
d the best make of twist drills have in-
ist, e.g., in the $\frac{3}{16}$in. long drill I have now
ie, 8in. long, the first half-turn at point
tch, the second $1\frac{7}{8}$in., the third $1\frac{3}{8}$in., the
n., and the fifth $1\frac{8}{8}$in.; and to do this well
a still further complication of machine.
e glad to give any further particulars to a
Parson." I, however, do not care much
ist-dwills, as they are difficult to sharpen,
oken, and take more power than the usual
ULCANITE.

.]—**Gas-Engine.**—"H. F. F." kindly
urther help from the experience he has
in the model he has made. Would he
ive a little information respecting the
and valve, supply of gas generally re-
r such size (as I am making one from Mr.
on's castings), which will greatly assist
ier amateurs?—SOMERSET LAD.

.]—**Cylinder Flute.**—The "extra" keys
pper octaves of the Boehm flute facilitate
ution of certain passages; but are not
. They can be fitted, to order, on the most
linder flutes, adding considerably to the
hey are worked by an ingenious con-
of levers, played with the fingers of the
id.—D.

]—**Legal: Dentists Act.**—If "Dens"
wise he would have remained silent, and
l himself with a honourable defeat; but,
of that, he has in his reply made a very
sad attempt at defence, which thus places
far worse plight, as it makes him appear
n the eyes of those readers of the ME-
who understand the subject. From be-
o end his reply is simply a mass of words
meaning, and altogether void of sound,
ative, and straightforward principles. I
e his object in replying, as he has neither
ny of his own statements nor has he ques-
ose of his opponents; he has altogether
hy of the real facts of the case. The
ject of his attack now is the "Dentists
he seems to have proved, to his own
on at least, that it is a miserable affair,
ing more than a barefaced attempt to
nonopoly; possibly his having been behind
s (what nonsense!) may have put him in
n of true facts which the Medical Council
bring before his professional confrères or
ic. Can "Dens," or any other professional
gine such a thing to be sense? For that
conceive in his statement "having been
he scenes." "Dens" can make out the
o be what he likes; but he can never
to be the miserable thing he speaks of, or
" that ought not to exist. Such men as
Lubbock, Sir Philip Egerton, Dr. Lush,
rs had a good object in view, and knew
k well when they prepared the Act and
d it into the House of Commons. And I
o say that not only the profession, but the
nerally, have felt the full weight of its in-
nd power, and which clearly aims at an
nding, if not to altogether link it, which
y it will be, with the sister profession
. The mere fact of a Dentist Act having
sed ought to convince "Dens" that
is considered a profession, and one that
just as much protection as that of medi-
leny that the aim of the Act in protecting
c is a huge piece of imposture. Its real
happily through time it will, is to
y eradicate from our ranks those parasites
barbers, and confectioners) who certainly
ight to earn a living from dentistry, but
gaining what must only have been a
g knowledge of the mechanical part, con-
hemselves eligible for the dental register,
got registered as dentists by paying the
of £2, and thus qualified, they were at
butcher as much as they liked (I speak
because I feel that their operating could
g else than the cruellest form of butchery),
possible for them to have any real know-
operative dentistry. "Dens" unselfishly
at all his sympathy towards his poorer
I hope he will pardon me in saying that it
wasted; all the sympathy he can give them
er alter nor improve their position. They
selves responsible if they do not care to
a place in the profession. The royal road
all who care to trample it; it only re-
little application with determination·
rentice, after his time is out, if he is at
his salt, will never think of remaining a
al assistant all his life. By being a fair mechanic, he can easily earn a good salary, at lowest from 85s. per week, from which he could save at least as much as could get him through one-half of his course, when with the knowledge gained he would be able to secure a better situation, and, of course, a higher salary, and thereby enable him to save for his second year a more handsome sum than the first in possibly less time. "Dens" must admit that his definition of "regular dentist" is wrong, if the title, as he says, belongs to an apprentice, who, of course, is unregistered, and therefore not professionally protected by law, and which means a violation of the same in using the title, as it implies that the person is registered under the Act, *which he is not*. "Dens" calls himself a "regular dentist" of 40 years' standing (registered). Would he kindly inform me what distinction there is between himself and his apprentice (also a "regular dentist" according to his own words)? If he is registered, and his apprentice not, I can see a mighty difference, and therefore define his definition as mere words. It is surprising to see a practitioner of 40 years' standing wasting his time with senseless talk, trying to vindicate a false position, when he ought rather to be a staunch supporter of dental education, which is admitted by all true professional men to be of vital importance to the profession of dentistry.—M. D.

[This must end the discussion.—ED.]

[62018.]—**Horse power of Compound Loco.**—The rule for finding this is just the same as for marine compound engines; but, of course, a certain speed must be assumed, and the dimensions of the cylinders must be known, with the order in which they take steam. The rules will be found in some recent back numbers, I am sure.—R. J. C.

[62019.]—**Optical Lantern.**—The lantern and lamp used by Prof. Tyndall in his American lectures on Light were in all probability designed by Mr. John Cottrell, and a note to him at the Royal Institution would no doubt produce the desired information.—NUN. DOR.

[62035.]—**Bellows.**—Strained sheepskin is the material which "Glaswegian" requires for his bellows. The leather must not be joined; but, if that is absolutely necessary, then use best glue. Attach to wood by glue. Leather is the material for hinges and valves. Rubber cloth might, perhaps, be used with advantage for some parts; but, as a rule, the little bellows for pneumatic actions are made of sheepskin.—ORGANON.

[62043.]—**Stains in Mackintosh.**—If mineral naphtha or benzoline will not remove the stains, try bisulphide of carbon.—NUN. DOR.

[62044.]—**Dissolving Amber in Chloroform or Oil.**—It is difficult to satisfy anyone who says positively that "amber will not fuse." Let the querist look in No. 691, p. 358, and he will find a patented method of making amber varnish, and he knows, I presume, that if a patentee gave directions in his specification for fusing amber, that it must be possible to fuse it, or the patent would be worth nothing at all. In the process above mentioned the patentee bleaches the amber first by heating it with sal-gemmæ and water. Sal-gemmæ is rock-salt.—NUN. DOR.

[62056.]—**Organ Bellows.**—Cut out the pattern in calico, and remember that leather will stretch; for which reason makers use unstrained sheepskin for gussets, while strained is best for other parts. Get your pattern to fit nicely, and with a little perseverance you will succeed with the leather gussets. Fitting gussets is, I suppose, the most difficult part of bellows making. I suppose I need scarcely say that the gussets should be put on when the ribs are fully extended—that is, when the openings at the corners are at their widest; hence, the proceeding differs with inverted folds.—ORGANON.

[62072.]—**Gulleting Circular Saws.**—Perhaps it is soap-and-water; but an emery wheel which burrs the teeth instead of cutting them is either not adapted to its work or is being driven at the wrong speed.—C. M.

[62082.]—**Exploding Gas-Burners.**—This is really a case of fractured glass chimney to an Argand burner, the exact cause of its failure being unknown. There are many workshops in London—I worked in one for many years—where the cylindrical chimneys are in use, and often crack in the most unaccountable way, after years of service. It is most probable that they get a scratch, or a crack is started by a blow; for so far from being like Prince Rupert's drops, they undergo, as the querist's did, a slow process of annealing by the continual heating and cooling. No matter how suddenly the gas is turned out, it is impossible to "chill" the glass, as suggested by "Electrician," p. 112. Perhaps the chimney was tilted when last used, and so strains might be set up in it; but no satisfactory explanation can be given.—J. T. M.

[62088.]—**Utilisation of Slag.**—Slag is also now being used extensively for other purposes than those mentioned, as we are importing from Paris large quantities of electric press buttons or pushes, which are manufactured by a French process from slag, and are excellent imitations of various marbles. There appears to be a very large field for the utilisation of this (hitherto) waste material, as it is capable of being moulded, and the finished goods are really very beautiful and cheap. F. T. & A. GARRETT.

[62127.]—**Finishing Repousse Work.**—Thanks to "S. L. P." for reply to above. I intend in future to buff the brass before working on it, as the polishing afterwards does certainly injure any fine matting, such as texture for leaves. This is specially the case if the ground is only to be marked with the single pick, and to show the frosted leaves well up this ground should be highly polished. I have now from experience learned most of the points about the manipulation; but I should be glad to compare notes with "S. L. P." if he cares to write to me.—F. C., Inver-Glebe, Donegal.

[62127.1—**Finishing Repousse Work.**—It is not desirable to give the final polish to the brass plates before they are worked, as if it is done the motion of the hammer is reflected in the bright brass, and distracts the eye from the edge of the tool and interferes with the working; besides this, laying down the work on the pitch, and cleaning the pitch off afterwards, effectually removes the high polish, and necessitates its being "glossed up" again. At the same time, as polishing involves abrasion, which, of course, to say the least of it, does not improve the chasing, it is as well to get a good polish before working, leaving the "colour" to be done afterwards. If "P. C." will advertise his address, I shall be happy to send him a piece of brass showing the different stages of polishing, and indicating where the chasing should come in. I could also give him the name of a professional who, I think, for a reasonable charge, would give him any instruction he wanted, provided he happens to live in London. Lime polishing does not suit amateurs. In the first place, they usually lack the steam-power necessary. Lime is also difficult to procure in the small quantities amateurs require, and being composed of unslaked lime ground to a fine powder, soon loses its "cut" by absorbing moisture from the atmosphere, and is consequently spoiled. On the whole, I think the best method for amateurs is to use first emery cloth No. 0, or, if you like, coarse sand with a buff in the lathe, afterwards fine sand, then chase, &c., and, lastly, finish with a calico clothing and rouge, or the German Putz Pommade. Personally, I think a very high polish, except for flat chasing waiters, &c., is a mistake, as the light catches the highest portions of the work and mars the effect. The brass you had from Gawthorp was doubtless "sanded." I have never met with the reddish tinge you speak of. I should think the acid is in fault—mine always dips of an even dead gold colour.—FAL.

[62182.]—**Electric Clock Factory.**—I do not know if I can make "Manufacturing Electrician" understand what I wish to describe; but I will do my best to help him. First, he will require a brass disc fixed on the centre arbor of his clock, or otherwise so placed so that it will make one complete turn every hour, and in this disc you must cut three openings, one corresponding to the five minutes to the hour, one at the hour, and the other at the half-hour. The width of the openings must correspond to the length of time you require the gong to ring at each time. The next you will want a wheel with twice the number of teeth, and to gear with the wheel that carries the hour-hand of clock, or otherwise so placed that it will make one complete turn in 24 hours. Next you will want a double disc, one of brass and the other of ebonite, both of the same size, and fixed together firmly. The brass disc must be cut down below the ebonite, except at the places which will correspond to the hours that the gong is to ring, and where the brass is left the ebonite must be cut away, so as to make a sure contact. This double disc is to be fixed on the same arbor as the 24-hour wheel, and so as it turns with it. Now you will want a bell-crank piece, fixed on a stud, one end of which must rest on the disc. That turns round once an hour, and is formed so as it will be able to drop into the openings in the brass disc. The other arm of crank must be carried to the disc that turns once in 24 hours, and so adjusted that when one end of the crank is in the openings in the brass disc, the other must drop on the double disc. If this end should now rest on the brass piece, that is not cut away, and one wire from the battery connected to this disc, and the other wire to the stud of the crank, the gong will ring until the disc works the crank out of the opening, and so lifts it clear of the other disc. To make it so as it will not ring on Sunday, you must fix a pin in the 24-hour wheel, and this pin must turn a star wheel with seven points corresponding to the number of days in the week, and this star wheel must have another pin in it, so that when it works round under the crank it will hold it up clear of the double disc, which, of course, must be on a Sunday.—G. CROWSLEY, Dartmoor.

[62183.]—**Wooden Pendulum Rods.**—Our sarcastic friend "W. J. R." has evolved from my answer to this query a meaning it was not intended to convey, and has fathered upon me a course of reasoning purely his own, and all based upon my assertion that an eight-day clock governed by a pendulum having a wooden rod keeps better time than a sidereal clock which cost £100! It may seem to be a miracle to "W. J. R."; but at any rate, it is a fact. Let me now enter into details. The ordinary anchor escapement causes the seconds hand to move backwards when the pallet slips off the tooth of the wheel. If the anchor be taken off and reversed, the pallet may be made to fit the tooth and to slip off without the recoil of the wheel, thus making it dead beat. My wooden pendulum is not compensated for temperature; but when the clock loses a small weight is placed on a stirrup affixed to the rod to accelerate its rate. The effective length of the pendulum can also be altered by an arrangement, similar to that used in regulating watches, placed on the suspending spring. During that part of the year in which the temperature changes but slightly this clock keeps excellent time, varying only a second or two, whereas the astronomical clock will probably vary as many minutes as the former does seconds. In fact, my astronomical clock does not keep good time, gains and loses according to its own sweet will, and utterly refuses to adopt a definite rate for either. With regard to my method of ascertaining the rate of a clock, I employ that method in common use for obtaining correct time—namely, by the transit of a star over the meridian.—SM.

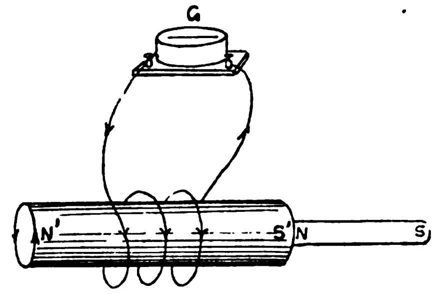
[62183.]—**Wooden Pendulum.**—"W. J. R." replies assuming that the pendulum is merely varnished, as has been the method usually adopted, and his experience agrees with the observation of others—viz., that a pendulum so treated is not reliable; but he does not appear to have tried a pendulum of wood saturated with paraffin wax. Now it is this method upon which I thought a discussion may be useful. With his other remarks as to some makers taking up the manufacture of steel and zinc pendulums at a cheap rate, I cordially agree, and more especially in his observation that when it is done we shall obtain them from America. English clockmakers will not supply clocks made on scientific principles at a price at all approximate to their real value as machines. The result will probably be, as with common household clocks, they will lose the bulk of the trade altogether. "Sm." appears to have tried paraffin wax, using the statement "a well-waxed wooden pendulum," and also appears well satisfied with it; but he does not say whether he "waxed" to the point of saturation. But whether he did so or not, if he fixed the wood to the centre of gravity of the pendulum bob, he must have left the pendulum without any compensation for temperature. Suppose he has saturated the rod; it may be that he has by so doing compensated the wood itself; but this is not my experience. Indeed, I strongly suspect the compensation will have to be increased rather than disregarded. I am not clear upon this last point until I can apply more delicate tests; with the means at command I am preparing a rate of the pendulum now going, which, with your kind permission, I will at a future time submit to your readers. There is some hope in a remark made by Lord Grimthorpe when Sir Edmund Beckett Denison (to whom we all ought to feel much indebted) to the effect that some substance might be found with which to treat wood, so as to prevent its variation.—A. W.

[62185.]—**Steam.**—To "T. C., BRISTOL."—If not trespassing too much on your kindness, would you kindly show me how you get nine expansions in the above query? For, with an initial press. of 33·31lb. in l.p. cylinder, I can only get a terminal press. of 5½lb., that is, allowing six expansions in l.p. cylinder, instead of 11·1lb., which you give.—YOUNG ENGINEMAN.

[62202.]—**Granite Turning.**—My thanks to "Dens" for corundum dealer's address. Through our Editor, I have just received a sample packet from Messrs. R. Baker and Co., of Mincing-lane. This is an excellent specimen of corundum flour, suitable for making wheels, &c., and just the powder for paper, cloth, finishing sticks, and such like in steel-work.—EOS.

[62211.]—**The Occultation of Aldebaran.**—The simplest plan is to place the XIIh. at the centre of the ellipse, and to make the East hour angle positive by deducting from XIIh. Unfortunately, I have not the diagram before me referred to by "J. W. C.," but I have marked out on a larger scale the occultation of Captain Noble's Observatory (Lat. 51° 0′ 56″ N.; long. in time 18sec. E.), as seen from Aldebaran the same evening. The hour angle in this case is 1m. 46s. East. The positive hour angle will accordingly be 11h. 58m. 14s., and this on the diagram must fall on the meridian in line with moon and star at the time of true conj. in R.A. From diagram, Captain Noble's observatory is occulted from Aldebaran at 11h. 56m. 30s., and reappears at 12h. 17m., the duration being 20m. 30s. This is 3m. 19s. in error on observed duration. Practically, on the projection plan, it is not possible to work nearer than 20 or 30sec., and I think "Enquirer" will readily see that when the moon's edge approaches very nearly to a tangent to the star, the slightest error in plotting will materially affect the beginning and ending, and consequently duration. I have been moving from Tow Law, or or would have replied earlier.—H. P. SLADE, F.R.A.S., 16, Westcott-street, Hull.

[62229.]—**Induced Currents.**—"Elem." has simply rediscovered Lenz's law—viz., "that the motion of a magnet towards a circuit sets up a current that tends to resist the motion." But he apparently forgets two things: first, the current set up only lasts as long as the forward motion lasts; secondly, the induced current is not so strong as the Ampèrian current which produces the induction. Guthrie, at Sect. 289 of his "Magnetism and Electricity," describes and illustrates this very case, in the following words:—"Thus, a bar of soft iron, N′ S′, is in a right-handed spiral, connected with a galvanometer. A magnet, N S, brought near to N′ S′ causes similar polarity—that is, the poles induced in the soft iron are towards the same parts as those of the permanent magnet. The currents in the electro-magnet will circulate as represented at the N′ end. The induced currents in the wire will, therefore, follow as in the figure." But since the Ampèrian currents are the stronger, the induced currents cannot reverse the magnetism of the bar N′ S″, though they tend to do so.—S. BOTTONE.

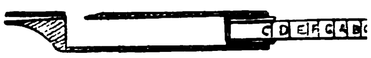


[62239.]—**Antimoniate of Potash.**—What on earth do you mean by "extemporising some antimoniate of potash by the wet process"? If you want to make some you can do so thus:—Project a mixture of equal parts of pulverised tartar emetic and nitre in small portions at a time into a red-hot crucible. After the mass has deflagrated, keep at a moderate red heat for a quarter of an hour, till in calm fusion. Allow to cool, and extract with warm water. Decant fluid from deposit. Concentrate by evaporation. After a day or two a doughy mass will separate. Treat the mass with three times its volume of cold water and mix well. This converts it to a granular powder, to which add the deposit from which the fluid was decanted, wash well with boiling water until the washings cease to be alkaline. Dry. 100 parts tartar emetic yield 36 of antimoniate. Why you should take the trouble to prepare the salt when it can be purchased at about 2½d. an ounce, I cannot imagine. —SM.

[62252.]—**Defective Hydraulic Ram.**—I have to thank "T. C., Bristol," and "W. A. S." for their replies to above query in last week's issue; but have to beg the favour of further advice with a view to getting the ram in good working order. I want to know what would be likely to make it work in exactly the same way as when originally sent out—viz., without a weight on pulse-valve. I have looked over joints of air-chamber and valve seat, and find the leather washers quite sound and air-tight. In practice I have found all the statements in the letter of "W. A. S." quite correct. His presumption as to the make and style of the ram was quite right. It has no air-chamber, and was made by the Gould M.F.G. Co., New York, and supplied by C. Churchill and Co. Might I ask the kind attention of Mr. Davies to this query? As from his many papers in back numbers on hydraulics and kindred subjects his advice on this question would be most valuable to, and thankfully received by, a—SUBSCRIBER.

[62254.]—**Creasote in Consumption.**—Should be mixed with an equal quantity of spirits of wine. It does not excite inflammation of the throat and lungs. On the contrary, is often used to allay it. I have used carbolic acid pure with good effect in bronchitis, but now prefer turpentine when I have caught cold. I have never heard of any of these remedies curing consumption.—B.SC., Plymouth.

[62253.]—**Pitch Pipe.**—Make a squ
exactly like an organ pipe, as shown bel



SECTION OF PITCH PIPE

this be rather more than 12in. long fron
to the open end. Now, make a square p
piston that nearly fits the square apertur
it to fit exactly by gluing a piece of stc
leather tightly round the bottom end. E
this plunger more or less in the tube, yo
any note between C′ and C″, and can
same on the side of the plunger.—S. BOT

[62258.]—**Legal: Nuisance.**—The b
leather scraps under a boiler would be a
under the 114th section of the Public He
provided the quantity burnt is sufficient
effluvia certified to be a nuisance or inj
health.—B.SC., Plymouth.

[62260.]—**Specific Gravity.**—1c.ft. =
litres. As 1 litre of water at 4° C. weigh
1c.ft. of water = 28·31531kilos., which, di
·453593, will give you the weight in pour
dupois.—SM.

[62263.]—**Azaleas.**—To "HORTUS."—
all the dead leaves, seed pods, remains of
&c., and repot them. Give them a good s
and keep them in a temperature varying
to 60° F. Keep them rather close, syri
pretty frequently; the atmosphere must
and moist, so as to encourage them to m
new growth. It is very important to get
wood formed early, so as to secure it be
ripened by the end of the season.—CŒPI

[62266.]—**Steam.**—Each cubic foot of
62½lb., therefore the work done by engine
62½ × 19 × 7¼ft. lb. per minute, and the
sumption = 32 ÷ 24 = 1⅓cwt. per hour, or
¾ hour, in which time it raised 45 times t
number of foot pounds.

$$\frac{75}{4} \times \frac{125}{2} \times 19 \times \frac{29}{4} \times 45 =$$

7,264,160ft. lb., or units of work, rath
figure; it should be 10 times at least.
Bristol.

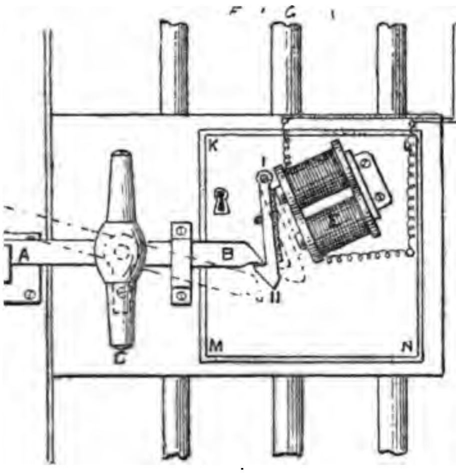
[62267.]—**Photographic Lenses.**—
tested for length of focus and for flaws in
without a camera; but most makers
their lenses on a three days' trial (except
best makers, who test their lenses befor
them out, and won't submit them to a tri
you could get an experienced hand to try
clearness of definition.—B.SC., Plymouth.

[62268.]—**Guano.**—Guano is often ad
with ground clay or brown earth. A r
for this is to place a little of the guano i
spoon between the bars of a clear fire til
hot. On cooling, the ash should be whi
earth or tribasic phosphate of lime) if t
be genuine. If the ash is red, the guano
terated. In the case of "dissolved g
"phospho-guano," the ash should be als
but a portion of it will be sulphate of lim
can be very little sympathy for any far
buys rubbish, seeing that the Peruvian
ment guano agents, and the different
Guano Companies advertise in every ag
paper, and guarantee pure material, an
penny post-card will elicit full informat
the manner of obtaining it.—HAMMER.

[62270.]—**Parochial Law.**—The onl
the subject I know of is Steer's "Pari
edited by Macnamara; published by St
Sons, 1881, price 16s. It can probabl
second-hand.—B.SC., Plymouth.

[62275.]—**Vapour of Linseed Oil.**
had occasion to boil large quantities of li
and to get rid of the offensive fumes ha
hood to top of pot, and to top of hood a
which, in my case, I led down to 6in. gl
underground for a distance of 40ft. to t
of a Lancashire boiler. I fitted a ¼in. st
pipe to form an ejector, and it most
sucked away the fumes and drove them
pits, where they passed through fire,
nearly destroyed. Perhaps above may
—T. C., Bristol.

[62261.]—**Electric Lock.**—As Mr. R
for some device to lock his gate by ele
think that the plan in Fig. 2 will be the
cessful; the mechanism can be underst
and does not differ much from the firs
the latch, E the electro-magnet. As s
electro-magnet begins to act it attrac
O P, which lets fall down the part H S
prevents the latch B A being moved. F
nary door the lock may be unlocked by p
ring Q; but as on a gate the visitor sh



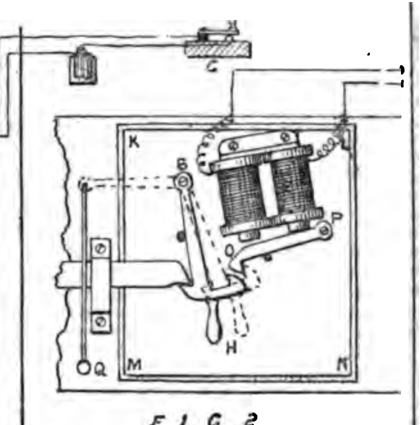


FIG 2

.f welcome, it is necessary to unlock the iron ↄL M N and to push back the handle H. is the plan of an electric lock. A B is the C the handle of the door, and E an electro-:t. By closing the communicator G, the cur-asses in the electro-magnet, it attracts the I I, and the visitor by moving the handle can the door. K L M N is an iron box covering echanism.—CHAS. DEHAESE.

:78.]—**Dynamo: Mather-Platt.**—To S. ONE.—Armature, Pacinotti, cog, laminated, liameter, 6in. deep, with at least 16 sections. four wrought bars, 7in. long, 2in. in dia-, connected by two heavy yokes 1½in. thick, ong, and 6in. wide. Pole pieces to extend so embrace ⅔ of the circumference of the arma- ⅓ one side of the diameter, ⅓ the other. the dynamo as a series machine for arc-ng—say, 6lb. No. 14 on the armature and No. 12 on the fields, being 16lb on each bar, ads of the F.M. wires being joined up in el with each other, but in series with the ure. Speed about 1,800 revs. per minute. will give about 45 to 50 volts, and 13 to 15 res.—S. BOTTONE.

279.]—**Door Springs.**—You describe an gement frequently fitted to doors of lavatories ilway stations, which answers admirably. is case, of course, they have little wind to ad with, and size of round steel used for g is about ¼in. I should think ⅜in. large h for you.—T. C., Bristol.

281.]—**Valve Gearing.**—In order that the ment of the link should not alter the motion o eccentrics, it is necessary to strike the curve centre of crank shaft—that being a mean of centres of the eccentrics in all positions. th of link only affects its own angle and con-nt tendency of block to slip more or less.— , Bristol.

281.] — **Valve-Gear.**—To "ENQUIRER."— length of the radius of curvature of the shift-ink is in the majority of cases equal to the al length of the eccentric-rod. This is a con-ı necessary to secure the equality of leads at ends of the piston's stroke; practice had it this principle long before theory proved it. the length of the link, it must be neither too nor too long; the latter case cannot however occur in locomotive engines, as the length is ad by the room left for the machinery under oiler or platform. Too short a link is too ive, especially with the notched outer and re-ng lever; a series of intermediate cut-offs not then be realised. However, the use of versing-screw palliates this to a great extent. long a link possesses the opposite defect, igh it reduces somewhat the slip of the ; the latter depends greatly upon the degree lination the link can take in the direction of alve-rod. This inclination increases as the of the throw to the length of eccentric The slip disturbs the distribution of the , and if the ratio referred to is too great, a some engines with outside cylinders and e valve-gear, the equality at both ends of roke is often altered to a great extent; ore short eccentric rods are to be avoided. uirer" would do well to consult my reply to 46220 in "E. M." for March 24, 1882; it on the same subject.—E. GOBERT, 7, Ducie-Longsight, Manchester.

282.] — **Small Arc Lamp.** — To. MR. ONE.—Any carbon up to 5 millimètres in ter will serve very well in this class mp. There is no simple mechanism for ng the carbons apart, at the start; but cally the light is struck at once, if the car-points are sufficiently fine, and when once d, the mechanism keeps the points at the right distance. A 40c.p. dynamo would only light one of these little lamps properly.—S. BOTTONE.

[62283.]—**Water Power.**—Disregarding friction, the 10cwt. will sustain 30·8lb. on the 3in. branch B, and 3·45lb. on the 1in. branch A. It is quite immaterial, friction excepted, whether branch B be 3in., 3ft., or 300 yards. The above arrangement is simply that of the ordinary accumulator. —W., Birmingham Hall.

[62283.]—**Water Power.**—The area of big piston is $18^2 \times \cdot 7854 = 254\cdot 5$sq.in., and $\frac{1120}{254\cdot 5}$ $= 4\cdot 4$lb. pressure per sq.in. in cistern. Then area of small piston $= 3^2 \times \cdot 7854 = 7$sq.in. $\times\ 4\cdot 4$lb. $= 30\cdot 8$lb., which is the weight B would lift supposing there was no friction on pistons, &c. The fact of A being open or shut would not modify the weight lifted by B; it would only alter the distance through which it could be moved, as the contents of the cistern would be exhausted sooner when both A and B were open.—ELAG.

[62283.]—**Water Power.**—The area of your piston being $18^2 \times \cdot 7854 = 254\cdot 47$ square inches, and the total weight of it 1,120lb., you have a pressure equal to 4·4lb. on every square inch of the cylinder and piston, and of course the same pressure per square inch on A and B, or on 40 A's and B's at the same time. Length of pipe does not affect the question, providing that P can descend to such a point as to maintain a compression of 4·4lb.; neither does it matter if one or any is cut off by a tap. $B = 3^2 \times \cdot 7854 = 7$ square inches, will carry $7 \times 4\cdot 4 = 30\cdot 8$lb., and $A = \cdot 7854$ square inches will carry 3·45lb.—T. C., Bristol.

[62284.]—**Model Engine.**—Yes, the same rules apply to them as to large engines as regards the H.P. given by the steam, and so you use the same calculations. But this, as in large engines, does not give the nett (or brake) horse-power, so that you must make a very liberal allowance for losses in friction in models. This allowance depends entirely on the workmanship, for some take all the steam to drive themselves where others are quite lively.—T. C., Bristol.

[62285.]—**Telescope.**—If your object-glass be a good one it might bear a power of 50 or so on moon and planets, and would be preferable to a chromatic lens, though the latter is not so execrable when well stopped down. No telescope of the size of yours, unless first-rate, will be of much value astronomically, whilst, if as you say, it is only an "ordinary terrestrial telescope," it cannot be expected to do anything extra. You are correct as to the rule for magnifying. To find single-lens of equal focus to ordinary eyepiece multiply together the foci of the eyepiece-lenses, and double the result and divide by the sum of the foci. —ARTHUR MEE.

[62287.]—**Billiard-Cue Tips.**—Make a cement of acetic acid and isinglass.—JACK OF ALL TRADES.

[62287.]—**Billiard-Cue Tips.**—You will find Kay's coaguline the best cement; but it is not infallible.—PROVIS EMSWORTH.

[62287.]—**Billiard-Cue Tips.**—The following is a recipe for a cement I find very effective:— 3d. of gelatine, and 3d. of acetic acid, mixed together in a small jar, and placed in hot water until all is melted, then use as usual.—E. J. SELBY.

[62287.]—**Billiard-Cue Tips.**—If you will try Le Page's liquid glue, I think you will find your cue tips stand a good many hard knocks without coming off. This glue is the best of its kind I have yet met with, and may be used instead of common glue for all purposes. It may be thinned with vinegar, if necessary.—SM.

[62287.] — **Billiard-Cue Tips.** — Get some isinglass or finely-shredded gelatine, and dissolve it in acetic acid, by immersing the bottle containing it in hot water. Use it hot. If too much trouble to make, purchase a bottle of coaguline. See that the surfaces to be united are clean.— NUN. DOR.

[62287.]—**Billiard-Cue Tips.**—In India I have generally seen shellac used for this purpose. There must not be an atom of grease on either wood or tip. Roughen each slightly with a coarse file, melt the lac, smear over the cue end while flaming with a bit of wire, and apply quickly to tip, press down very firmly on a rather warm bit of iron covered with a piece of paper, and hold it down till cold. I have an idea that bicycle cement would be better, applied in exactly the same way. I find this compound holds everything tight—even metal to metal.—EOS.

[62287.]—**Billiard-Cue Tips**—Will always be liable to loosen or fall off if only glued or cemented on in the usual manner. Let "Steward" ask any walkingstick maker to treat all his cues as follows. Into a 3in. piece of metal tubing (browned or bright), of the same substance as ordinary stick ferrules, and exactly the same diameter as the cue tip, insert a well-fitting piece of sole leather, 1½in. in length, and let it project nearly ¼in. beyond the end. Trim off edges very neatly, and when properly fixed on the end of cue it need not show in the least; but if in silvered or gilt metal it is an improvement rather than otherwise. Of course, the cue must be left the same length as before. If preferred, the leather may be left out altogether, and the hollow tube be fitted with one of those beautifully made corks any chemist will provide him with. Any billiard-player will pronounce cork to be the most perfect material he can possibly use. The sharp edges can be very carefully bevelled off with a very sharp penknife or hot iron. I would strongly recommend all who use crutches to adopt the same method. It deadens the noise, and reduces concussion.—J. H., Balham.

[62291.]—**Legal.**—Two vehicles do not become one by being tied together, so I think the turnpike man was right.—KAPPA.

[62291.]—**Legal.** — An answer to this query would depend on the table of tolls authorised on the turnpike-road referred to; but, in all probability, the gateman is right. One horse and two carts should pay more than a horse and cart; equally, a cart and two horses pays more than a cart and one horse.—B.SC., Plymouth.

[62292.]—**Ornamental Wood Turning and Staining.**—There are many special tools made and used for wood-turning; but the tools that are in general use are the gouge and chisel, which answer all purposes in the hands of those who have learned their trade. Many use them as scrapers, which is wrong; they should be held in a position to cut, and that is to be readily learned by practice. It would take up a tremendous lot of time and space to illustrate fully. For black stain, make a strong decoction of logwood and nut-galls, and apply it hot; two coats, letting the first dry before applying another. Afterwards go over it with some acetate of iron; this is made by putting some old nails, iron filings, borings, or turnings, into some strong vinegar. Brush over with that; one coat will be enough. If turned work, put into the lathe and polish with shavings, afterwards with cloth and linseed oil; if a higher polish is required, use French polish. The woods for your purpose are sycamore, plane-tree, beech, mahogany, birch, elm, lime, and holly; these are all good for staining, more especially holly and lime. These two can be made to take any colour and very delicate tints. Many of the articles called ebonised are done over with fine lamp or gas black and glue-water, which fill up the pores of the wood. Any article to be stained should be dressed with weak glue-water and papered off again before staining; the pores of the various woods can be stopped with any pigment or glue-water. The colour required—elm, umber; mahogany, red ochre; black, ivory or lamp black.—JACK OF ALL TRADES.

[62293.]—**Vice Repairs.**—If the thread is out of bore, get a bit of square iron and fit, and bend around the screw; take off and braze in the bore.— JACK OF ALL TRADES.

[62293.]—**Vice Repairs.**—Take a piece of square wire the proper size, and wind it round the male screw between the threads. Have the box well cleaned out of old thread and of grease, and introduce the screw with the wire round it, and which should just push in tight. Now unwind the screw, leaving the wire coiled inside. Put in a paste of borax and water so as to coat inside, also some clippings of sheet brass. Put the whole on a clear fire or forge, and, when the brass fluxes, remove and roll over two or three times on floor for braze to take well.—T. C., Bristol.

[62294.]—**Folding Screens.**—Make frames like those used for clothes-horse, only having rail at bottom. Hinge together, and cover with calico. Next cover with a coloured paper (wall-paper), and paste on the pictures.—SM.

[62294.]—**Folding Screens.**—Here is the simplest form made by an amateur in my house, and covered with linen and pictures by myself for a bedroom: Three to four frames 6ft. high by 3ft. broad are requisite; work them out of clean 2in. deal, 2in. by 1in.; four hinges to each frame—viz., just above bottom, just below top, and the others equidistant between them; nail three stays of upholsterer's tape across each frame with tacks, stretching them as tight as possible. You have now to decide on the covering material; mine is stout green calico. After laying the united frames on the floor, measure and join the cloth, leaving it an inch over length and breadth of woodwork. The linen is to be very correctly and smoothly fastened with little tacks here and there along the bottom frames and sides, only enough tacks to hold the work; and then as you proceed you can smooth and fix your covering permanently. Lastly, you will pull and sew the top ends neatly together; then you will continue the permanent fastening at the sides and bottoms with tacks at every two inches. The screen is now ready for mounting the pictures. This is about the cheapest form. I have others on a different plan, hand-painted on prepared canvas, the oak-wood frames polished.—EOS.

[62295.]—**Walking-Stick.**—Give it a coat or two of good copal varnish.—JACK OF ALL TRADES.

[62295.]—**Walking-Stick.**—Two coats best carriage varnish, laid on very thinly with a soft brush, will give your stick a fine gloss. If varnish needs thinning, do not use turps, which spoils the varnish by absorption of oxygen; but add a little benzoline.—PROVIS EMSWORTH.

[62296.]—**Hack-Saw Frame.**—I should not care to make this article. I got mine from Melhuish, tool-shop, Fetter-lane, London, solid frame, with one dozen 8in. blades, for six shillings. These saws are harder than files, and as brittle as glass; but they work magically with soft-soap and oil, and great care in pressure and movement of wrist. Melhuish says: "One saw will cut through a bar of ½in. round iron 80 times; a bar of untempered steel 40 times." The staple-shaped pins securing the blade to frame are very ingenious—they cannot drop out, yet the saw can be removed in an instant. See one, is my advice.—EOS.

[62297.]—**Tempering Steel Tubes.**—I do not think you will do any good at that—rather a risky job as well as dangerous. If you do not get blinded over the job, you may stand a chance of some severe scalds. You will not harden and temper them with any certainty at one operation. Use oil or tallow to blaze them off; but I should harden in water at as low a heat as they will harden at.—JACK OF ALL TRADES.

[62299.]—**Battery for Surgeon's Lamp.**—If a "Disgusted M. B." will call on me, I will with pleasure show him what he requires; battery been charged about nine months, non-fuming.—My address in "Advertisement Column."—T. J. ROBINSON.

[62299.]—**Battery for Surgeon's Lamp.**—Leclanchés will run longest without attention. Has "M. B." tried them? If they fail, I have another form which should work well for two to three months, but I should not care to guarantee it longer. I feel sure, however, that special Leclanchés would please him.—ELECTRICIAN.

[62299.]—**Battery for Surgeon's Lamp.**—As price is a secondary matter, "Disgusted M.B." might find what he wants in the battery supplied for the use of our dental lamps. It is a three-cell, bichromate of potash and sulphuric acid battery; and if "M.B." is in London, he could see and judge for himself by calling upon the Messrs. Ash and Sons, 8, Broad-street, Golden-square, W., or the Dental Manufacturing Company in Lexington-street.—DENS.

[62299.]—**Battery for Surgeon's Lamp.**—TO MR. BOTTONE.—A battery such as described and figured at p. 435, Vol. XLIV. of the "E.M.," will suit admirably. It need only occupy a space of 5in. by 5in., and, being fitted with lifting arrangement to the cells, absolutely no consumption goes on while the battery is not in action. It may be charged with solutions of different strengths to suit voltage of lamp employed; but will work up to 8 volts. If a "Disgusted M.B." will write to me, I will lend him one to copy.—S. BOTTONE, Carshalton.

[62302.]—**Cogs for Patterns.**—Sycamore, plane-tree, and good close mahogany for small work; for other purposes pine.—JACK OF ALL TRADES.

[62302.]—**Cogs for Patterns.**—That depends on the size, and whether the patterns are required for temporary or for permanent and standard use. For large patterns, yellow pine is decidedly the best, for small patterns yellow pine will also do; but mahogany will be more durable where large numbers of castings are required. Both woods are superior to any others in ordinary use, because, when seasoned properly, they stand well, retaining shape and size, unaffected by heat and moisture less than most other kinds. It is often the practice to make the body of a pattern of pine and the teeth of mahogany.—J. H.

[62303.]—**Stopping Wax.**—Take two of beeswax and one of rosin; melt and mix for use.—JACK OF ALL TRADES.

[62306.]—**Solution for Coating Oil Tanks.**—If the tanks are galvanised after being riveted they seldom leak. We have two such here that have been in use several years, and have never given trouble.—FLAVIUS.

[62306.]—**Solution for Coating Oil Tanks.**—It is a plain iron tank, I expect; if mine I should clean well, free from grease; give it a brush over with a strong solution of nut-gall, and with a coating of glue and treacle afterwards.—JACK OF ALL TRADES.

[62307.]—**Promissory Note.**—No renewal is needed; payment of interest or an acknowledgement in writing prevents the Statute of Limitations from applying. The holder has six years from the last payment or acknowledgment.—KAPPA.

[62307.]—**Promissory Note.**—The Statute of Limitations does not apply to a promissory note more than six years old, on which note the interest has been paid within six years (see Archbold's Law of Nisi Prius, 137). "N. N.," however, should insist on getting a new promissory note, the former amount payable being increased by the interest overdue; he will thus get compound interest, and may be saved future trouble.—B.SC., Plymouth.

[62308.]—**Chloride of Silver Cell.**—Use ebonite tube, and seal with "Chatterton."—ELECTRICIAN.

[62309.]—**Violin Repairing.**—If the crack is not a very bad one, try a method which has been successful with me: Remove the strings and the soundpost, warm the part gently before a fire, dab it well with good hot and thin glue, work it well into the crack or cracks by using the thumbs, now quickly bind it round with cord, using a needle or two driven into the edges if necessary to keep the cord from slipping off, and leave until next day. If the damage is very serious, it becomes necessary to remove the belly or the back, and to thoroughly glue up each crack, with the addition of a piece of narrow tape soaked in thin glue laid over same. (Memo.: If a valuable one, this latter job ought to be intrusted to a professional man.) I remove superfluous resin by alternate rubs of a piece of flannel moistened with turpentine and a duster.—A., Liverpool.

[62310-1.]—**Electrolysis.**—Get Mr. Sprague's book, where you will find full details of plating, &c.—PROVIS EMSWORTH.

[62315.]—**Cylinder.**—The stroke being 3½in. and piston ¾in. thick, the total length of cylinder should be 4⅜in. at least. You do not say if it is so. The ports are a little closer than I should have put them; but the sizes you give will do if you allow piston to pass ¼in. over each port at each end, this allows spring ring to pass over ⅛in.; $\frac{1}{32}$in. would have been enough. You will have to cut away a little at each end of port to allow steam to get behind piston easily. This practically removes the port to next the cover.—T. C., Bristol.

[62316.]—**Storage Cell.**—Why waste money making storage cells? Try non-fuming solution, such as I use. If you must use storage cells buy a set ready made. In charging use lamps in series with cells, then regulate the current. Your lamps would probably take ½ amp. each if 105 volt 16c.p.—ELECTRICIAN.

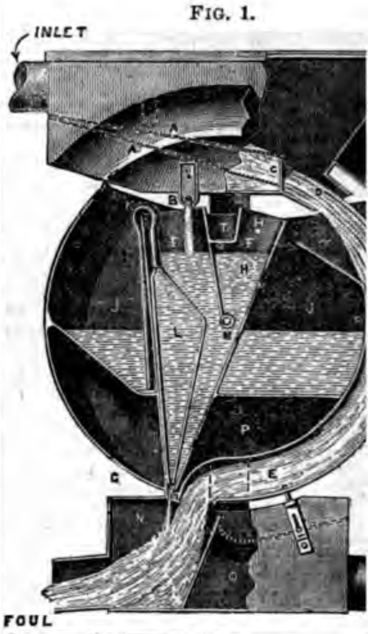
[62317.]—**Rain-Water.**—There are several plans for securing clean rain-water, but perhaps the simplest is that of Mr. Shirley Hibberd, described in No. 769. Briefly he arranges tanks in this order:—

$$D \quad C \quad \begin{matrix} A \\ B \end{matrix}$$

The water from the roof enters A first and passes through some screen or coarse filtering material fixed near its upper half; then it flows into B through a pipe fitted with a ball tap. As soon as a certain quantity has entered B the tap is shut, and the water is siphoned from A into C, and thence to D, which are settling tanks. It will be found that they contain rain-water which is practically pure and fit for any purpose when drawn from D. In the *Building News* of last week (April 29) there is an arrangement which may suit the querist, and will no doubt interest others. It is called "Roberts's Improved Rain-Water Separator." In order to insure a thorough washing of the roof, it is desirable in a smoky town that no water should be stored before two gallons of rain have fallen on each 100sq.ft. of the roof; in other localities one gallon or one and a half gallons of rain on each 100ft. will be enough to wash it. By the insertion of a slide marked 1, 1½, or 2, the requisite amount of washing for each locality was secured, and the separator canted as soon as that

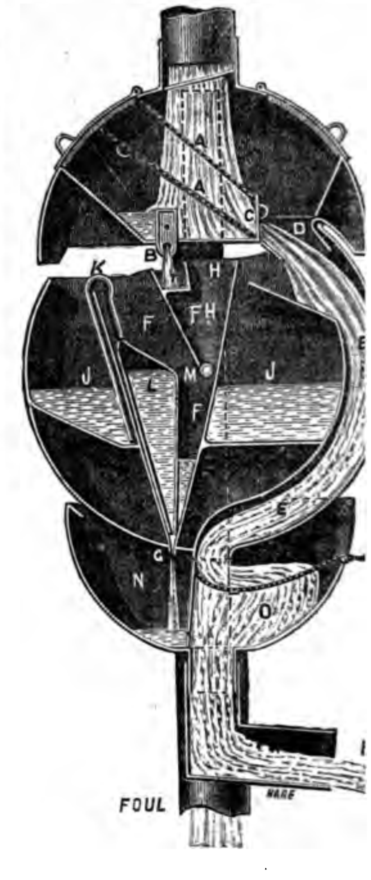
amount of rain had fallen, whether it ca
minutes of storm, or in 60 minutes of st
There was comparatively little difficult i
the automatic action with heavy rain,
more difficult to insure an unfailing actic
rains that took an hour to yield the
quantity; and until recently all the
came in still lighter rains was of necessi
to run to waste. By the recent imp
perfect regularity of action is obtained
lighter rains, and in a town house the
with the slide marked 2 will be certa

FIG. 1.



water to storage as soon as two gallons ha
upon each 100ft. of roof, even if it has
two hours' time in descending. This imp
is effected by the introduction of the

FIG. 2.



shaped chamber H, shown in the two se
ing illustrations. Fig. 1 gives a sectio
horizontal and Fig. 2 a section of the
separator. While the inlet and outlet bo
it will be seen that the centre part, o

ns upon the pivot M, is the same in
on in each drawing, but different in posi-
. 1 shows it before it has canted and
still running foul water to waste. Fig. 2
after it has canted and is running the
er to storage. In the earlier form of
the water that came through the slide B
into a large chamber with a hole at the
it rather smaller than the hole at B, and
this chamber filled to a certain height
canted. In the new form of separator
from B falls into the funnel F, and only
roportion passes thence by the holes H
hamber J. There is no aperture in the
f this chamber, but when the rain has
is emptied by the action of the siphon L.
noticed that the longer leg of the siphon
enlarged; by this very simple and, as far
w, original contrivance, the air in the top
hon is prevented from interfering with
being made to take the shape of a short
, instead of a long and narrow, bubble. If
not meet the querist's desires, I would
d him to read Shirley Hibberd's
which was published by Effingham
The title is "Water for Nothing."—A
ER.

]—**Rain Water.**—Allow first few gal-
irty water to run into a small cistern,
h a pipe provided with a stopcock leads
in, and furnished with a float which will
ally close an electric circuit when a cer-
ntity of water has flown in. Arrange a
flexible tubing to turn on a pivot, and an
agnet to pull the tube from over the
tern to the large one. Three cells Le-
ught to work it if nicely made, and you
ge it so that the movement of tube just
ntact and prevents battery wasting. You
lace tube over small cistern (which would
d of its dirty water at leisure) by means
er electro-motor worked by a press-
any convenient part of the house. If
t understand, will send sketch.—PROVIS
TH.

]—**Astrometroscope.** — If "Amor
" will turn to pages 128 and 168 of
Popular Educator, Vol. VI., he will find
ument described and figured. Should he
le to refer to this work, and will repeat
, I shall be happy to reproduce the de-
and cuts in "Ours."—S. BOTTONE.

]—**Driving Washing Machines.**—If
only a family's wash to get done, and
means to get a one-man gas-engine, the
steam-engine is ridiculous on account of
se. Get a steam-washer, cost about £3,
little space. I saw one of Fletcher's, of
on, yesterday, so easily handled that a
d work it.—B.Sc., Plymouth.

NSWERED QUERIES.

*bers and titles of queries which remain unan-
five weeks are inserted in this list, and if still
are repeated four weeks afterwards. We trust
will look over the list, and send what information
the benefit of their fellow contributors.*

draulic Bending, p. 574.
stern Transparencies, 574.
npressed Oxygen, 574.
ter Question, 574.
ro. Mounting, 574.
n store, 574.
.R. Locos., 575.
gan Question, 57 .
lometer, 575.

que, p. 90.
R. Engines, 90.
V.R. Engines, 91.
V.R. Broad-Gauge Goods Engines, 91.
namo, 91.
ttice Cloth, 91.
idified Oil, 91.
namics, 91.
d Ores, 91.
ust Bean, 91.
per, 91.
rking in Sheet Lead, 91.
isting Crab, 92.

ive **Eyesight.**—We strongly recommend
ffer from defective eyesight to procure a
enny pamphlet we have just perused,
y Mr. T. Henri, of 34, Aldersgate-street,
l oculist optician of many years' experi-
many people make bad worse by buying
s—or glasses unsuited to their particular
t a word of caution may not be thrown
he pure "Periscopic Pebbles," recom-
y Mr. Henri, are spoken well of by all we
o have tried them, and by Mr. Henri's
em patients residing at a distance can
r eyes tried and the glasses suited for
ted, as satisfactorily as after a personal
on.

QUERIES.

[62320.]—**Rupture Truss.** — Will "Eos" (letter 27063, page 128) kindly give a drawing of this truss in position, as I have failed to discover how the support is afforded?—JASON.

[62321.]—**Watch Pivoting, &c.**—Would some correspondent inform me the shape of centres used by the trade for watch pivoting, &c., with the graver? Also if I should have the edge of the graver at a different angle for brass and steel, or is there any book on the above subject from which I can gather this information? I have consulted Britten's, Reed's, Glasgow's, and Beckett's books, and have not been successful.—A WORKMAN.

[62322.]—**Utilising Waste Suds.**—Will any kind reader give me the description and sketch of an apparatus to abstract the oil from soap suds and lant which is used in the manufacture of flannel? We now use about three tons per month of olive oil, which runs to waste in the sewer. It would be a great saving if I could abstract the oil from the above.—G. C.

[62323.]—**Engine Governors.** — Would some of yours inform me how to put governors of 4H.P. engine, and what sort would be the best for wood turning? It is a vertical engine, with a 1in. steam pin.—WOOD BUTCHER.

[62324.]—**Gas-Engine.**— Can "R.A.," or any other reader, explain how the "Dougall" engine works?—A. R.

[62325.]—**Joint.**—In making a joint in a flanged pipe conveying hot gases, should asbestos packing be used, and should it be soaked in water or oil? Is there any better method?—A. R.

[62326.]—**Diagram of Brake Stops.**—To C. E. STRETTON.—Mr. Stretton (April 15, page 158, reply 62097) promised to supply a diagram to show the forces applied to stop a train. Perhaps there are others than myself would like to possess it. Will Mr. Stretton oblige by giving us an illustration?—ROVER.

[62327.]—**Size of Boiler for Engine, &c.**—I have nearly completed a horizontal engine, 2in bore by 3½in. stroke. Would someone well up in such work be kind enough to advise me what size boiler I shall require, and what pressure and number of strokes per min. to drive a 6in. lathe for light wood and metal turning? Please advise as to cut off, and, if not asking too much, the lap and lead and throw of eccentric to obtain it. The inlet ports are ¾in., and the exhaust ⅜in.—C. H. T.

[62328.]—**Burnishing Plated Goods** —I can electro gold and silver plate very well; but I have tried and tried to burnish articles so plated until I am sick. Neither can I polish them on the lathe to bring that beautiful black polish so desirable, though I use buffs, dolleys, rouge, crocus, &c., and soapy water with burnisher, no matter how smooth the article is before I plate it. Can any practical or other man give me full simple directions so that I can turn it out as nicely done as new? Also specially as regards a watch case I should be glad. I cannot find such in any textbooks published, and I have not a few. Owing to limited means and to a great measure dependent on above, very thankful for good information will be—A PERPETUAL SUBSCRIBER.

[62329.]—**Perpetual Motion.** —According to the biography of George Stephenson, by the Rev. G. R. Gleig, M.A., is written as follows: "His ambition being to study the principles of mechanics, he, like many other enthusiasts in that science, laboured night and day to discover what is called perpetual motion." Now, will any kind reader of the "E. M." give me an idea what sort of a machine he tried to make? Would it be one containing its own power, capable of moving without the use of air, wind, water, steam, gas, firing, electricity, or animal power, and only requiring attention, such as cleaning, oiling, and repairing?—JOHN W. HILLIER.

[62330.]—**Boiler.**—To "T. C., BRISTOL"—Will you kindly help me in the following? I thought of having a horizontal boiler made, 3ft. long, 18in. dia., shell 5-16in. thick, ends ⅜in., one end to have a flange joint, to be bolted or screwed on. Which would be the better, to have the flange inside or outside of boiler? Please say what thickness the bolts should be, and how far apart. Also width of flange. Also, what stays are required to stay the ends? Would it be large enough to drive an engine 3in. bore, 6in. stroke, at about 150 revs. per min.? Supposing that half the dia. and one end was utilised as heating surface, what pressure would it stand?—R. S. A.

[62331.]—**Dynamo.**—To MR. BOTTONE.—I have just finished a 20c.p. dynamo, made according to instructions given in your book. I have followed out your instructions to the letter; but the machine will only light one 5c.p. lamp, and this you say in back numbers of "E. M." it ought not to do, unless a shunt is inserted. There is no sparking at the brushes. The iron of the fields is not very soft, and is consequently magnetic when the machine is at rest. Is this the cause?—F. S. Sc.

[62332.]—**Bisschop Gas-Engines.** —Can any of "ours" help me in this case? My Bisschop gas-engine runs perfectly well at night when the full pressure of gas is on but is irregular and weak at day. The gas company decline to put on full pressure. Is there any method known by which the pressure can be increased by the engine itself? I have tried compressing the rubber bag at each stroke, with but partial success. I do not want simple theory, but something in actual use elsewhere.—HOPEFUL.

[62333.]—**Legal.**—A proper method to test the legality of trustees selling an estate left by deed of gift, who have sold the estate and appropriated the same to their own use. What would be the legal method of action to recover same?—C. S. W.

[62334.]—**Hose Pipe.**—Seeing no answer to my query as regards above, I have been recommended to paint it with red paint. Will any of our readers let me know if it would keep it in good condition? It will be exposed all summer to the heat of the sun, but I will keep it always full of water. I tried burying it in the soil, but it made it quite soft.—JOINER.

[62335.]—**Dynamo.**—To MR. BOTTONE.—Will you please give me dimensions of F.M.'s and armature of a dynamo capable of lighting brilliantly eight lamps of 10c.p., armature of Siemens H form? Also weight and size of wire for F.M.'s and armature, machine to be shunt wound? Would a ¼-horse engine be powerful enough to work the above, and do you think the boiler could be heated by an arrangement of Bunsen burners instead of coal? What would be the probable cost of making the above machine, inclusive of all items?—FRANKLYN.

[62336.]—**Microphone Coil and Telephone.**—Please state how is the coil made and how connected when a microphone is used as a transmitter for a Bell telephone? Could the coil be dispensed with by using greater battery power, or would the wire of telephone bobbin be damaged by sparking?—R. E. M.

[62337.] — **Air Pump Valves.** — What is the membrane used over the holes? It looks like green oiled silk. The packing is leather.—R. E. M.

[62338.]—**Removing Surface of Indiarubber.** Please state how the white powder can be removed so as to get tire cement to stick to grey rubber?—R. E. M.

[62339.]—**G.E.R. Locos.**—Can any reader give me any particulars regarding No. 129? It appears to me to be designed for the use of surveyors, being a small 4-wheeled engine, with all its wheels coupled, and covered with a kind of carriage body, like a tramway locomotive. It is dated Stratford, 1885. I should also be glad to know if there are any other engines on this line of a similar type.—J. T. L.

[62340.]—**Double Stars.**—To "F.R.A.S."—I see near to Regulus (I think about 5" south of him) a tiny companion. Would "F.R.A.S." please tell me its magnitude and distance from Regulus? It is not mentioned in "Webb." I also remember seeing a very faint and close pair near Sigma Orionis, a little to the left, but in the same field as Sigma, the distance and magnitudes of which I should be glad to learn. Would "F.R.A.S." also please say if it is wise to leave a telescope out in the yard in all weathers? Can it injure the o.g.? I am rather afraid that the damp is doing harm to my glass.—ARCTURUS.

[62341.]—**Bottone's Medical Coil.**—Have made a coil after particulars given in "E. M.," 17th Sept. last, with primary coil complete. No secondary yet. I cannot get it to work. I have used as battery a marmalade jar, 5⅛in. by 2⅜in., with zinc cylinder amalgamated with mercury in some parts. It did not adhere. The charge: 3 parts bichromate, 1 part sulphuric acid, 6·6 parts water, one carbon, 7½in. by 1½in. by ⅜in., with brass clamp, and all connections soldered. Any information will assist—ONE IN A FIX

[62342.]—**Weighing Machines.**—Could any reader inform me respecting the principle on which these self-registering machines are constructed, and oblige with sketch?—AMBER.

[62343.]—**Hydraulic Leathers.**—Will any of our readers kindly tell me how to press U and other leathers for hydraulic machinery, and the best leather for such? Sketch of dies would oblige—G. L. C.

[62344.]—**Hand Bells.**—I have a set of hand bells, and find that the leather hammers (which are covered with a soft leather) after a little use become hard, and give to the bells a harsh tone Is there any other kind? I am told there is. Also, is there any way to repair a cracked bell? I have tried soldering, but it won't stand, and running a saw cut through the crack alters the tone. —A. S, Cheltenham.

[62345.] — **Blacking Cast-iron Frames.** — Required to know the best method of blacking cast-iron frames, measuring about 4ft. by 3ft., to appear like being japanned. Can they be done cold?—JAPAN.

[62346.]—**Dead Dipping.**—Would any brass finisher give me a hint as to dead dipping? Also a good green bronze (a stain)?—INQUIRER.

[62347.]—**Barbotine Work.**—In reference to the answer to C. North's question of the 18th March about the clay used in barbotine work, the present inquirer would be glad to know what the proportions are of the different ingredients used.—M. O.

[62348.]—**Civil Burial.**—Is there any ceremony in this country corresponding to civil burial in France? Probably it is open to anyone to direct that he should be buried in a field of his own, but in that case how would his exors. obtain the burial certificates which are required by public companies before securities standing in the name of a deceased person can be transferred? There are, doubtless, many who would prefer that their remains should not be carried into a church which they felt obliged to attend while alive.—HAMLET.

[62349.]—**Rhubarb.**— Recent replies [illegible] to rhubarb did not notice a point on which I once heard a caution given—viz., that persons of the male persuasion should avoid that vegetable in districts where there is much lime in the water, because oxalate of lime is thus formed, and that is the basis of renal calculus. Is there truth in this?—HAMLET.

[62350.]—**Dead Black on Brass.**—Can anyone kindly tell me the method used for blacking the Waterhouse diaphragms used in photographic lenses? I have tried boiling in platinum chloride, but the deposit soon rubs light.—SM.

[62351.]—**Boat Varnish.**—I have a Thames-built double-scull skiff, which has not been varnished in four years. She has not had any hard usage, but I am told that such boats should be varnished every season. Will some fellow reader tell me the best kind of varnish to use, and how to apply it? I know about washing thoroughly with hot water and soap; but would like to know if it is necessary to rub down with sand paper, or to do anything towards removing the old varnish. I would not trouble "Ours" with this query, but that I live in Scotland and cannot get a practical boat-builder easily.—TAVUS.

[62352.]—**Antiseptic Dressing.** — Will "Doctor Medicinæ," or some other authority, kindly inform me what is the best antiseptic dressing for application to cuts and minor accidents. I am employed at an extensive works where accidents often take place, and am a certificated pupil, St. John Ambulance.—AMBULANCE.

[62353.]—**Loaded Dice.**—Can anyone tell me how to load dice for conjuring purposes? Have tried them all ways, but cannot succeed.—A. B.

[62354.]—**Bobbin Making.**—Querist will be thankful for information on the subject of this manufacture—the machinery required, descriptions of woods mostly worked, and the names of any books bearing on the subject.—CELTICUS.

[62355.] — **Phosphorus Manufacture.** — Will some of "ours" give information respecting recent improvements in this manufacture—formerly made from bones. It is now, I believe, obtained from phosphate rocks, such as are used for superphosphate manufacture. References to recent books or patent specifications will much oblige—TANDSTICKER.

[62356.]—**Intensity Coil.**—The reel is 4½in. inside, with two layers of No. 16 cotton-covered for primary, measuring 1⅝in. in diam., with a condenser of 60 sheets, 4in. by 3in. each. The secondary is wound on in five sections, each containing about 1oz. of No. 36 silk-covered. I have now 3oz. left, and only room for two more coils. Would "Electrician," or other friend, tell me how to proceed, as I now get about ¼ spark.—SLOPER.

[62357.] — **Levelling Machinery by Spirit Level.**—Recently I was annoyed at the time taken to level some heavy machinery. The method taken was: apply level, and put a piece of packing below low foot, said packing being selected apparently at random. The difficult operation of lifting low foot to alter thickness of packing had to be performed several times before it was proper height. Is there no means of ascertaining the proper thickness of packing required, so that one lifting will probably do? A few hints on levels and levelling would greatly oblige—NON-PRACTICAL.

[62358.]—**Length of Emery Cloth Sheets.**—What is the greatest length to which these are cut without being specially ordered? I don't see them over 12in. Are there longer ones in common use? I suppose they can be had any length to order.—NON-PRACTICAL.

[62359.]—**Illuminated Fountains.** — I want a little advice as to the best way of illuminating a fountain. I propose to do it with a magic-lantern and lime-light; but it strikes me there would be a considerable loss of light through the great divergence of the rays, and that instead of the rays passing through a condenser and front lens, it would be better to reflect them with a parabolic mirror, so as to get them nearly parallel. I should want to use coloured glasses occasionally, and supposing the lantern to be used in the ordinary way, would you insert the coloured glasses where the ordinary slides go, or place them in front of the front lens? Would it be a good plan to let the rays pass through a narrow slit, and so cut off the side rays of the disc which would pass by the fountain?—GERION.

[62360.]—**Beam Engine.** — I am in charge of a McNaughted beam engine, which is giving some trouble at starting. Both the high and low-pressure cylinders have relief valves, for the purpose of clearing the cylinders of water; but there does not seem to be any water present, yet when the piston of the low-pressure cylinder gets near the bottom, the engine makes a thud for about five or six strokes, so much as to make the engine tremble all through. Now, will some of our readers that have had some practical experience in such matters say what is the probable cause of the same?—W. C.

[62361.]—**Statues in St. Paul's.**—What do the letters L M N R and Q N X I over statues in the Dome of St. Paul's stand for?—G. F. O.

[62362.]—**Soda Ash and Bleaching Powder Analysis.**—Will some of "ours" kindly inform me how soda ash and bleaching powder (chloride lime) are tested for the percentage strength? I am employed where they are used daily, and have a knowledge of elementary chemistry.—PERSEVERANCE.

[62363.]—**Legal.**—I have the under-lease of a house for 21 years. I have paid to my landlord by mistake the rent in full for the last 12 years without deducting the landlord's tax under shedule A. This amounts to about £20. Can I recover the whole amount, or can I only deduct this tax for one year? The tax-paper says: Any person refusing to allow the deduction is liable to a penalty of £50.—F. KORNER.

[62364.]—**Billiard Cushions.**—My billiard cushions have become hard and inelastic, can any reader tell me of a plan by which they can be restored?—NORD.

[62365.]—**Mirror Galvanometer.**—I am making a mirror galvanometer with hinged coil bosses, and should be glad of some practical advice. How are coils turned so that the winding can be carried out on Sir W. Thomson's plan—gauge of wire to get 6,000 ohms on. How is the mirror constructed, and what metal is the damper made of? Also its suspension? Is the circular level the best? If so, how is that best made and fitted in base to depend on its truth for level. Any hints about the general construction of the above instrument would be received with thankfulness. I have the frame, bosses, and base-angle pieces made, but stopped with regard to coils and mirror.—G. H.

[62366.] — "**Theory of Machines**" — **Spiral Wheels**—I have tried in vain to solve the following by the rules given in recent numbers. Will some reader kindly help me? A pair of spiral wheels, 4ft. dia., geared at right angles, deliver a power of 1,500lb. at circumference. What is the additional power required to overcome the friction?—COTTON.

[62367.]—**Small Dynamo.**—Will Mr. Bottone kindly enlighten me on the following? I have fitted up a small dynamo, 6-candle, Siemens pattern. Space for winding field magnets, 2½ high, ¼ thick; pole-pieces, 1⅞ long, 1½ wide; armature, laminated, 1⅞ long, 1½ wide; armature wound with 2oz. of 20 silk-covered, ½lb. of 18 d.c.c. on each field magnet. Will you tell me if I have the right gauge and quantity of wire on armature to balance fields or not, or where I am wrong? It is connected-up right, and thoroughly well insulated. It works well as a motor, but can't get a spark out of it when run as a dynamo. I have got the right polarity. I have put a current from a 30-candle machine through it, but with no success.—SMALL SIEMENS DYNAMO.

[62368.]—**Bellows Query.** — Is a circular 24in. bellows with double action (that is, where both the up and down stroke of handle are effective in forcing air) as powerful for raising a welding heat in a forge fire as a 36in. ordinary pear-shaped bellows?—AMATEUR BLACKSMITH.

[62369.]—**Silk Underclothing.**—Will some reader kindly inform me whether silk underclothing is as healthy to wear as merino?—TRITON.

[62370.]—**Beam Centre.** — Will someone be kind enough to inform me of a good way of taking the brasses from under the beam centre? Also, which is the best direction to cut channels in the brasses, so as to allow the oil to get down between the beam centre and brasses?—W. C.

[62371.]—**Geological Formation.** — Can any of "ours" inform me to what formation the cliffs on the Suffolk coast belong? The particular part of the coast I refer to is about three miles south of Lowestoft. The cliff at this point is about 80ft. high for a few hundred yards, consisting of various sands, grey clays, and black clay. At the base of the cliff is a layer of fossil trees, some of which are in a good state of preservation. The fossils found here are: bones and teeth of mammalia, ammonites, belemnites, &c. This must belong to the Tertiary strata; but yet there are the ammonites and belemnites to be accounted for.—OLD FOSSIL.

[62372.]—**Dioptric Telescope.**—I have a dioptric telescope that has two draws, or is in three lengths, which when drawn out to sight focus, is 37in. long from o.g. to eye-glass. The o.g. looks to be two lenses put close together, and is 1⅝in. dia., and in the eyepiece draw, or the first length, there is in the inside end a 4in. chamber, with two lenses. The lens next to the o.g. is 23in. from it, and is 1¼in. diam., and 4in. from this in this chamber is another lens, ⅝in. diam.; then 6½in. from this is the eyepiece chamber of 4in. long, and the inside lens of this is 1⅜in. diam.; and 4in. from this is the sight disc, of ⅝in. diam., which is near the eye-glass. Will some of your intelligent readers kindly say if this can be made also an astronomical telescope, and, if so, how, and at what cost, and also say if it would make as good an astronomical telescope as one with an o.g. of 48in. focus, with a 1in. focus eyeglass, with the prices of each of these lenses?—DIOPTRIC.

[62373.]—**Photo.**—TO MR. BOTTONE OR OTHERS.—Will any photographer assist me in the following? What is the difference in effect, not in speed, between the front lens (screwed into the back of mount) of a Ross ½-plate and a Rapid Rectilinear? Will the landscape be affected in depth of focus or otherwise? 2nd. In developing with ammonia-pyro., is the negative any worse by using a small quantity of ammonia at once and prolonging the developing? Does it veil over by prolonged immersion in the solution so long as the ammonia is held back?—HULL.

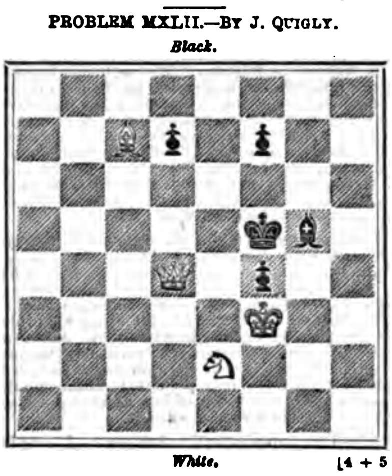
[62374.]—**Spark Coil.** — TO MR. BOTTONE.—Will you kindly give me the dimensions and quantity of wire to make a 1in. spark coil with two regulators, as described? Also in which direction it has to be wound, and if secondary could be divided into two sections?—F. BETTS.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXLII.—BY J. QUIGLY.

Black.



White. [4 + 5

White to play and mate in two moves.

SOLUTION TO 1,040

White.	*Black.*
1. Kt-K Kt 7.	1. K moves.
2. Q-K 6 or B 7.	2. K moves.
3. Q or Kt mates.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,040 by A Beginner, E. C. M., Ipswich, Major, V. S. Pochin, A. Dean, F. Krassor (a capital problem, with several very near tries), Link; to 1,039 by J. Palmer, J. J. Spence, Avon, J. W. Hamill, and Hen.ing.

A. DEAN.—You were credited with the extra solution, as you will see if you refer to the notices.

THE last three-mover in Tourney A has been published, and the next two-mover will be the last in Tourney B.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Ointment and Pills.—A few doses of the Pills taken in time are an effectual preventive against Gout and Rheumatism. Any one who has an attack of either should use Holloway's Ointment also, the powerful action of which, combined with the operation of the Pills, must infallibly effect a cure.

ANSWERS TO CORRESPONDE

*** *All communications should be addressed to the*
of the ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put d
for illustrations on separate pieces of paper. 2. E
to queries, and when answering queries put the
as well as the titles of the queries to which th
refer. 3. No charge is made for inserting letters,
or replies. 4. Letters or queries asking for add
manufacturers or correspondents, or where tools
articles can be purchased, or replies giving such
tion, cannot be inserted except as advertisement
question asking for educational or scientific inf
is answered through the post. 6. Letters sent
spondents, under cover to the Editor, are not fo
and the names of correspondents are not give
quirers.

*** Attention is especially drawn to hint No.
space devoted to letters, queries, and replies is n
the general good, and it is not fair to occupy it w
tions such as are indicated above, which are onl
vidual interest, and which, if not advertisements
selves, lead to replies which are. The "Sixpe
Column" offers a cheap means of obtaining such
tion, and we trust our readers will avail themselve

BACK NUMBERS.

WE receive so many queries asking for direction
make many instruments and appliances which h
fully described in back volumes, that we have co
list, which we shall insert in this column at inte
those most frequently sent, and as the numbers
in stock, new subscribers should consult the lis
sending their questions.

Bookbinding : No. 613.
Electric machines : Nos. 1,009, 1,025.
Electro-magnets : Nos. 772.
Lacquers : No. 866.
Pattern Making : Nos. 938, 941, 943, 945, 948, 950,
955, 956, 958, 959, 962, 963, 969, 974, 978, 986,
995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,01
Silver-plating : Nos. 1,009, 1,010.
Varnishes : Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to
to Wednesday evening, May 4, and unackno
elsewhere :—

G. WESTON.—Jensen and Son.—F. R. B., Exeter.—
T. Witham.—Blacking.—Rex.—Forest Gate.—Ni
F. S. Bowles.—Opifex.—O. O.—W. A. Barber.
Edmunds.—Silke.—W. E. Rogers.—Edwd. A. R.
—A. Marson.—S. Beeching.—Logs.—Eos.—Geo.
—Rev. John Bone.—H. Austin.—Vladimir.—S.
tone.

J. H. D. (The water drawn from a well whic
sewer within one yard of it, an earth-closet
pigstyes close by, should on no account be
culinary or drinking purposes, unless it is bo
filtered. As good a filter as can be made is that
as Prof. Guthrie's penny water-cleaner, which
of a large flower-pot packed nearly full of frag
well-burned brick; it was described in No.
J. P. R. (The sun's rays do not extinguish a fi
latter is attended to in the ordinary way. See
477, last volume, and settle the matter by an
ment.)—C. BAYLEY. (We believe the chain b
been removed; but it was worked by a fricti
on one of the axles winding up the chain. See
and recent numbers—1146, for instance.)—
GILBY. (See advertisement columns. We h
space for such a purpose. They generally adv
the daily papers.)—F. J. TANNER. (We really
know which is the best book, and we do not an
post. See Hints No. 5 above. Probably you
the information by searching the indices.)—
(Depends on the arrangement; but thre
Leclanchés should do. 2. Brighten the wire, t
together, cover with rosin, and run over with s
Run the melted solder in grooves in wood or
proper moulding sand.)—W. R. (Directions fo
a bellows camera have been given several tim
No. 894 or 953.)—A YOUNG NOVICE. (Illust
the valve for air-gun in No. 1094; also in the
for August 12, Sept. 9, 1870.)—ICEBOUND. (It
of a doubled case of zinc or galvanised iron. T
packed between the two, and drainage holes
vided. You can make one by lining a stout
box with sheet zinc and making an ice chamb
all round or on one side by soldering up sheet
UNIVERSE. (We do not know; but no doubt
near a bookseller who can not only answer the
but procure the work for you.)—FLAVIUS.
have been given many times. The Berlin is m
ivory black, and is "dead"; the other with as
but often with pitch. For Brunswick black,
of asphaltum in an iron pot, add a pint of b
oil, mix well, and when cooled add two quart
pentine.)—G. H. (See the indices of back vol
procure the little book noticed last week, p. 1
ginner's Guide to Soldering." It is an art that
a good deal of practice, especially soldering t
cious metals.)—APOLLOS. (Your query was a
so recently as pp. 485, 504, 547, of the last volu
can obtain price lists of any dealers in such m
or of artists' colourmen.)—J. C. (The boiling
mercury is 674° Fahr. The mercurial thermo
only approximately accurate beyond 220° F
cannot be used for temperatures higher than 66
—WISHING TO BUILD. (You should procur
lists of the fittings from those makers who sell
—AL FARD. (If the question has not met with
it will be inserted in the "Unanswered" list
course. Possibly you will find the answer to t
question on p. 384, last volume.)—F. W. D. (If
specified the pattern we might have given a
answer. Perhaps it is to bring the steering ba
reach of the rider without bending the handles
W. HITCHINS. (Directions for making banjo
1125, 976, 980, 986, 989.)—BOOT FINISHER. (S
understand the use of the glazing iron and hee
Have you tried chalk for the stains? You sho
cure Leno's "Boot and Shoemaking," publis

ckwood and Co., Stationers' Hall-court, E.C.)
P., Waipawa. (The best book is Culley's
›k of Practical Telegraphy," eighth edition,
shed by Longmans, Paternoster-row, E.C. It
or postage 2s. 8d.)—FRAMEMAKER. (Do you
ing with leaf or electro-gilding? "Practical
d Gilder's Guide, and Picture-Frame Maker's
a," published by Savory, Cirencester, 2s. 6d.,
—NUMSKULL. (Vegetable charcoal or char-
ts. Get the pamphlet advertised by Gent
eicester, and for the other procure a work pub-
Mr. Eldridge, 54, Murray-street, Hoxton, N.)—
EST. (The dentist's vulcanising process has
ently described. The mixture of rubber and
placed in the flask which is inserted in the
. The pressure and heat of the steam then
e change.)—J. HY. T. (Recipes for inks of
inds in back volumes. The common stuff is
a logwood or sumach and copperas, or chromate
—say a pound of logwood chips with plenty
and boil or simmer to a gallon; when cool,
ains of yellow chromate of potash. Thicken
. 2. Do not understand the question about
oal. Better for what purpose? If for filtering
haps because it has then had time to become
xygen.)—GALVANO. (The question has been
answered. The goods are thoroughly cleaned
ng with sand, pickling in acid, &c., and are
ersed in a bath of molten zinc.)—CALX. (Is
some explanation in the journal? We are
to refer.)—P. M. BAKER. (An improved
er on that principle was patented by the late
ikerfues, of Göttingen. It was illustrated and
in No. 963. 2. You do not say which dynamo
; but you can find something suitable in many
k numbers.)—BLEACH. (You cannot do what
st; for it is the acid gas that escapes: it does
b water.)—WM. WASS. (Ricardo's "Company
, and Slack's "Battalion Drill," 2s. 6d., both
by Clowes and Son, Charing-cross, W.)—
It is a secret. At all events, the nature of the
on has never been published, though an
ould soon answer the question for you.)—U. M.
ds on the wages to be paid; but say from £20
according to the status of the firm. 2. In
k it is usual to add £2 15s. per rod reduced as
en Portland cement is used; but roughly you
will cost 60 to 75 per cent. more than mortar.)
B. (Why insert it? The statement is well
and bears out exactly what has been said.
kilogrammes" is 22lb., and the pile of 6,000
, which would cost a trifle, would not give
an 2 horse-power. A gas-engine and dynamo
very much better than that.)—KARL. (Yes,
"really bad in gout." Hot water has been
nded as the best beverage in cases of gout.)—
I STARTER. (Just so; but we cannot repeat
ek. Use a chromic-acid battery. An accumu-
described on p. 169. You had better buy the
it is cheaper than attempting to make.)—C. P.
(See the indices. That for the last volume,
ace. Much depends upon skill, the object being
many coils as possible close to the core. The
round coils are no doubt the best.)—B. HAR-
(Fairly ingenious, but we have long ago de-
thers as simple and inexpensive, and they have
red in the "Sale Column.")—WELSHMAN. (Does
rike you as more reasonable to expect you to
epence in obtaining the back numbers by post
office, than to ask us again to occupy space
y with information already, and so very re-
iven?)—J. W. WALKER. (You must pay. If
r provided a competent assistant, he fulfilled
gement.)—THE SUPERNATURAL DARKNESS,
e cannot possibly print the many letters to
me very sensible ones from either point of
d think this subject may now drop.)—SILKE.
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the block; it is not the custom to keep blocks
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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MAY 13, 1887.

POPULAR METEOROLOGY.

ALTHOUGH meteorology does not hold a very high place in the opinions of those who study the exact sciences, being for them what its name implies, a discourse much too "high in the air," it is nevertheless one of the oldest branches of science, using that term to designate "any art or species of knowledge." The earliest denizens of this globe must by mere force of observation have acquired some little knowledge of weather signs, if only from noting the different cloud appearances and the effects produced, while it is tolerably certain that they soon found that some animals had a natural ability for anticipating a few of the more important atmospheric changes and disturbances. Sir T. Browne says: "In animals we deny not a natural meteorology, or innate presentation of wind and weather"; but since his time the word has acquired a wider significance, and animals are no longer regarded as capable of indicating anything more than an immediate change. Our forbears had their weather lore, however, by means of which they prognosticated the character of the coming seasons, and ventured on prophecies which the most ardent believers in the modern science of meteorology would hesitate to make. Those who have made the subject a study are contented to say that it is possible to foretell the probable weather twenty-four hours in advance; but many of them would express a doubt as to the advantage of being able to know exactly what weather would prevail for every day throughout the year. It would enable us to fix dates for picnic parties and cricket matches, as well as transacting business occasionally; but it is doubtful whether it would be altogether agreeable or profitable. As Prof. Cleveland Abbe said in a recent lecture, "As nearly as I can see, he who should perfectly foreknow the weather, would find himself at every step confronted by some approaching dilemma, some inevitable disappointment or loss; and shrinking, as we all do, from such events, he would sit down in despair and do nothing at all." Yet Dr. Abbe is so confident of the future development of man and of science, so clearly does he see the wise provision by which everywhere in Nature we find the right thing, in the right place, at the right time, that he dares to predict the time will come when men will be able to endure and utilise detailed weather predictions for months and years in advance. At present it is advisable to regulate our business regardless of such predictions as may be made, even though we may know from previous experience that at least 25 per cent. of them will prove correct. The early observers of natural phenomena would perhaps think little of the fact that many of the animals around them showed that they were aware of the approach of a storm or even of rain, but the migratory habits of birds and the actions of hibernating animals led them to believe that the lower branches of creation were more highly endowed with the power of foretelling weather than the human race. We know, however, that the migratory bird acts simply by inherited instinct, as does the hibernating animal, and both are adapted to the habits they adopt, which is possibly the reason they have survived; but he who consults the habits of insects, of birds, or of animals for a knowledge of meteorology—and there are hundreds of rules in the old books of weather wisdom—is simply trusting to the inferior intelligences and neglecting those faculties of observation and reasoning with which he has been endowed. The animals have either acquired their habits, as other intelligent creatures do, from experience and reason, or they are wholly guided by natural causes beyond their control. An instance of the latter is given by Prof. Abbe in the case of the Rocky Mountain Locust, which, after its last moult, finds itself feeding in or near its native fields on the tender vegetation near the ground. Every day, as the sun rises and the dew is dissipated, the atmosphere about it grows hotter and drier, and its moist, tender wings become stiffened. A nervous irritability is produced which leads to flapping of the wings, and, without any other profound instinct or an intention on its part, the locust is carried above the ground to cooler, moister air, and there comes into the control of the strong north-west winds which carry it southward, even to the Gulf of Mexico. Its migration into a region of rich pasture lands is not due to any superior knowledge on its part; nor is its return, for the eggs hatching out in the season when strong southerly winds prevail, the young locusts are carried back to the starting place by causes beyond their control. In other cases, the migration or hibernation is due to a gradually acquired experience inherited from ancestors; but so far as natural causes are concerned, what is true of animals is more plainly true of vegetables or plants, for all the rules of weather prediction founded on the behaviour of flowers or the foliage are so many instances of hygroscopic phenomena, which correspond with the action of a good hygrometer. The phenomena of the atmosphere are, in fact, governed by laws which, so far as we know, are immutable; for where there appears to be some change in them, it is probable we are confusing effects with causes, simply because we are at present unable to see the latter. It is undoubtedly true that in this country, but more especially in the less advanced and sparsely populated districts of the so-called civilised world, much reliance is placed upon weather predictions which appear in almanacs that have been made up months, sometimes years, in advance of the dates to which they refer. As a rule, these prognostications are based on what are known as astrological principles, which have little to do with what may be called the science of meteorology. The influence of the moon, the planets, and the stars upon our atmosphere might appear considerable if we could only view it from some point external to our cosmos; but so far as we have any means of knowing it is absolutely inappreciable. If any of the heavenly bodies, as they are termed, can exercise an effect upon our atmosphere, it is the sun; but we are so very small compared to the atmosphere, to say nothing of the sun, that in spite of strenuous efforts on the part of the director of this or that "Sonnenwarte" very little can be said to have been demonstrated as absolutely true—as the usual effect of a definite cause. On the contrary, as Prof. Abbe says, sunspottery has been "worked up and overdone by very many." In the United States there is one who stoutly maintains that the appearance of any special sunspot enables him to at once predict a corresponding special storm or weather—an "idea arrived at apparently by a complete violation of all laws of logic." Prof. Abbe demolishes the sunspot hypothesis with happy ridicule: "Areas of stormy or cold, or hot or windy, weather are so frequent all over the earth, and spots on the sun are so frequent, that it is always possible to pick out a number of coincidences in time; and the style of logic that demonstrates a certain storm to be caused by a certain spot would equally well be applied to demonstrate that my body is warmed by the mass of hot coals in the fireplace, while my cold hands are due to one special coal that will not burn as briskly as its neighbours." It is an old belief that the meteorological phenomena depend upon the sun's heat, and that variations in that may affect the earth's envelope to such an extent as to produce a change of temperature in one part of the world, a difference in the rainfall in another part, and alter the course of the wind in another; but such effects are barely appreciable in the earth's atmosphere as a whole, and "it is utterly illogical to conclude that there is any direct connection between special spots on the sun and special localities on the earth"—at least, so says Prof. Cleveland Abbe, and he takes the view that is at once common-sense and scientific, while in his case it is based on an extensive experience in connection with the Army Weather Bureau, Washington. Solar radiation playing an important part in the phenomena classed under meteorology, instruments for measuring the sun's heat at a given spot are necessary towards the determination of the probable weather, and these take the form of various thermometers with dry and wet bulbs, solar radiation, terrestrial radiation, radio-solar, and the apparatus known as a pyrheliometer, which registers the power of parallel solar rays by the quantity of heat imparted to a disc of a given diameter in a given time. The diffusion of aqueous vapour through the air by the action of the sun's heat renders it necessary to ascertain the weight, or rather the changes in weight, of the atmosphere by means of barometers, the indications of which are corrected by readings of the hygrometer and the thermometer; and by a long continued series of observations definite rules can be laid down by means of which the probable weather in the vicinity of a given observatory can be foretold with approximate accuracy for twenty-four hours, with a percentage of failure ranging from 25 to 50 and more according to the want of practice or experience of the meteorologist or observer. When, however, it is desired to foretell weather, not merely in the vicinity of a station, but over a wide district, the difficulty is enormously increased, especially in such a country as the United States; and yet the Army Signal Office there is expected by some people, not merely to make correct local forecasts thirty-six hours in advance, but even to predict the weather for several weeks. The telegraph has played an important part in modern meteorology by acquainting observers at different stations with the indications at others; but in utilising the messages much experience is needed, for the frequent prediction of storms that do not arrive somewhere near the selected time does a great deal more harm than the non-fulfilment of printed prophecies in the almanac. Amongst a certain class of meteorologists there is a tendency to explain inexplicable phenomena by referring them to the action of atmospheric electricity or to ozone, and accordingly at some observatories arrangements are made for studying the electric condition of the air in all states of the weather. Although daily records have been kept for many years no satisfactory results have followed, in the sense of being able to demonstrate that purely atmospheric phenomena have been observed: hence Prof. Abbe rates as a popular error the frequent mention of atmospheric electricity and ozone as active causes of meteorological phenomena, though the former is supposed to be the great generator of the latter. Clear, cool air does frequently follow a thunderstorm, especially those occurring in summer; but it is not always the case, and it is very doubtful whether the thunderstorm produces any ozone. The coolness or freshness experienced is probably due to the fact that the uprising of the warm, moist air has caused both the thunderstorm and the inrush of cool air. Nowadays, however, popular meteorology has got out of the old ruts, and has taken the form of careful observation with a few but accurate instruments, which will enable any diligent observer to form a good idea of the impending weather, better than any amount of study of the animal indicators—especially when it is combined with a little experience.

EXPERIMENTS WITH ARTIFICIAL VORTICES.

SOME interesting and instructive experiments, devised by Herr C. Weyher, were recently described to the Paris Academy of Sciences by M. Mascart. These consisted mainly of experiments to show the effects produced by vortices—*e.g.*, artificial waterspouts and whirlwinds. Thus an artificial whirlwind is created by revolving a drum containing radiating blades within its circumference, and the effect produced is demonstrated by causing the drum to revolve rapidly over the surface of a tank of water. In M. Mascart's experiments the drum was 3ft. in diameter, with six radiating pieces, and it was mounted on a vertical axle, the velocity of the periphery being from 90 to 120ft. per second. The drum is open beneath, and is placed as a rule about 10ft. above the surface of the reservoir or tank of water. Motion is imparted by means of a pulley and belt, and as soon as the speed rises to the lowest mentioned above, spirals are observed to form on the surface of the water, which converge towards a centre from which a cone speedily makes an appearance, and may often be about 8in. in diameter by 4in. in height. This first cone is then surmounted by a second cone, but reversed, which is formed of numerous drops which rise to heights of perhaps 5ft., and fall back at distances ranging from 3ft. to 10ft., according to the velocity of the drum. The finest drops or spray will reach as high as the drum itself. Bits of straw or chips of wood placed on the surface of the water are drawn together by the vortex, and form a sort of cord, which will rise spirally in the axis of the artificial waterspout. If a wet board is placed on the water, the vortex will form upon it a focus of about ¾in. in diameter of a whitish appearance, from which a peculiar whistling sound may be heard, as if there were a hole in the board through which air and water were passing with great force. The divisions of the 3ft. drum leave at the centre of the latter a free circle of 15in. in diameter; but the vortex concentrates and contracts on the board according to the velocity of revolution down to ¼in. It is easy to demonstrate that the artificial whirlwind produced by the rapidly rotating drum presents exactly the same characteristics as the lower part of a vortex in the atmosphere which has descended from the upper regions to the surface of the water; but as the focus shifts with the least breath of wind, the experiment is not always satisfactorily performed in the open air. It can, however, be shown on the small scale in a closed vessel. A cylinder of glass about two feet long and a little more than a foot in diameter is fitted with a cover, which serves as a bearing for an axle carrying a couple of cardboard vanes mounted crosswise. Instead of water, the lower part of the cylinder is supplied with dry sawdust, oatmeal, bran, or some similarly light material, and if that is arranged to form a cone, the imitation waterspout will form at the apex as soon as the axle carrying the vanes is revolved with sufficient rapidity, while if the motion is continued the sawdust or whatever is used gradually hollows out into a hemisphere, perpetually running in spirals from the circumference to the centre, where it forms into the lower cone seen in the case of the water, then the reversed cone above, the particles of which describe spirals from the centre of the circumference. The experiment can be varied slightly in effects with different materials, as, for instance, with small balloons filled with air; but the result shows that if a rotary motion round a vertical axis is communicated to a mass of air it will constantly ascend in the interior and descend in the external circumference, carrying along with it any particles sufficiently light. A remarkably amusing experiment can be performed with a stand supporting the rotating vanes or drum, and tall enough to allow of a small round table or disc of glass being placed beneath the drum. The latter is set in motion, and a coin spun on the table. The coin is quickly brought within the control of the vortex, which makes it spin like a top, and holds it absolutely captive within the radius of its action. The coin in spinning generates a sphere, and it is shown by other experiments that revolving spheres constitute a centre of attraction. Thus, a free sphere remains in equilibrium, and revolves round another having a rapid rotary motion. A spindle is placed in a support at an angle of 45°, which seems to offer the greatest difficulties, and on it is mounted a sphere formed of eight or ten rings. When this is rapidly rotated the hand can feel a strong stream of air issuing from the equator on every side, and bits of paper when presented are blown away. If, however, a balloon, such as a light rubber ball, is used, it is strongly attracted towards the sphere, and will describe orbits around it in the plane of the equator, until it receives a blow from one of the rings, and is then sent too far away to be recaptured by the rotating sphere. To avoid that a wire guard is placed round the sphere in its equator, and held in place by three wires connected to the support. This guard keeps the balloon from touching the rings forming the sphere, and the former revolves round the latter so long as the sphere is rotated. This experiment can be varied in many ways, one of the neatest being the use of a paper ring having an internal diameter greater than the external diameter of the sphere. In this case the wire guard is dispensed with, and the paper ring slipped over the sphere while the latter is rotating, when the ring is found to be firmly held in the plane of the equator. As regards the amount of attraction exercised by the drum or the simple vanes, that is easily measured by resting a light rod on two pulleys. At one end of the rod is a disc about the size of the drum, and at the other end is a cord connecting to a little scale pan. When the drum is set in motion it attracts the disc, or, rather, the latter is compelled to move forward by the action of the vortex, and this attraction is found to vary in the inverse ratio of the square of the distances. It will be understood that these experiments should be carried out in some room where the air is comparatively still, as they are affected by atmospheric currents; hence, they are not adapted to the lecturer's table in every hall, for platforms are generally rather draughty.

FLETCHER'S IMPROVEMENTS IN STEAM-RAISING AND WATER-HEATING.

IT will be remembered that at the meeting of the Gas Institute last year Mr. Fletcher, of Warrington, read a paper on "Flame Contact: a New Departure on Water-Heating" (see p. 338, Vol. XLIII.), the principal features of which he had protected by patent, which has been recently completed. As the invention is of considerable importance, we give below the substance of the specification, which will show what Mr. Fletcher claims as his invention:—

It is known that when a metallic surface upon one side of which there is water has its other side exposed to a flame or to highly-heated gases, there is a zone or space between the flame or gases and the metallic surface which offers great resistance to the transfer of heat from the flame or gases to the metal, and consequently to the water upon the metal. This has been demonstrated by cementing paper upon the bottom of a kettle or the flue of a boiler containing water, and then allowing flame or heated gases to play upon it, when, so long as the paper is in actual contact with the metal and water remains on the opposite side the paper continues uninjured. Further, upon looking at the bottom of the kettle or the surface of the flue, the dark or cold zone becomes visible. For a long time Mr. Fletcher sought to extinguish, diminish, or overcome the resistance to the transfer of heat through the cold zone, which he found could be effected to a considerable extent, experimentally, but in an impracticable form, by fully exposing metal rods to the action of the flame or hot gases, and bringing them into contact with the heating surface while so exposed. Similar rods attached to the heating surface quickly burnt away at their free ends until they were reduced to definite dimensions dependent on the conditions of use; and their employment, when first constructed of the correct dimensions, although in many cases unsuitable, and sometimes involving a dangerous risk, was found to be comparatively satisfactory in other instances; their efficiency moreover was found to be far less than the methods of construction which constitute the present invention. These improvements consist in constructing or manufacturing the metal plates or some of the plates employed in the construction of boilers and water heaters which are to be exposed to the source of heat or to the heated gases or products of combustion in or upon the boiler or water heater, with solid projections or protuberances upon one side or surface. These improvements further consist in constructing or manufacturing the boiler or other water-heating vessel with or from metallic plates having solid projections or protuberances upon one side or surface thereof, these plates being used by preference in such positions only as may be exposed to the action of flame or heated gases or products of combustion and in such a manner that the projections or protuberances are upon the side or surface of the plates exposed to the action of the flame or heated gases. The exact dimensions of the projections or protuberances formed upon the plates will depend, among other conditions, upon the thickness of the plate and the temperature of the flame or gases; but for ordinary purposes a total projection from the normal surface of the plate of about ¾in. will be found convenient, while with a mean thickness of 3-16ths of an inch they may be advantageously placed about ½in. apart. The form of the projections or protuberances is not material, provided that they are such as can be produced by rolling, casting, pressure, forging, or by other ordinary or equivalent means, during or subsequent to the process of manufacture of the plate, and so that they form integral parts thereof. Mr. Fletcher does not make any general claim to the use of projections, such as tubes, rods, and the like attached to or inserted in the heating surfaces of boiler plates, as these have been publicly known and used for some years, as, for example, in "Field" boilers, the rivet heads of fireboxes, and screwed studs in marine boilers.

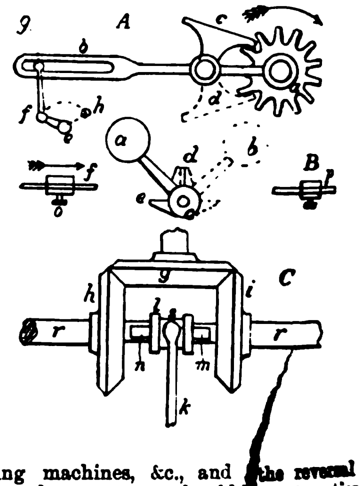
THE THEORY OF MACHINES.—IX.

By Francis Campin, C.E.

Automatic Movements.

IN machines of all descriptions it is eminently desirable to make their details so depend upon each other for their action that all necessary movements may be automatically regulated without manual intervention; thus the adjustment of the cutting tools in lathes, planing machines, &c., and the reversal of motion when necessary, should be automatically effected, as well as the advancement of the work known as the "feed" of the machine.

FIG 36



At A (Fig. 36) is shown a very common kind of automatic feed-gear for machine tools.

ı a piece of work is being planed, l, or slotted, or otherwise shaped, it is ry that after each cut either the tool or ɾk should be advanced for a fresh cut, s is done automatically by some arrange- f the type shown at A. In a planing ıe, for instance, the cutting tool is in a socket or box capable of moving ıtally between guides across the work; ›vement is the "feed," and is produced action of a screw between the guides, works in a nut attached to the back of l-box, so that when the screw is turned l is moved in a direction at right angles of its cut.

he end of the feed screw shaft is keyed toothed wheel *a* (view A), and on the this shaft works freely a link *a b*, having ənd *b* a slot to receive a pin *g*, which adjusted to work at any part of the of the link, so as to give a greater or c of vibration to the link about the of the wheel *a*, as may be required by the ıies of the feed, for the motion of the will be constant, it depending on the of the crank *e f*, which receives motion rocking shaft in a manner presently to ribed; *c* is a double-ended pawl which is in the position shown, or in that ed by the dotted lines *d*, according to ection in which it is desired to rotate eel *a*.

evident that if the end *f* of the crank ıised, the wheel *a* will, through the pawl ushed in the direction of the arrow, ırning the screw and advancing the tool ɾesh cut; on the crank *e f* reaching the ı shown by the dotted line *e h*, the pawl ve been withdrawn ready to give a fresh ıs extremity sliding back freely over th of the wheel *a*, which is steadied by ction of the screw in the nut at the f the tool-box. If it is necessary, the ıay be steadied in either position by a pring acting on a flat part of its bearing.

he planing machine is double-acting— , the tool, by turning round at the end h stroke, or, being duplex, cuts in both ɔns; then, at the end of each stroke, the *'e* must describe the arc *f h*; but if the ıingle, the work running back untouched tool after each cut, the feed must be ıt the end of the back stroke, the link ›eing then raised to its highest position, rown back to its lowest at the end of its ; stroke, and this order of the feed move- must be observed, for if the feed were at the end of the cutting stroke the ·f the tool would strike on the higher the metal (to be cut away next stroke) ə broken. The tool is prevented from ıg on the work by its socket working on in the tool-box, which allows it to ' up a little in the return stroke, although forward or cutting stroke it is supported rtical position by the lower front part of l-box.

his class of machine tool the cutting ·elf is at rest, the table of the machine, he work securely fixed upon it, moving ıeally under the cutting tool which, after ; one narrow cut, is laterally moved in ne, as above described, in order to attack ıaterial.

ꞁ, Fig. 36, is shown an arrangement ɔmatically reversing the direction of of the table after each stroke, and at me times actuating the feed motion at A.

c is a shaft fixed transversely to the length machine and below the level of its table, ies the elements necessary to reverse tion of the table and to actuate the feed he feed crank (*f e*, A) being firmly keyed he far end of it clear of the table and ɾork of the machine.

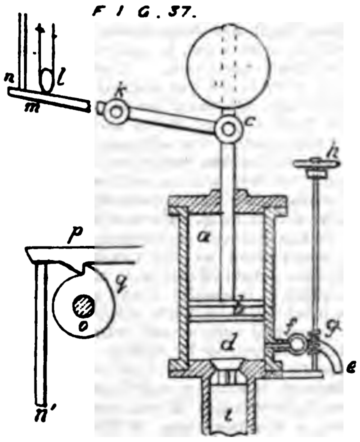
ıe front end of the shaft *c* is secured an carrying a weight to steady the shaft ın the position shown or in that indi- y the dotted lines at *b*. Behind the arm ted a boss carrying two catch pieces, , arranged as shown, the use of which esently appear.

small block or tappet which is secured ·let on the edge of the table of the e, wherever it may be required, by the w *o*; the position of this stop deter- he stroke of the table, which must be adjusted to suit the length of the work operated on.

If the table is moving in the direction of the arrow at *f* it will pass over the catch *e*, and striking the catch *d* will throw the arm *a* over into the position shown by the dotted lines, carrying with it the shaft *c* and its appurtenances, and thus actuating the feed motion. On the return stroke, another tappet *p*, similar to *f*, passing over the catch *d*, strikes against *e*, and throws the arm *a* back to the position shown by the full lines, and again moving the feed gear.

We must now show, by reference to the view C, how this movement also reverses the direction of motion of the table of the machine.

FIG. 37.



g is a shaft carrying on its extremity a bevel wheel firmly keyed on; it has also (not shown in the illustration) a pinion which, acting upon a rack beneath the table, causes it to move backwards and forwards according to the direction in which the shaft *g* is revolving; *h* and *i* are two other bevel wheels on the driving-shaft, *r r*, of the machine: these wheels are secured as to their longitudinal position on the shaft *r r* by collars firmly attached to it; but they are capable of revolving freely upon it, but are, by their longitudinal positions on the shaft *r r*, always kept in gear with the wheel on *g*; it is obvious, therefore, that the wheels *h* and *i* will, when the machine is in motion, move in opposite directions.

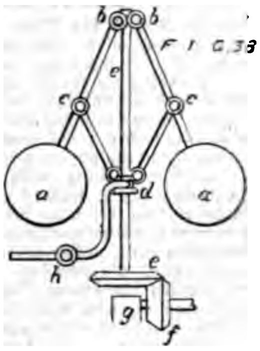
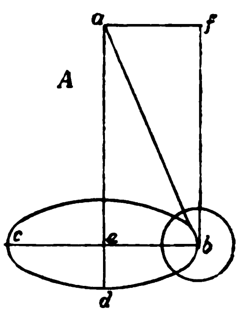


FIG. 38



Between these two wheels there is a contrivance *l* called a clutch, which consists of a collar grooved round the centre, and carrying at its ends projections of which two are shown at *m*, *n*; there is a key or feather fixed on the shaft in a recess or slot, and this projecting above the surface of the shaft fits a slot or cut longitudinally in the interior of the collar *l*.

Thus the collar or clutch is forced to *revolve* with the shaft *r r*, but may be moved longitudinally upon it, and such motion is given by pins in the end of a fork *s* fixed on the shaft *k* (which is in plan the end of the shaft *c* in view B).

The collar revolves freely with these pins resting in the groove; but as the fork is thrown to right or left, the clutch is pressed against one or other of the wheels *i* and *h*; but in the faces of these wheels are recesses corresponding to the projections upon the clutch which enter them, and thus for the time being the wheel so engaged revolves solidly with the shaft *r r*, thus by the rocking motion of the shaft *k* (*c* in view B) the clutch is alternately engaged with the wheels *h* and *i*, and a reciprocating motion of the table is obtained.

In some machines, instead of employing the bevelled gearing as described, the fork *s* is used to shift a driving belt from one pulley to an adjacent one, but the principle of action is the same.

The application of similar apparatus to other machines is obvious, and needs no further example.

In some cases the action is required to be suspended for some definite period, and one method of attaining the end is exemplified in the "cataract" used for regulating the valve action in some Cornish engines.

Figure 37 represents the modern "cataract" in vertical section. *a* is a cylinder fitted with a piston *b*, of which the rod carries a weight W, being also furnished with a pin *c*, embraced by the forked end of the lever *c k m*, of which the fulcrum is the "dead centre" *k*. The cylinder *a* is fitted with an outlet cock *e*, the passage of which is regulated to a nicety by a plug, having on its spindle the worm-wheel *f*, gearing with a tangent screw *g*, actuated by the hand-wheel *h* on the vertical shaft shown.

In the bottom of the cylinder *a* is a valve, *d*, of ample dimensions, opening freely inwards from the suction-pipe *i*, which is in immediate communication with a water-tank below, into which the water from the cock *c* returns. *l* is a tappet on a vertical rod connected with the main beam of the engine. On the descent, of which the end *m* of the lever *m k c* being depressed, the piston *b* is raised, and the valve *d* opening freely, the cylinder *a* is filled with water. The valve which the cataract is to control is now shut, its rocking shaft *o* being held in position by the catch-piece *p* working on a dead centre *q*.

The cylinder *a* being filled with water can only be discharged by the cock *e*, the water flowing out under the pressure of the piston and weight W. The rapidity with which it flows will depend upon how much the plug and worm wheel *f* are turned; the opening thus given can by means of the hand-wheel *h* be regulated with the greatest nicety. As the weight W sinks, the end *m* of the lever *c k m* lifts a rod; *n* which moves vertically in suitable guides, its upper end, *n′*, ultimately lifting the catch *p*, and so release the valve-shaft *o*, after which the valve connected with it opens by the action of a weight, and the engine makes a fresh stroke.

Thus, by adjusting the opening of the cock, any required interval of time can be insured between the strokes.

It is obvious that this arrangement is applicable also to other purposes.

Amongst automatic movements may be ranked various forms of regulators or governors for controlling the speed of steam-engines and some other motors.

In Fig. 38 is shown the commonest form, known as Watt's governor or the conical pendulum. It consists of two heavy metal balls *a a*, carried upon two arms *a b*, *a b* jointed at *b b* to a cross-piece fixed on the top of the vertical spindle *e e*; *d* is a collar fitting freely on the spindle *e e*, and carried by two arms jointed to the rods *a b*, *a b*, at *c* and *c*.

On the bottom of the spindle *e e* is keyed a bevel spur-wheel, actuated by another on the shaft *f*, which also carries a pulley, a strap round which is carried to some revolving part of the motor in order to communicate motion to the shaft *f*, and through the bevel wheels to the vertical spindle *e e*, which, carrying with it the balls *a a*, will cause them to diverge from each other to an amount depending upon the velocity of rotation; with the varying divergence, the rods from *c c* are raised or lowered, and with them the collar *d*. In a groove on this collar rest the ends of a forked lever which, turning the spindle *h*, varies the extent of opening of the (in the case of a steam-engine) steam valve.

Referring to the diagram A, we will now explain the principle upon which the action of the conical pendulum depends.

Let *a b* represent a wire or string fixed at *a*, and carrying a heavy ball *b*; let this ball be revolving in an orbit such as that shown by the circle *b c*. From *a* let fall, perpendicular to the horizon, the line *a d* passing through the centre of the circle *b c*. From the centre of the ball *b* draw the line *b e c* at right angles to *a d* and intersecting it at *e*; complete the parellelogram *a e b f*; there will then be two forces acting upon the ball *b* tending to move it in a vertical plane about *a* as a centre. Let w = the weight of the ball, then by the force of gravity a moment will be produced about *a* equal to $w \times e\,b$.

If c = the centrifugal force of the ball in the direction *e b*, the moment of this force about *a* is $= c \times e\,a$. If the ball is in equilibrium these two forces must balance, therefore $c \times e\,a = w \times e\,b$.

Let h = height of the point of suspension *a* above the plane of gyration *b c*, and r = the radius *e b*. Let n = the number of revolutions per minute, and v = the velocity in feet per second.

From the usual formula we have $c = \dfrac{w\,.\,v^2}{32{\cdot}2 \times r}$ but $v^2 = \left\{\dfrac{3{\cdot}1416\,.\,r \times 2\,n}{60}\right\}^2$; r being taken in feet. $c \times e\,a = c \times h$ and $w \times e\,b = w \times r$; therefore $c\,.\,h = w\,.\,r$; $h = \dfrac{w\,.\,r}{c} = w.r \div \dfrac{w\,v^2}{32{\cdot}2 \times r}$ $= \dfrac{32{\cdot}2 \times r^2}{r^2} = 32{\cdot}2 \times r^2 \div \left\{\dfrac{3{\cdot}1416\ r \times 2\,n}{60}\right\}^2$ $= \dfrac{29{\cdot}36}{n^2}$ feet $= \dfrac{35239}{n^2}$ inches. This formula may be also written $h = \left\{\dfrac{187{\cdot}7}{n}\right\}^2$; whence $n = \dfrac{187{\cdot}7}{\sqrt{h}}$.

This apparatus is certainly very simple; but from its principle of action cannot insure absolute constancy of velocity in the engine under its control. Suppose, for instance, that suddenly an additional load is put upon the engine, it requires additional steam, the governor balls will fall with slackening speed and open the steam, or throttle, valve wider; but for it to remain so a slower speed must continue; otherwise the governor balls would again fly out to their previous position, and restrict the steam passage to the corresponding area.

Although, however, this governor is not absolutely perfect, it is practically of great value, and for ordinary purposes holds its position up to the present time against some of its more complicated rivals, of which there is a great variety in the market.

THE INFLUENCE OF TEA, COFFEE, AND COCOA ON DIGESTION.

DR. JAMES W. FRASER, in the recent number of the *Journal of Anatomy and Physiology*, has recorded the results of an interesting series of experiments on the action of our common beverages on stomachic and intestinal digestion. The experiments have been most carefully arranged from a physical standpoint, and give us some valuable hints on the digestion of the chief alimentary principles, but they have no bearing, it should be mentioned, on individual variations of human digestion, or on the influence of the various glands in preparing the gastric or intestinal juices. They are, however, of much value in showing how standard preparations of the peptic and pancreatic ferments are modified in action when our ordinary daily beverages are allowed their free action on the digestion of various articles of food. The digestive processes were carefully investigated, and absorption was imitated by a proper dialysing arrangement. An artificial peptic juice, and afterwards an artificial pancreatic juice, were employed, and the amount of nitrogenous matter dialysed was most carefully estimated. The food stuffs experimented on were raw and cooked serum and egg albumens, raw and cooked myosin, syntonin, alkali *albumen*, casein, gluten, starch, and oleine. The results obtained from an exhaustive series of experiments and analyses show that all the three typical infused beverages—tea, coffee, and cocoa—retard the digestion and absorption of all the nitrogenised proximate principles of dietic substances when peptic and pancreatic digestion are taken together, and that they uniformly retard peptic digestion, although tea may assist the diffusion of peptones from the stomach. Pancreatic digestion is also uniformly retarded, and diffusion thereafter is but rarely assisted, so that neither of them compares advantageously with water as a standard beverage for experimental investigations. A summary of dietic advice is added to Dr. Fraser's observations, which will, in the main, agree with that which is now given by our best authorities in cases of dyspepsia; and we are glad that experimental inquiries afford so strong a basis of support to empirical clinical observations:—

"1. That it is better not to eat most albuminoid food stuffs at the same time as infused beverages are taken, for it has been shown that their digestion will, in most cases, be retarded, though there are possible exceptions. Absorption may be rendered more rapid, but there is a loss of nutritive substance. On the other hand, the digestion of starchy food appears to be assisted by tea and coffee; and gluten, the albuminoid of flour, has been seen to be the principle least retarded in digestion by tea, and it only comes third with cocoa, while coffee has apparently a much greater retarding action on it. From this it appears that bread is the natural accompaniment of tea and cocoa when used as the beverages at a meal. Perhaps the action of coffee is the reason why, in this country, it is usually drunk alone or at breakfast, a meal which consists much of meat, and of meats (eggs and salt meats) which are not much retarded in digestion by coffee. 2. That eggs are the best form of animal food to be taken along with infused beverages, and that apparently they are best lightly boiled if tea, hard boiled if coffee or cocoa, is the beverage. 3. That the casein of the milk and cream taken with the beverages is probably absorbed in a large degree from the stomach. 4. That the butter used with bread undergoes digestion more slowly in presence of tea, but more quickly in presence of coffee or cocoa—that is, if the fats of butter are influenced in a similar way to oleine. 5. That the use of coffee or cocoa as excipients for cod-liver oil, &c., appears not only to depend on their pronounced tastes, but also on their action in assisting the digestion of fats."—*Lancet*.

DEATH BY ELECTRICITY.

AT a recent meeting of the Paris Academy of Sciences, M. d'Arsonval read another paper on the dangers of dynamo machines, having had an opportunity of pursuing his studies at the Collége de France with both alternating and continuous current machines. The following abstract is from the *Comptes Rendus*:—My researches have been directed successfully to the physiological effects of (1) A static machine (Holtz with four discs) charging a battery. (2) A battery of 420 volts. (3) Continuous current Gramme machines. (4) Alternating current Gramme machines. (5) Extra current or induction coils, either associated or not with static condensers. To complete this series I ought to have studied the effects of transformers, which are beginning to enter into the domain of practice, and the effects of which are formidable in a way quite different to those of the preceding machines, but this omission will soon be rectified, thanks to the kindness of M. Picon, chief engineer in the Edison workshops. With all the sources of electricity enumerated above, death may be caused by placing oneself in certain conditions. This death is accompanied by very variable phenomena and injuries, according to the manner in which it has taken place. In this note I will confine myself simply to showing the practical conclusions to be deduced from my experiments. I found that the very varied effects of electricity on living creatures may be classed into two principal categories which include them all. Electricity causes death in the two following ways:—(I.) By direct action (the disruptive effects of the discharge acting mechanically so as to distort the tissues). (II.) By reflex or indirect action (acting on the nervous centres, the irritation of which brings about the infinite variety of effects so thoroughly investigated by M. Brown-Séquard, under the names of inhibition and dynamo-génie). This simple distinction, resulting from a careful observation of facts, is also of practical value, in that, in the first case, death is certain and definite, whereas, in the second, experiment has shown me that very often the victim may be restored to life by practising artificial respiration immediately after the accident.

The static discharge is only fatal when the *bulbe* is struck directly with well localised discharges, the energy of which corresponded in my experiments to about three kilogrammètres. Under these conditions, the different tissues (nerves, blood, muscles, &c.), when struck singly by the discharge, lose irremediably their physiological properties. If the discharge has not the force required in order to distort the bulb mechanically, it acts by exciting it and produces the phenomena of respiratory inhibition, inhibition of the heart, sub-pleural ecchymosis, pulmonary emphysema, paralysis, stoppage of circulation, &c., which M. Brown-Séquard has obtained by directly irritating the *bulbaire* region by excitations of various kinds. Contrary to what is generally believed, it is very difficult to kill an animal by shocks. These secondary effects are not, therefore, the work of electricity itself.

With the battery of 420 volts death is only caused by frequent and prolonged interruptions of the current. It is due to the tetanic condition provoked by the current, rather than to the direct action of electricity. Later on I will enter into the effects produced by a battery of 2,000 to 2,500 volts.

The continuous current Gramme machine is only dangerous, as mentioned in a former paper, from its extra current on breaking. I have ascertained that compound machines or doubly-wound machines give less powerful shocks than machines excited in series or series dynamos. The extra current of a series dynamo, giving 20 ampères and 45 volts, killed a guinea-pig, whereas the extra current of a compound machine, giving 20 ampères and 45 volts, produced no harmful effect. This difference is explained when we consider that the second coil serves as a derivation wire. I succeed in suppressing this extra current by breaking the circuit gradually by means of a simple stoneware tap containing mercury, which serves to cut off the circuit.

An alternating Gramme machine only causes death above 120 volts of mean difference of potential.

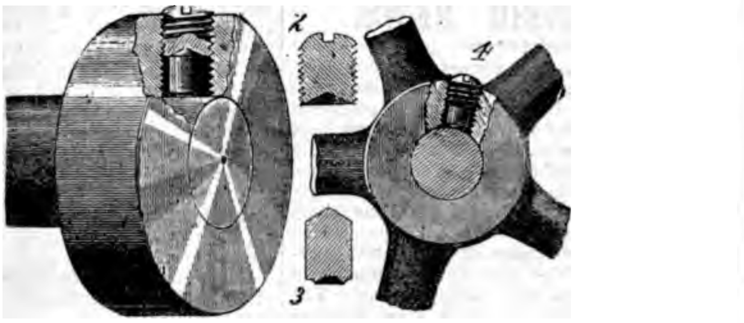
An extra current coil is more dangerous than an induction coil, especially if it is coupled with a condenser.

The danger of an insulated discharge is defined solely by the electrical curve of that discharge. The knowledge of the difference of potential and the adverse intensity is not sufficient; the duration of the discharge must also generally be taken into account. For the purpose of analysing the physiological effects of electricity, I some time ago designed an apparatus which registers automatically this electrical curve of excitation, a curve of which all the parameters may be made to vary singly and at will. We thus can easily dissociate the effects of the electrical excitant; I will return to this point later. It is the same with alternating currents, in which we must also take into account the frequency of the reversals. As I cannot dwell upon this now, I will confine myself to saying that under the conditions usually realised in the industrial arts the current kills by reflex action. And I have succeeded, in the majority of cases, in restoring to life animals that have received shocks by subjecting them to artificial respiration.

The practical conclusion to be drawn from this note is that it is necessary in electrical works to be able to practise at a moment's notice artificial respiration upon anyone who has received a shock, for by this means there is a good chance of restoring him to life. The currents employed for industrial purposes up to the present most often kill by stoppage of respiration. Artificial respiration, by preventing asphyxia, enables natural respiration to be re-established. On this point, M. Brown-Séquard says:— M. d'Arsonval might have said that for several years we have successfully employed at the Collége de France a mode of excitation having great power in bringing back respiration stopped by inhibition. This process is far superior to trans-current cauterisation, which is employed by Faure and other experimentalists. It consists simply in the application of a faradic current to the sides of the larynx on the skin, which is moistened or superficially incised. We know that in laboratories galvanic shocks are given with a certain amount of success at any point to restore respiration in animals in which that function has been stopped under the influence of chloroform or by other means. We have found in comparative experiments, which remove all doubt, that of all parts of the body that which being galvanised has the greatest power in restoring respiration is the one we have mentioned. There is a very natural reason why this should be so; by the faradisation of this part the nerves are slightly irritated, which, as all physiologists know, is a cause of respiration, and even sometimes of a considerable increase of respiratory energy.

SAFETY SET-SCREW FOR COLLARS AND PULLEYS.

THE ordinary mode of fastening collars and small-sized pulleys on rotating shafts has been by means of one or a number of set-screws—although it is well known that this is a most dangerous device, as the protruding head of the set-screw will, as the collar rapidly revolves, in-

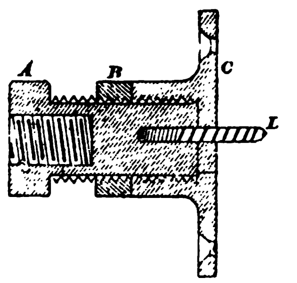


itably entangle anything that comes in contact ith it and carry it round the shaft, and thus very ten break belts, and, much worse, often endanger ıman life. It, therefore, seems strange that ırdly any attempt in the way of invention has ıen made to obviate that dangerous contrivance; rtainly no attempt has been made at all to substitute for it a safe method of fastening collars or ıbs to shafts. The annexed illustrations show ch a substitute and its adaptation on a collar and ı a hub of a pulley.

The set-screw heretofore used is replaced by two eces, a short screw, Fig 2, flush with the circumrence of the collar or hub, and which is slotted on p, so that it can be set up by a screw-driver, and ıich is countersunk on the inside where the cond piece, Fig. 3, a small steel plug, fits into the untersink, and is forced against the shaft by the rew. The surface of the steel plug is serrated on e side towards the shaft, and the collar is made so at there is a clearance all around the steel plug. hen this screw is set up snugly against this steel ug, so that the serrated surface of the latter is mewhat embedded in the shaft, then the plug ts like a pawl and toggle in any direction on ıich a strain might be brought against the collar hub, and the greater the strain, the more wiil the ug imbed itself in the shaft, and the tighter it ll hold the object to the shaft. By means of is simple device a collar or hub can be fastened a shaft much firmer than by a mere set-screw, d, there being no projection beyond the periery, all danger is obviated. This invention has ın patented by Mr. F. Rochow, of Bridge-street l Plymouth-street, Brooklyn, N.Y.—*Scientific erican.*

A SCREW CENTRE CHUCK.*

S patternmaking and tools for doing it have been the theme for some articles in your ıable paper of late, I will describe a screw ıre chuck for such work which we have been g for the past two years. It has one feature onvenience not possessed by those previously ribed, if I remember correctly—viz., the power btaining any length of screw desired, from ing to its full length, about 1¾in. in our case, without any extra parts. I give a sectional h herewith which nearly explains itself. It



y of cast iron except the screw, which we tool steel. The part A is threaded on its ɔ a good fit on the lathe spindle, and on the to receive the face-plate C and its check- The screw D is firmly screwed in A, so as ımovable, and passes freely through the ıole in C, its length being adjusted by the face-plate along to the desired posi- fastening with check-nut B. The threads D and of the face-plate fit on A should be ıme pitch, to allow of blocks previously to the face-plate being screwed over the rew if desired. Holes for spanners are A, B, and C, by which means they are djusted and firmly fastened. It is not in theory, but works well in practice, ɔuld not go back to the old style again

ERHARD'S CIRCULATING BATTERY.

A NUMBER of rectangular plates of zinc are covered on one side with lead foil and on the other with a cloth, which acts as a diaphragm. The battery is built up of these compound plates alternately, with three-sided frames of papier-mâché, the same size as the plates, the open side being at the top, so that a space is left between each two plates to contain the solution. The two ends are closed by boards, the whole being held together by bolts passing right through. Above the battery is placed a glass vessel containing crystals of copper sulphate and some water. This vessel can be closed at the top, and is provided with a tubulure below, into which are fitted two tubes, one above the other, each of which leads to a distributing pipe with spouts opening into each cell. The battery being filled with water, the cocks on the two tubes are opened, the heavy solution of copper sulphate flows out of the vessel by one tube into the cells, and the water rises through the other tube and dissolves a fresh quantity of the sulphate. The lead plates are at once covered with a layer of metallic copper, and the battery then works like any ordinary Daniell cell. As the zinc is dissolved the specific gravity of the ascending liquid becomes gradually heavier, and, finally, the circulation ceases and the battery has to be charged. The largest size of battery consists of 17 cells, and has a useful surface of 450·5sq.cm. One of these was submitted to ten discharges of from 3 to 8 ampères, and a total output of 305 ampère hours. The E.M.F. was, on the average, about 15 or 16 volts; the internal resistance for the greater part of each discharge was less than 1 ohm, but rose at the end of each discharge to about 1·5 ohm. In the total of 70 hours' work 8·8 kilos of zinc were dissolved, and 40 kilos of copper sulphate used up; these quantities are in excess of those required theoretically—viz., 6·3 kilos of zinc and 24 kilos of copper sulphate. The experiments on the two smaller sizes showed analogous results, but not so satisfactory as those obtained with the larger size.

USING THE GRINDSTONE.*

ALMOST every shop, no matter what business it does, has need of a common grindstone, and there is no machine yet made which requires more thought and brain, in order to secure its operation to its full capacity, than the homely ill-used grindstone. A grindstone should be hung on a shaft stiff enough to allow the bearings, or at least one of them, to be removed 2ft. from the stone. If the stone be a heavy one, no caps are needed to the boxes, for gravity will hold the stone in place. Water should be brought to the stone through a pipe, not by a nasty trough beneath the stone, which seems to catch and retain all the dirt and filth which falls from the work when grinding. Let the water pipe terminate in a cock or a valve, or let a nozzle be screwed to the valve, and the nozzle opening needn't be more than ⅛in. or ¼in. in diameter. The water pipe should deliver its contents upon the side of the stone or upon the shaft within 8in. or 10in. of the stone itself. Water delivered in a stream upon the face of a stone always gives trouble. It seems to be all in one place, and flies off, spattering everything with dirt, while another part of the face of the stone will be quite dry and glazed. When the water is applied to the side of a grindstone centrifugal force causes the water to travel quickly toward the face of the stone, and if the stone be trued up the least particle conical—that is, one edge of the face be made ⅛in. larger than the remaining edge, and the water received at the edge having the lesser diameter, the water will diffuse itself over the face of the stone by the same power which caused the water to travel from the shaft to the face of the stone.

One of the very best arrangements for a grindstone is to put one bearing close to the stone, and make this box of phosphor bronze, or of some other composition which water will lubricate. Let the pipe nozzle deliver the water upon this bearing at a point farthest from the stone, so the stream of water will travel the whole length of the bearing towards the grindstones. Build a loose cover over this bearing to keep the dirt from falling into it. When grinding, always use plenty of water. If the stone begins to glaze, or to get muddy, there is a lack of water, and the stone is not working as fast as it might. When a man is seen trying to grind an axe or a machine knife with only half a pint of water, then you may be sure that man has not got all the "shop lore" in his head yet. When a job of hard, rough grinding has to be done, a big, coarse stone is needed; but if this be not available, the job may be well done by sprinkling sharp, clean sand upon the stone while grinding. Emery works well too, and if anything, it is a little better than sand. Sometimes, with heavy pressure upon the work, a stone will glaze a little, even when there seems to be plenty of water. In this case, it is well to have a piece of flat iron handy, and with it turn off the part of the stone which is glazed. Doing this takes but little time, and makes the stone cut very much faster. Sometimes a grindstone is so situated that "Tom, Dick, and Harry" have liberty to grind thereon. Such a case is the outcome of bad management, and different arrangements should be made at once. The writer recollects a case where a certain workman always used to play the mischief with a grindstone every time he ground thereon. No matter how true the stone, this man would always gouge out the middle of the face, leaving the stone in such condition that it was useless until it had been turned and faced up. The stone was stopped and allowed to dry a few minutes, then a little cold tallow was rubbed on the middle of the face of the stone, forming a greasy streak all around the stone. The next time the grinder attempted to dig out the face of the grindstone he got gloriously "left." Should a stone be found to contain soft spots, which may be known by the face of the stone getting full of holes and low places, a little tallow judiciously applied to the soft spots will prevent them from wearing away, and thus the stone will be kept smooth and true.

Most grindstones are used too long before they are "trued up," and consequently they get badly out of round. This matter may be attended to by more skill on the grinder's part, who will let up a little when the low place comes along, and it may also be prevented by the free use of a good truing device. It is the "proper caper" now to have a truing device permanently attached to each grindstone, then, when a slight eccentricity shows itself, a turn of a hand-screw brings the device into use, and the eccentricity of the stone is at once corrected. Excepting a truing device, the best tool to use in truing up a grindstone is a piece of ¾in. or ⅝in. pipe. A piece of pipe never gets dull like a solid piece of iron. The section is always narrow, and iron cuts a stone much easier than hard steel would do. By constantly rotating the pipe, a clean new surface is presented to the stone, which is cut away very fast.

CARD-MOUNTED FLEXIBLE GLASS FILMS.*

ON a previous occasion I had the pleasure of drawing the attention of our members to my flexible glass films, and I then pointed out the importance which, from the earliest practice of the photographic art, had been placed on the medium carrying the negative, as affecting the results.

A matter of not less importance in these days of haste and impatience is the production of a negative which will print quickly, and be equally suitable for the production of either paper or glass positives, or for enlargements; these conditions are more perfectly obtained on my flexible glass films than on any semi-transparent medium.

The drawback to the use of these films has been that they were not quite ready for use, also that they were much more costly than glass. I now send them out quite ready for use, by attaching them to cards strong enough to hold the film in the camera flat and true. When it is desired to develop the latent picture, the film is drawn from the card, and placed in the developing dish, and treated in all respects as if it were a plate. Recent improvements have made the supporting medium free from any tendency to curl or twist in the developing or fixing processes.

The only other point requiring attention in the working of these films is the method of drying, which has always been the weak point with films. The plan which I now give has been well proved, and is in all respects satisfactory, and produces a negative as flat and true as a glass plate. It consists simply in pasting the negative upon a stiff cardboard to dry; the card allows the plate to dry from the back; the film itself

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C. S. BEACH, in the *American Machinist.*

* By JAMES F. HOBART, in the *Manufacturers' Gazette.*

* By A. PUMPHREY. A paper read before the Birmingham Photographic Society.

being impervious to moisture, cannot be dried upon glass. The varnish is applied when the film is dry, and before it is removed from the card.

Directions for Drying.—When the negative is washed it is placed face downwards, all moisture is removed from the back, and it is then placed on a piece of thick cardboard which has been evenly but not thickly brushed over with paste, and the negative is well rubbed down to exclude bubbles; this may be done either with the hand, or a piece of paper may be laid upon it and rubbed. It is then allowed to dry, which will take ten or twelve hours. The paste is made by mixing 1oz. of flour with 6oz. of cold water until perfectly smooth, then boil it, and use when cold.

Varnishing.—This is an important point, and should not be omitted, as it prevents the film curling by the gelatine surface absorbing moisture. When the surface of the film is quite dry, apply the special varnish (cold) with a soft brush; it will dry in two or three hours. The brush should be kept soft by being placed in spirits of wine when not in use.

ELECTROPLATING: FLOWERS AND INSECTS.

A NEW process for electroplating delicate organic bodies, such as flowers or insects, which is carried out upon a large scale by a French company, is described as follows:—"The process consists in the employment of an albuminous liquid, with which the different substances in question are treated to prepare them for metallisation. This liquid may be thus obtained: A quantity of snails or slugs are first washed in ordinary water to free them from all earthy or calcareous matter. They are then placed in a vessel containing distilled water, and are left here sufficient time to give off slowly their albuminous matter. The albumen thus obtained is now filtered, and boiled for about an hour. After the boiling is added a quantity of distilled water sufficient to replace that lost by the boiling, and about 3 per cent. of nitrate of silver. This liquid is then placed in bottles, hermetically closed, and kept in the dark. It will thus keep without any alteration. To use this liquid for the preparation of the objects, about 30 grammes of it is dissolved in about 100 grammes of distilled water. In this solution the objects are submerged for a few moments; they are then placed in a bath consisting of distilled water with about 20 per cent. of nitrate of silver in solution, and afterwards submitted to the action of sulphuretted hydrogen gas, to reduce the nitrate of silver adhering to the albumen-covered surface of the object. Thus treated, all organic matter is rendered fit to receive a galvanic deposit; and the galvanic products obtained by this process are far superior in fineness and neatness to those obtained by any other known process. Even the finest and minute fibres and veins, the smallest unevenness of surfaces, and hairs scarcely visible to the naked eye are clearly discernible, and come out with striking neatness, the metallic deposit being of perfectly uniform thickness and adherence."—*Electrician.*

Cotton Seed in Olive Oil.—The *Drogisten Zeitung* quotes a statement to the effect that olive oil is frequently adulterated with cotton seed oil, the refining of which has made such progress of late years that it is produced quite clear in colour, and thus there is no longer a reddish tint to indicate its presence, which can only be proved by chemical analysis. The extent of the admixture sometimes reaches and even exceeds 75 per cent. One mode of readily testing for this adulteration is with nitric protoxide of mercury, the yellow simple basic salt of this chemical combination being employed ($2Hg_2O, NO_5H.O$). About one-seventh to one-sixth of an ounce of this is dissolved in a cylindrical test glass in about one-sixth to one-fifth of an ounce of nitric acid. On this solution the oil to be tested is poured in such quantity that the test glass is about two-thirds full. The two fluids are then shaken together for five or six seconds, and the change in colour is at once noticed. Cotton seed oil, when treated in this solution, becomes dark brown, or almost black; but, after a short time, the solution becomes colourless and clear. Pure olive oil has a greenish or light yellow tinge, while the solution under the layer of oil assumes a dark red or brown colour. Olive oil mixed with 50 per cent. cotton seed oil assumes in this process a brick red to a brownish red tinge. A mixture of 25 per cent. makes orange yellow to red yellow. The solution of the mercurial preparations remains for the most part colourless with mixed olive oils, as well as pure cotton seed oils. Pure olive oil should never assume a reddish tinge in this test. The redder or browner it is the more cotton seed oil does it contain. Thus, a little practice allows of a colour scale being formed, by which the presence even of 5 per cent. of cotton oil may be discovered in a few seconds.

SCIENTIFIC NEWS.

THE International Congress of Astronomers which met recently in Paris to settle the details of a scheme for obtaining by co-operation a photographic chart of the heavens have agreed on all the main points, and the only question to be decided now is that of funds, which concerns the Governments respectively represented. It was decided that the chart should be constructed on a uniform system with telescopes of about 33 centimètres aperture (say 13in.), the scale being 60mm. to a degree, or 1mm. to each minute of arc. The principal chart is to depict all stars down to the 14th mag., but a supplementary one of short exposures is to be made, registering stars to the 11th mag., the places of which would be indicated in a more precise and accurate manner by the sharper images. Admiral Mouchez announced that the French Government would enable the observatories of Paris, Bordeaux, Toulouse, and Algiers to accept at once the conditions proposed by the Conference, and M. Cruls also accepted for the observatory of Rio de Janeiro, and M. Beuf for that of La Plata. There is no doubt that many other observatories will be added, but their representatives had no authority to accept at once, without communicating with their respective Governments. The estimated cost for each observatory is about £4,000, and it is stated that France will erect one at Réunion if England will provide for one in New Zealand. A permanent committee has been appointed under the presidency of Admiral Mouchez to decide upon the final arrangements and the distribution and details of the work.

The death is announced of Mr. Thomas Stevensón, of Edinburgh. Born in 1818, a son of the Robert Stevenson who built the Bell Rock Lighthouse, he became engineer to the Commissioners of Northern Lighthouses in 1855, and during his career he made many improvements in the illumination of lighthouses. He was the author of "The Design and Construction of Harbours" and "Lighthouse Illumination." Both works are acknowledged textbooks on these subjects. A large number of papers on other scientific matters, especially relating to meteorology, proceeded from his pen. Mr. Stèvenson was a president of the Royal Society of Edinburgh in 1885, and he was also connected with several other scientific societies.

Herr George Sigl, the first to establish a steam-machine factory in Austria, and a famous builder of locomotives, died the other day in his 76th year. Unlike some of his Continental contemporaries, he did not attempt to force his productions by mere lowness of price, but endeavoured always to surpass, if possible, the high standard set by English makers. Herr Sigl was an engineer of the old school, and a man whose loss will be regretted by many of his poorer neighbours.

At the meeting of the Royal Society of Edinburgh last week Prof. J. B. Haycraft read a paper on "The Sense of Smell," in which his remarks were based on the vibration hypothesis, as accepted in the senses of light and hearing. He pointed out there was indication that the members of a certain group of subjects behaved in the same way in the sensory organs of sight as to the organs of smell. He admitted at the same time that it was dangerous to proceed beyond the truth of the general fact that one might establish far more close relationship between chemical proposition and the effects which allied chemical substances had on the organs of sensation. Prof. Crum Brown made a communication on "The Physics of Noise." He dealt only with vocal noises, which were continuous and uniform, and most easy to study and analyse. He explained that the analysis of certain sounds of the vocal organs was difficult, as, in the main, very loud sounds were necessary; and he said that he hoped to invent a machine to enable the necessary analysis to be carried out. This machine would hiss with thousand-man power; he trusted it would not be used for political purposes. He also described another machine he was considering—its main construction being a hollow wheel fitted with a series of tuned tongues, which emitted sounds on the passage of air.

At a recent meeting of the Linnean Society, Mr. P. Geddes read a paper "On the Nature and Causes of Variation in Plants and Animals," in which he remarked that the fact of organic evolution is no longer denied, but its physiological factors have not yet been adequately analysed. Avoiding the mere postulation of an inherent progressive tendency, common to writers before and after Darwin, he holds that the definite solution of the problem starts with that conception of protoplasm which is the ultimate result of morphological and physiological analysis—namely, to interpret all phenomena of form and function, of cells, tissues, organs, and individuals alike, in terms of protoplasmic constructive and destructive changes.

The Council of the London Mathematical Society have sanctioned the issue of a complete index of all the papers printed in the *Proceedings* of the society since its foundation. Seventeen volumes have been published. All persons who take an interest in mathematical researches, and who wish to know what has been done in their respective branches by the society, are invited to apply to the secretaries, 22, Albemarle-street, W., for a copy of the index.

At the meeting of the Royal Geographical Society on Monday last, Dr. Junker gave an account of his travels, prefacing his remarks with the announcement that on the 26th of October last "all was well with Emin Pasha." It would seem that he and Mr. Grenfell between them have left little doubt that the Wellé and the Mobangi are indentical, and represent different names for the great tributary of the Congo. Dr. Junker extended his journeys southward as far as the Nipoko, which is also probably identical with Stánley's Aruwimi.

Mr. J. T. Last, in charge of the Expedition organised by the Royal Geographical Society in 1880 to explore the Rovuma and Lojenda rivers and the unexplored region to the south-east of Lake Nyassa and round Lake Shirwa, has arrived at Zanzibar. He states that the expedition has been attended by successful results.

Letters have been received in Vienna from Dr. Emil Holub, dated from the Transvaal. The natives between that part and the Zambesi seem to have been hostile, as a rule, and the explorers consider themselves fortunate in escaping with their lives.

Technical education in Yorkshire is progressing in the right way with the establishment of technical schools for the teaching of the principles underlying the special industries. At Dewsbury the Clothworkers' Company have promised 10 per cent. on the total amount locally contributed up to £10,000, with an annual contribution of £50. To the Bradford Technical School the same company has promised £500 to help to extinguish a debt of £8,000. The new buildings of the Textile Industries and Dyeing Department of the Yorkshire College have been completed and equipped at a total cost of £30,000. The cost of maintenance will be £1,500 per annum.

The *Journal* of the Quekett Microscopical Club for May contains, amongst other matters, a paper on the "Finer Structure of Certain Diatoms," by E. M. Nelson and G. C. Karop, a continuation of the notes on the famous fossil marine diatomaceous deposit from Oamaru, by E. Grove and G. Sturt; the list of members, the rules, and notices of the meetings.

The Indian Government has arranged a scheme for the complete and systematic botanical survey of India. The country will be divided into four great districts, the first under Mr. Duthie, superintendent of the Government Botanical Gardens at Saharunpur; the second under Surgeon Major King, superintendent of the Royal Botanical Gardens at Calcutta; and the third and fourth under the Madras and Bombay Government Botanists respectively.

M. Mercadier, in a memoir presented to the Paris Academy of Sciences by M. Cornu, contends that the transmission of articulate speech is chiefly, if not solely, the result of molecular motion in the plate of the telephone receiver. Vibrations of the plate as a whole are only capable of yielding a single tone and its harmonics. This tone remains unaltered when the plate is supported at various points which ial points for this particular note, but these circumstances the transmission of ones is much enfeebled. Such an instru- I. Mercadier calls a mono-telephone. On er hand, a diaphragm supported in such ner as to be incapable of performing ersal vibration is still able to transmit with perfect clearness, although with erable diminution of intensity.

new Orient liner, *Ormuz*, has lowered cord for the fastest passage between le and London, or rather Brindisi, where ivered the mails, which occupied in tran- ly 27 days 5 hours of actual time, in- g a delay of 12 hours at Suez.

Victoria is the name of a new electric which is to race the *Volta* across the el. She measures 90ft. by 11½ft., and driven from accumulators charged by mo carried on board. The new launch e patent Elieson accumulators, made up als of lead ribbon separated by asbestos. plates can be "formed" and stored for use when required in secondary es.

Thirteenth and Fourteenth Annual s of the Geological and Natural History of Minnesota have reached us together. ork accomplished by these state surveys, out at considerable expense, will bear a uit in the future.

rding to a news item, fruit perfumes are hion in Paris just now, instead of floral Handkerchief and glove sachets are l with essence of pears, plum, or s. It would be interesting to learn how "fruit" has to do with these perfumes.

UL AND SCIENTIFIC NOTES.

onification of Fixed Oils.—Concerning onification of fixed oils, Mr. A. H. Allen lected, grouped, and tabulated analytical obtained by various investigators in the ation of a large variety of fatty substances ttstorfer's saponification method. Oils con- of olein mixed with comparatively small ies of stearin or palmitin, whether of or vegetable origin, neutralise about the uantity of potash—from 18·93 to 19·66 per Oils from cruciferous plants require 17·02 per cent. of potash to neutralise them. ble drying oils require 18·7 to 19·6 per These numbers are not characteristic, but hat linoleic acid must have a higher atomic than is generally supposed. With marine oils, also, the numbers obtained are not eristic, varying from 18·51 in cod-liver oil 8 in porpoise oil, which contains much acid; marine waxes, however, require only 2·30 to 14·74, much less than the marine oils. utter class contains—butter fat requiring o 23·24, cocoa-nut oil 24·62 to 26·84, palm-nut 0 to 24·76 per cent. of potash. The various es of palmitin, stearin, and olein require 9 to 20 per cent. of potash for their neutra- n. Beeswax requires 9·2 to 9·7, Chinese wax stor oil 17·6 to 18·15, Japan wax 21·01 to

lecture delivered recently at Liverpool, Mr. gg, after reminding his hearers that one- of all the gas rent might be saved by using urners, said that the small Aladdin burners, consumption of 2½ft. of Liverpool gas, on a pedestal or chandelier, give down an e light equal to that given by twenty-eight s. As compared with this, the ordinary using 5 cubic feet per hour for sixteen was referred to. But a still greater im- ent is said to have been made by the rtie burner, which gives fifty candles for feet per hour.

general way, aluminium may be said, ac- g to Mr. Edward D. Self, Stevens Institute hnology, to improve the qualities of every to which it is added in small quantities. It es the strength and lustre of the softer and renders others much less liable to cor- It alloys with nearly all the useful, as precious, metals. When alloyed with iron, ot be entirely separated in a metallic form. ontaining over 7 or 8 per cent. of aluminium es brittle and crystallises in long needles.

TICULTURISTS have rediscovered an old- ed flower, a daffodil, which differs from all daffodils. Its blossoms are of a clear, chrome yellow, and it has been called Nar- cyclamineus, on account of its reflexed h.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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NOVA ORIONIS (1885).—THE STAR D.M. (+ 20°) 1,169.

[27231.]—I NOW forward the whole of the observations I have been able to obtain of the Nova discovered by Mr. Gore in 1885. The first three have been already given in the "E. M."; but I include them here for the sake of completeness. The magnitudes have been found either by comparison with the seventh-magnitude star *p.* χ' Orionis, D.M. (+ 20°) 1,169, or a star lying south of the Nova D.M. (+ 20°) 1,172, or by estimation. As to D. M. (+ 20°) 1,169, its D. M. mag. is 7·2; but it was found by Mr. Espin to be 7·0. On the 29th of last November I found, in a sequence, its mag. to be 7·0, and at this mag. I have assumed it in reducing the observations of the Nova. D.M. (+ 20) 1,172 is 9·2 in the D.M. On Sept. 10, 1886, I estimated it at 9½, and on the 27th and 30th of the same month 9 magnitude. From these estimates it may be inferred that Argelander's mag. is about right.

1885,	Dec.	25	6½		or less.
"	"	28	7	±	
"	"	29	6·8	±	very fine tawny red orange.
1886,	Feb.	24	9½		
"	Sept.	30	9·7	±	
"	Oct.	10	9·4	±	
"	"	23	9·1		
"	"	25	9·2		
"	"	29	9·2		plainly *red* in comparison with D.M. (+20) 1,172.
"	Nov.	24	7½		vivid orange-red.
"	"	29	7·1		deep orange
"	Dec.	15	6¼	±	
1887,	Jan.	17	7·3		deep orange-red.
"	"	19	7·4		deep orange-red.
"	Feb.	5	7·8		deep orange.
"	"	18	8¼		fine red.
"	Mar.	15	8·6		ruby. *Comes* 10·2.

It will be noticed that these observations make the star pass from orange to ruby, in losing light this year. I should suppose this due to the smallness of the aperture (8½in.); but have found, by comparison in other cases, that I can determine colour with my instrument, even in the case of stars as small, when the colour is deep. I would like to know what has been the experience of others in regard to this star?

In some respects this Nova must be pronounced one of the most interesting variable stars known. It is almost incredible that it should not have been discovered long since, if it had always been as bright at maximum as it is now. If so, then we are forced to conclude that either it is a variable star in which the light-producing processes have been much intensified by some sudden event, so that its variations now take place between extremes very differently placed in the scale of magnitudes than they formerly were; or else, that it is a variable star which has come into view by the removal of some obstruction which formerly hid it. An idea involving the latter view which has been put forward, and which is to the effect that it is a star which proper motion has brought into such a position that parallax alternately brings it into view and hides it behind an obscuring body, seems to me to err in this—that it surely assumes an exceedingly large parallax, and so far as I have noticed none such seems to have been found. Have any observations been made of its parallax? The other view to which I have referred seems to derive some confirmation from the difficulty which existed in classifying its spectrum, and in ascertaining whether or not it exhibited bright lines when it was first found. There is one matter connected with the phenomena of the star's variation which has not been much noticed, I think, and yet deserves attention, in case it should turn out to involve an actual fact. I refer to the circumstance that its general variation seems to exhibit slight minor fluctuations. Of course, these may be due to errors of observation, yet they may also prove to be actual. The ordinary method adopted in drawing the curve of variation would, of course, obscure such slight changes as I refer to; for, of course, the curve is drawn so as to give the *mean.* There is always some danger attendant upon taking the mean, that we lose sight of slight, but actual, differences and variations of great consequence—a circumstance very generally overlooked. From what I have seen of the published observations of this star, I think it might be advisable to bear this possibility in mind. As it is now an established member of the class of variable stars, it would be well if it had a name upon Argelander's nomenclature, and as I have not noticed that it has one, I would suggest that as the letter U does not seem to be appropriated in Orion, that it should be called U Orionis. Most of the other stars lettered U are very remarkable objects, such as U Geminorum and U Cygni.

The star D. M. (+ 20°) 1169, has been, I find, recorded twice by me, using e.p. 45 on the 3¼in., on Sept. 27 and Nov. 24, 1886, respectively, as "pale orange." **S. Maitland Baird Gemmill.**

Glasgow, May 6.

A BRIGHT STAR SEEN AT MID-DAY FROM THE BOTTOM OF A COAL PIT.

[27232.]—OBSERVING the differences of opinion amongst writers in the journal during the last few weeks respecting the seeing of bright stars at the bottom of wells or coal pits, I am induced to write to you on the subject giving confirmatory evidence that such have been seen.

Formerly it was much more likely to observe bright stars from the bottom of coal pits than now, inasmuch as they were not so deep, much narrower, and nothing to obstruct the view out. In my neighbourhood, for instance, the coal pits were only about 40 or 50 yards deep, very narrow, and the sides well blackened with smoke from the fire cage which was let down the shaft every day to cause ventilation—conditions, perhaps, the most favourable for observing anything in the heavens from the bottom of the shaft. There were no trap doors or landing stages over the pit mouth, as is now the case to prevent anyone from seeing straight out, and there were nearly constantly persons at the bottom of the pit who had brought coals from the several workings to be drawn up the shaft. When they had "hung on," they would look up the shaft and call out, "All right" or "Go on." Under such favourable circumstances a bright star *in transit* over the mouth of the pit would almost be certain to be seen by some one perhaps a little more observant than others; in fact, I am acquainted with a case in point.

I remember when I was an apprentice, between 40 and 50 years ago, a collier or miner came to our surgery, and he had some time to stay. I had known the man from my earliest childhood, knew him to be a truthful, honest man. I entered into conversation with him about coal pits. He worked in one similar to what I have described above, and he told me, amongst other things, he had seen at mid-day or noon, when at the bottom of the shaft, a bright star right over the pit's mouth shining down the shaft of the pit. I have not the slightest doubt about the man's veracity, for he had no object to gain by telling me a lie. **Medicus.**

STARS FROM BOTTOM OF WELL.

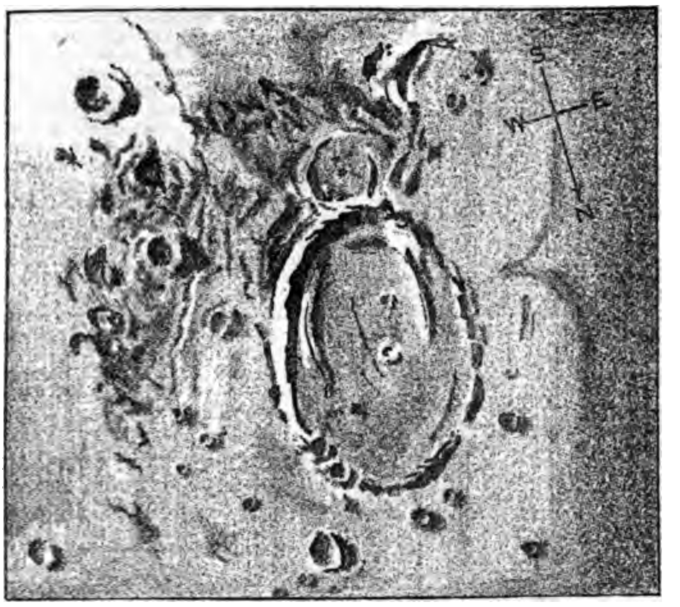
[27233.]—ALLOW me to point out to "F.R.A.S." that Sir J. Herschel does not make the statement on his own knowledge, but on very vague authority.

If "F.R.A.S." would do as Mr. Swift and I have done—look up a chimney or from a well on a bright day, he would alter his opinion. Let him remember King Charles II. and the fish.

Dubitans.

POSIDONIUS.

[27234.]—I INCLOSE a drawing of Posidonius and Chacornac, which may possibly interest some of your readers during the commencement of the next lunation. Being a formation near the western edge of the first quadrant, it is well seen in the twilight of the spring months; therefore, may be more easily drawn than many others. The sharp, knife-edge ridges of the double walls in the southern portion of the floor were well seen on the 28th with a very exquisite 8½in. With mirror. The definition was not at its best, by reason of a quivering air that I have generally noticed succeeds a hot sunny day in the cold weather of spring, such as we are accustomed to in the North. I have tried often to speculate on the origin of these singular formations with the walls of large ring plains—such as Posidonius and Gassendi. Could it be that these ring plains were formed by the accumulation of gas or vapour from some volcanic exit beneath the surface, causing a swelling or mound, like those that are to be seen in the N. of Fracastorius? These were most accurately drawn by Mr. T. G. Elger in the "E.M.," Nov. 16, 1883, Vol. XXXVIII. No. 973. Let us suppose that such swellings increase until they become so thin



that they are like a gigantic bubble, which at last bursts, and leaves its *débris* precipitated upon the floor. The centre of pressure being beneath the vertex of the dome, and the greater thickness near the circumference, when the fall takes place, there is left a more or less tumbled mass of material in the centre and rugged walls as the parapet. The materials forced upwards in the dome-like expansion will have left the floor below the level of the exterior plain, and the pressure will equalise and smooth its surface. The formation of very large ring-plains seems to have been accompanied with considerable longitudinal shrinkage. This is specially remarkable in Copernicus, where the surface seems to have been squeezed from W. to E. and from E to W. The great tension placed upon the surrounding surface by the formation of the swelling would, after its subsidence, cause these wrinkles and furrows which are seen branching north and south from the ring plains. The density of the moon compared with the earth, and her lesser force of gravity, must considerably modify any idea, of the nature of the moon's crust that we may have formed upon what we know of the crust of the earth. The density of the moon being 3·44 compared with water, we must see how honey, or treacle, or tar would behave under a force of gravity diminished to ⅙th, if we would know what appearance the bursting of bubbles would leave upon the surface.

The rills in the interior of Posidonius were not observed; but the fine rill E. of Bond was well seen in its northern extension. Neison says, on the authority of Schmidt, that this rill is 200 miles in length. I could see it well with 8½ With mirror; but not in its extreme southern extension. Afterwards I could detect it, though not plainly, with 8½ refractor. This rill, and those of Chacornac and Le Monnier, would be interesting objects of investigation at the next lunation for those of your readers who are interested in Selenography. It will be best seen on May 28th. I was able to catch a glimpse of the principal rill E. of Burg, but the moon was now low and the air still more unsteady. A look at all these objects will be interesting another time. **John Bone.**

St. Thomas's Vicarage, Lancaster, April 30.

"JOURNAL" OF THE ROYAL MICROSCOPICAL SOCIETY.

[27235.]—As this subject will, I understand, be dealt with in the next number of the *Journal*, I will not trespass on your space further than to point out that while "F.R.A.S." thinks his word has been "impudently denied," my doubts on the subject are exactly confirmed, as he now admits that his inquiry was not made of any authority of the R.M.S., both of whom were absent. The only difference between us is that whereas I (wishing to be polite) described the person whom he took for an authority of the R.M.S. as an "irreverent wag," "F.R.A.S." says he was a "person who emulated the clown in a pantomime." The distinction is not worth quarrelling about. We both mean the same thing; but how was it that the chalk and paint, and even the broad grin, were not better recognised by "F.R.A.S."?

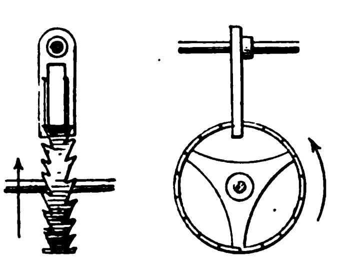
One Who Knows.

[This ends this matter. Our space is too precious to devote to the endless discussion of the merits or shortcomings of other publications, of no interest to one in a hundred of our readers.—ED.]

AN OLD ESCAPEMENT.

[27236.]—ABOUT three years' since while on a visit to Lulworth, Dorsetshire, I found in the tower of the church there the remains of the movement of a turret clock still in position, the escapement being of the form represented in the sketch.

I could obtain no information on the spot as to its age or how long it had been out of use. The pendulum had been removed; but from the attachment still remaining on the verge, it was evident that its connection with the escapement had been by links.



Not having been able to gain any information as to the date to which this escapement belongs or by whom introduced, it occurs to me that some one among the many horological readers of the ENGLISH MECHANIC may be able to clear up the matter. It will be seen that although the escape wheel is but a double-cut, old-fashioned "crown," the arrangement is not without its advantages. The pallets may be formed either to make the escapement "recoil" or "dead." The impulses are both in the same direction and endwise on the pivot of the verge, which would doubtless be provided with an end piece.

The examination was made under difficulties, the clock-room floor being so rotten that it was unsafe to venture, and the room so dark that it was only by continually striking wax vestas that the imperfect view was gained. I am, therefore, unable to say whether the pallets were "dead" or otherwise. The movement appeared to be constructed of brass or bronze, and in very green condition. The chief objection to this escapement would appear to be that the wheel is perhaps somewhat heavy in comparison with the ordinary "spur" on account of its necessarily broad rim and the plane of vibration of the pendulum being at right angles to the plane of the wheel, rendering it somewhat awkward when compared with the ordinary arrangement.

May 2nd. **A. Marson.**

THE SEXTANT AND ITS USES.

[27237.]—IN reply to Mr. John Hampden (query 27179, p. 200), I beg to say that it is *because the distance from the earth to the sun is so much greater than the diameter of the earth* that we are able to measure "such infinitesimal angles" as would be necessary to fix the position of the ships referred to; for example, Let E be the earth, and S the sun, in the figure below (Fig. 1) and let a, b, represent 4,000 miles on the earth, and let the distance from E to S be 93,000,000 miles (approx). Now, since the position in latitude of the ships can be obtained from the meridional altitude of the sun above the horizon of the place of the ship, it will be seen that the smaller the circumference of the globe representing the earth is, the more accurately can this angle be obtained, because a small distance on its surface will make a great difference in the angle measured. For instance, suppose E the earth, and S the sun (Fig. 2), and place an observer at ¹O, the meridian altitude of the sun at this place will be the angle a, ¹O, b. Then let him move 30 miles to the south at ²O, and the angle c, ²O, d, will represent the meridian altitude, which, it will be seen, is much greater than a, ¹O, b. Now go through the same process again, only make the earth much smaller, and it will be seen at once that 30 miles (not minutes of arc) will make a much greater change in the angle of altitude. So much for the first part of the question. With reference to what is said about the motion of the earth in its orbit, allowance is made for this by correcting the declination of the heavenly body; but if a star is used, the amount of correction is so small, owing to the immense distance, that it is hardly necessary.

FIG 1

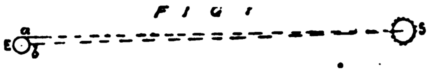
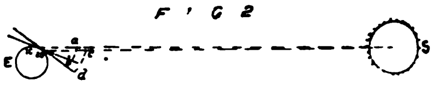


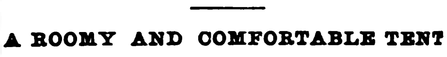
FIG 2



The above also answers the second question, for the difference of temperature between the Torrid and Frigid zone is caused by the great angle that 3,000 miles makes with the sun on a globe of the size of the earth, thus causing a great difference in the angle of the rays falling on the earth's surface, and making the duration of sunlight so much longer in the Torrid zone than it is in the Frigid. Upon consideration, it will be seen that the supposed difficulties are really the solution of the matter. **Edward A. R.**

A WORKSHOP KNIFE.

[27238.]—THE skinners of India always use a blade of the curve here illustrated, and I always carried a stock of these knives in all sizes for flaying wild beasts. In after years an engineer friend of mine undertook to remedy the defects in a new sewing-machine, and broke a new table knife for me, of Harrison's best steel. I thanked him for the accident, and ground the blade into a useful tool. I keep it with razor edge in a brass sheath on my work-table for cutting hide, pasteboard, &c., for shaping cork—oiling the blade first; for dividing rubber—dipping the edge in water; reducing soft-wood patterns, and many other purposes. **Eos.**



A ROOMY AND COMFORTABLE TENT

[27239.]—I BEG to inclose drawings and description of a tent I made and used in 1877, which might interest some of your readers, being the result of many experiments and experiences. It was made for a walking expedition with three companions, and proved efficient in all weathers, the weight being probably one-half that of the tents usually obtainable. A note I made puts this at 16lb. for tent and pegs. The whole is constructed to make four equal portions when struck. Fig. 1 shows the tent with entrance open and ground sheets in place. It is divided across the middle and along the top ridge and ends, making four pieces, which for use are secured together by buttons and buttonholes. Fig. 2 shows the other end of the tent, in which cooking utensils are stowed. This end portion is made of fine holland, likewise the entrance pieces and the small wall at each side; the rest is made of canvas. The ventilation is a separate piece with a strip of whalebone sewn in at each end and secured in place, as shown, by buttons. This is an essential feature of the tent. The poles are made of four bamboos (the length of a walking-stick each), fitted at their ends with long brass ferrules or tubes. These ferrules again fit into two short lengths of brass tube, one of which is soldered on to the back of a flat lantern, the other having hooks soldered upon it. For use, two sticks are united by being pushed into the lantern tube, the other two into the hook tube, thus forming two poles. Into the top of each pole fits a length of small brass pipe with collars attached, the [illegible] collar to prevent slipping in of the tube; t [illegible] other

FIG 1.

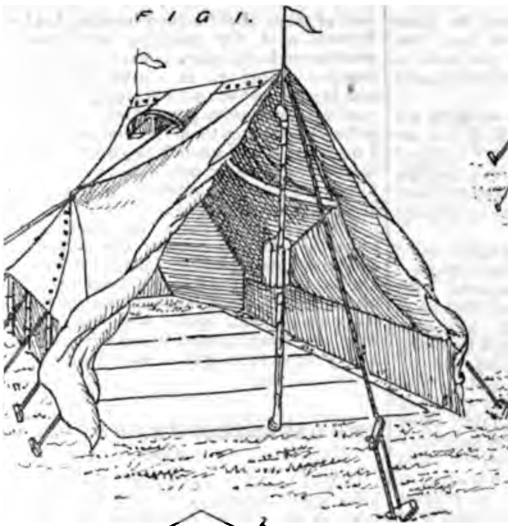


FIG. 2.

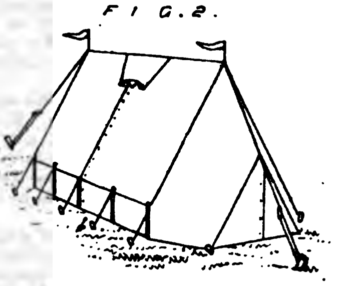


FIG 3

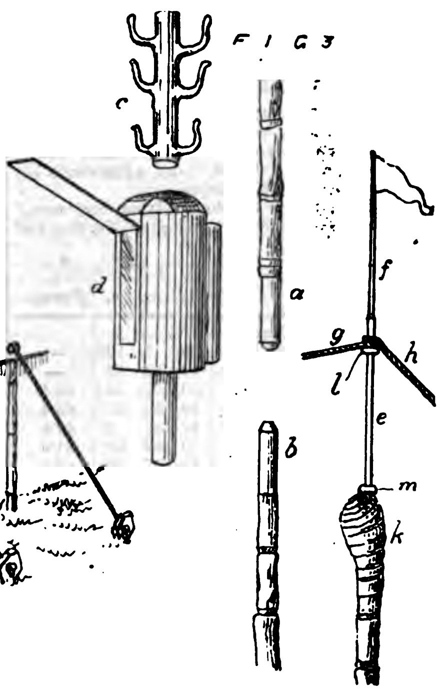
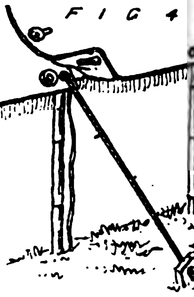
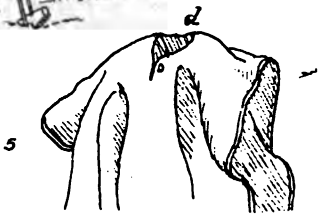


FIG 4





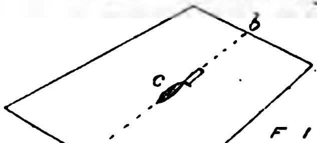


FIG 5

ɔrt the ridge and straining ropes of the tent. all walls of the tent are supported by thin ımall pegs, and lines. To give additional ıe centre of each side of the tent was pulled hown in Fig. 1, tapes being sewn from the to the centres of these sides to resist the

As ground sheets we used indiarubber cs," being sheets 7ft. by 5ft., with a slit in ldle. These sheets were used doubled in ıther, and in wet, one-half on the ground, er half as covering to the body. They also ıs waterproof cloaks in rainy weather. We d a narrow fur rug and a woollen bag for ; and our cooking utensils fitted into camp- which again slipped into canvas haver- or carriage. These camp-kettles served ols. This tent was used from the of April till end of August, though confess we did little walking with it. How- e were able to carry all our things on our quite independent of other help, and in these cycles such a tent would be even more port- The parts invented were, the adoption of for parts having no strain, the addition of hen" at one end, the increase in roominess ıing the tent on walls, the adoption of s for poles, and method of obtaining the with only two walking-sticks, the method of ing the walls, the ventilator, the lamp and rrangement, the ponchos and the bags. 2, 3, 4, 5 show these features. I may say ıboo walking-sticks were amply strong in thers, being sometimes found bent like a ter a rainy night, through carelessness in ropes. The height, length, and breadth of ıre portion were each 7ft.

silke.

CONTINUOUS BRAKES.

0.]—I AM quite at a loss to know what use- ct Mr. Kiernan (p. 224, 27221) can hope to by the publication of statements which are ıccordance with the facts. He states, p. 224, important feature in the vacuum brake is valves, and that "they were no part of the s apparatus."

to refer your readers to the patent of Mr. ıanders dated 12th March, 1879, No. 980, in he fully describes and illustrates an auto- valve to be placed in the brake van for ng air to the train pipe to obtain rapidity n.

epted an invitation (January, 1881) from nders to inspect his brake as fitted to a d train working between Bristol and Bir- m. I rode part of the way in the van and d the working of those valves. In face of cts as these, how can Mr. Kiernan expect ıders to believe that valves were no part of ders apparatus?

said in a former letter, Mr. Kiernan *is* a great point about the name of the auto- acuum brake. I am perfectly well aware ıe automatic vacuum at Guisburn was as the Sanders, as I was present at the invitation of the railway company.

Sanders, assisted, I believe, by Bolitho, in- d the automatic vacuum brake upon the Western and Midland lines. Those com- then purchased the right to make the apparatus for themselves. Mr. Dean, of the Great Western, and Mr. Clayton, of the Midland, made some alterations, and Mr. Clayton's alterations have since become the property of the Vacuum Brake Company. Your readers will thus see that the changes are in *name*; and, as a matter of fact, I may say that the Vacuum Company to-day cannot obtain better results than those obtained by Messrs. Sanders and Bolitho in 1880, 1881.

Mr. Kiernan occupies a considerable space with extracts from my various speeches before meetings of the Amalgamated Society, from my letters, and from "Safe Railway Working." I do not know the object of his giving those quotations; but they distinctly prove that my views in 1830, 1884, and 1887 are exactly the same, and the readers of the "E. M." know well that since I formed my opinion upon the brake question in 1875, I have had no necessity to change, as it still proves to be the correct opinion.

It is perfectly useless for advocates of vacuum brakes to constantly say "what their brake can do." Why do they not have an official trial and prove it? Let a committee be formed of independent experts and practical enginemen, and, as the *Engineer* of last week remarks, "some valuable and interesting information would be the result." If Mr. Kiernan and the Vacuum Company believe that their brake is the best, they should do all in their power to push forward such a practical trial; if not, Mr. Kiernan's letter cannot alter the facts.

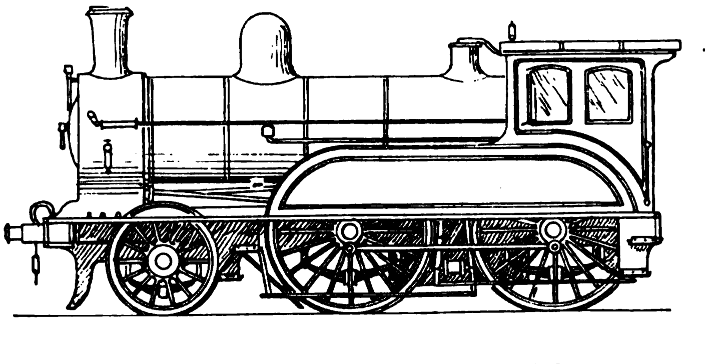
Clement E. Stretton, C.E.,
Consulting Engineer Amalgamated Society of Railway Servants.
306, City-road, London, E.C., May 2.

N.E.R. EXPRESS.

[27241.]—I VENTURE to send the accompanying sketch of the new N.E.R. express locomotive, designed by Mr. Worsdell, and which, I believe, has not been illustrated in your columns. The driving wheels are 6ft. 8in. diam., cylinders 18in. by 24in. by 26in., and working pressure 175lb.

The engine has been working the Scotch traffic, and is reported to have drawn heavy trains up the Grant's House incline beyond Berwick without the usual bank-engine.

F. S. Bowles.



A REMARKABLE RAILWAY COLLISION.

[27242.]—I SHALL hope to see an explanation from those who so zealously defend all the actions of railway servants, especially when amalgamated, of the remarkable accident which occurred at Harringay Park station on the Tottenham and Hampstead Junction Railway in the early morning of March 19. Briefly, the accident occurred because an engine and van were allowed to run "down" on the "up" line until they went full pelt into a passenger train proceeding up to London. According to the Board of Trade Inspector, the collision was due to the starting of the G.E. engine against the disc signal at danger, and to the unaccountable omission of the G.E. driver, fireman, and guard (! ! !) to perceive—first, that the engine had not gone through the cross-over road, and secondly that it was running upon the wrong road for nearly two miles through stations and under bridges. The inspector does not attribute any blame to the signalmen at Upper Holloway or Crouch Hill for failing to see that the engine was on the wrong line. As he says, that was the last thing they could have suspected, and the morning was dark. Let me give these details. The engine ran past four platforms and two intermediate signal-boxes, under, I think, no fewer than ten bridges, and then crashed into a passenger train leaving Harringay station. If anyone had been killed, would that have been an accident, or would anyone have been found guilty of manslaughter? There may be some explanation; but if so, one would like to know what it is, for if ever there was a case of (what might have been criminal) carelessness, this Harringay Park accident is that. The beautiful blunder at King's Cross, when two trains were permitted to attempt to run into the station at once on the same metals has never been explained in these pages; and I suppose the above accident will not. I have seen only a newspaper report. Probably some of your readers have the full text, and can therefrom preach a little sermon as a warning, which may serve as the fly in the pot of ointment—the grit in the unctuous matter which is so persistently rubbed in.

It is charitable to suppose that those in charge of the G.E. engine were sleepy, from the effects of long hours. If so, the fact shold be known.

Nun. Dor.

SOME EXPRESS RUNS.—IV.

[27243.]—Returning from Scotland last year with the 10.15 a.m. Glasgow, the highest speed attained on the G. and S W. to Carlisle was 67 miles an hour, and on the Midland afterwards 73½ miles. The load was 17 coaches.

The following run by the "Flying Scotsman," I made in October, 1886, 8ft. "single," No. 666, and 10 coaches:—

		h.	m.	s.	Speed.
	King's Cross mile post	10	1	10†	—
13*	"	10	22	52	—
17	"	10	27	18	54·1
20	"	10	30	10	62·8
26	"	10	37	0	52·6
32	"	10	42	51	61·5
37	"	10	47	10	69·5
48	"	10	57	40	62·8
53	"	11	3	10	54·5
57	"	11	7	10	60·0
65	"	11	16	40	50·5
71	"	11	22	13	64·8
76¼‡	Peterborough	11	28	27	50·4
78	mile post	11	32	6	—
100	"	12	0	58	45·7
105¼	Grantham	12	7	56	45·0§

Remarks.—* Foggy till post 13. † Due 10.0. ‡ Usual slack, 10 m. p. h. § Due 12.9.

Has any reader of the "E.M." travelled by the 9.12 a.m. Peterborough (Mondays only), booked to arrive at Finsbury Park, 73¾ miles, in 80 minutes—over 55 miles an hour? This is at present the fastest timing in the country. **Kappa.**

RAILWAY SPEEDS.

[27244.]—I am gratified to find—from communications addressed to me privately, as well as from letters in these columns—that my remarks on railway speeds and timing of trains have been read with interest. I was quite prepared to have my conclusions as to possibilities and probabilities of maximum speeds challenged, so I am not at all surprised to have instances of 77 and 78 miles an hour hurled in my teeth. I do not intend to argue the point further on the general question. I have said my say (pp. 393 and 411, Vol. XLIV.), and need add nothing. But with regard to the specific case offered by Sir Owen Scourfield (Vol. XLIV. p. 479) of a Midland engine (1562 class) averaging 77 miles an hour over an undulating road, I can only say that when engines of that class, and those of the 1327 and 1667 classes, were specially tried over that same length, they failed to accomplish anything like such a speed. Instead of doing the 10¼ miles from passing Luton to passing St. Albans in "8min.," they very rarely, even on the fast Leeds expresses, could manage it in 10min., and only on one or two occasions succeeded in doing it in a few seconds under 10min. My experience in some dozens of trips was that the speed usually ranged between 50 and 65 miles an hour from Luton to about the 23rd mile-post where the five-mile descent of 1 in 176 begins. The speed then rose rapidly to 70 or more near St. Albans, to fall again ascending past Redhill round Elstree summit; so as the engines could not do the alleged work when specially tried, it is unlikely they would achieve the feat in ordinary practice, and I fear your correspondent has inadvertently read off "8min." instead of "10," or else that his watch must have stopped, and gone on again, as they sometimes have an aggravating way of doing. I should add to my former hints this—that it is always safer to carry *two* watches—or a watch and a chronograph—when any special timing is to be done, be the second timekeeper ever so cheap. I invariably adopted this course.

I may remind other correspondents that I did not name "75 miles an hour" as the absolute *maximum possibile*, but that rate, "or a trifle over," which latter I have in a few rare cases recorded. Perhaps I should have said "about 76"; but anything over 75, with ordinary trains, is most exceptional, and even that is not frequently, attained.

Respecting my runs with old "single" engines Sir Owen Scourfield says I am probably unaware that they "have been quite recently rebuilt," and are "to all intents and purposes new engines." He is wrong: I am well acquainted with the history of all those engines, and I know that they never had *new boilers;* but, if they were "as good as new," it is strange that nearly all the engines I mentioned have since been either broken up or placed in the "condemned" list.

The distance stated by the same correspondent to have been run by "Prometheus" in 37min. is not 35 miles but 34½, and I have known the same engine do it with a similar load in 34m. 50s. That, however, proves nothing, for the road is nearly dead level, and there is even a slight descent between Twyford and Reading.

"French Loco." (page 452) is quite wrong in his dimensions of No. 2009 (G.W.R.), which has not "8ft." wheels but 7ft. 6in., and has not "1,952ft." of h.s. but only about 1,600ft. I observe that his "best" and "worst" runs between London and Swindon are identical in time. Did he only make one each way?

With regard to the coal lists, of which several have been published as showing the fuel-consumption of Mr. Webb's compounds compared with other classes, I should like to point out that mere coal consumption *per se* goes for nothing; an engine which did no work at all, but only stood in steam, would consume far less than one which worked, but it would assuredly be less profitable. The whole question turns on the consumption of fuel *in proportion to work done*, and to test this fairly every source of resistance must be taken into account—weight of train, speed, gradients, curves, condition of road, state of weather, else the comparison is unfair and untrustworthy. Hitherto no reliable data on these heads have been authoritatively published; therefore my judgment on the compounds is still suspended, but as Mr. Webb and his directors are satisfied, I really do not see why other people need distress themselves on the subject.

Wellington, N.Z. **Charles Rous-Marten.**

WORKSHOP SCRAPS—GOOD METAL.

[27245.]—Two or three years ago, being in want of reliable centre punches, I obtained some of the best American octagon steel rods, ⅝in. and ⅜in.; after annealing two 6in. pieces and bringing the points to 60 degrees taper in the lathe, and a trifle at the blunt ends, leaving the octagon entire about one-third of the metal, I carefully brought them to red heat in a dull coke fire. I then hardened them throughout, dipping endways in rather warm water. I removed and dried them while the wrought-iron pot of molten lead was preparing; when this was ready I plunged the blunt end first, cautiously watching the colours. As the brown tint rose towards the point, I grasped each one with hot pincers; and as the colour rose to pale yellow near the point, I lifted and quenched, point down, in the same warm water, leaving the punches to cool therein. Though submitted to many hard blows, they are as good as ever; the smaller one has once had its point rubbed on a stone. The heads are slightly enlarged by hammer blows.

Some time afterwards I made a set of boring bits to do the 1in. holes for mandrel screw in chucks. I got some picked octagon steel, used for making quarry bars. From a wooden model I got the quarrymen's blacksmith to forge the metal into shape for the lathe, at least the D-bits, for the greater part of the work on the pointed bit, with cross edges and hardwood cylinder-guide, was done by the file. These three bits I constructed of very slight variation in diameter (tissue paper thickness perhaps), a half-way hole to be made by the pointed, and followed up by the D's. Having gauged my three tools and finished them, I gave each separately a heat in a slow fire of leather scraps on the burning coke, till the metal showed blood-red up to midway or more of the long shanks, dipping endways in rather warm saline bath. I removed and dried each bit; then laid half the shank across dull red coke, watching the colours rise. At the proper tint I lifted the tool, and quenched the cutting end with a slow, stirring motion till it reached the bottom in the same jar of warm saline solution as before. The point drill and finishing D-bit have done their work well, without a scratch, on the rather hard cast-iron chuck; the intermediate has depressed corners, and will have to be rehardened. I noticed that the metal had been overheated by the smith when I was turning it. I must keep it for brass boring if I cannot cure the temper. I have just turned out a tiny D-bit, 1/16in., its edges as hard as a file, for boring solid ferrules I require as steam jets, done in a tin tube muffle full of horn shavings, and quenched in the tallow pot. This is from ⅛in. Sheffield square stuff.

Case-Hardening.—The better the iron, the better the quality after the operation; hence I make everything of the pure, ductile Cumberland iron, so malleable that the hammer will flatten a cold bit without making cracks. I can actually scrape it with a knife-blade after forging and filing. Never throw away the old cast-iron pots and kettles; I have done some good things in such vessels I got from a rubbish-heap, using plenty of clay with a piece of old sheet metal behind it for stopping any cracks or holes in the pots. Pack your pieces, without touching, in broken bones, as tightly as possible; a plate of sheet metal fastened with stout iron wire, clayed over is better than any other cover; lastly, rub all over with a good coat of clay. I get a good burning heat out of the furnace used for warming my house; and the washhouse boiler-place is nearly as good; the cast-iron has melted out in a patch from side of kettle and big pot at second burning; but I hope, with good precautions, to get a third one out of them before consigning them to their old place. When I draw my pots I quench the pieces of work at red heat in warm water, acidulated with sulphuric acid, for all works to be polished; in urine, for all such as are to remain mottled.

With all my patience in experiments, I have hitherto failed in getting the iridescent colours and maculated surface (mackerel colour) of the high-class gun-makers. Those inimitable lock plates they do not manufacture, but obtain from the experts, and stamp with their own names. This, and much more, I learnt when amateuring in a very respectable gun-maker's workshop.

Eos.

THE CATASTROPHE OF 50 CENTURIES AGO.

[27246.]—As "Memnon's" last (p. 197) is to have some comment, I will be very brief, and without the least pretence to alter any view of such persons as him or "F.R.A.S.," who must blunder on to the last, but to open as many other eyes as I may to their ways. It is just as vain to refer me to Manetho or Sayce as to quote for "Memnon" the Bible or Ussher, because I regard the whole of Egyptian so-called "history" in Manetho or on the monuments as fabulous rubbish. Probably all the dynasties and names are those of real rulers, but many of whom were simultaneous over different provinces; as in the scheme of Wathen, who fitted them all into 30 centuries quite as well as Bunsen in 55 or Sayce into 70. All the monuments date themselves (if we believe them) in some half-dozen reigns alone, separated by long, traceless intervals of many centuries each! What would be said of English history, or rather of some reign-list like *Whitaker's Almanack*, if that alone were extant, and all vestiges of buildings dated themselves from the four Williams and three Richards, but not a stone from any other reign?

The Babylonian "records" are in nearly the same plight, but with the difference that the Flood is not ignored (for in Classic times the Egyptian was the sole priesthood to deny it), and in the early periods years are often put for days, and *sari* of 3,600 for the natural *saros* of 18 years 10 days, the name of this lunar period having become also an arithmetical term for 60 sixties.

In short, I deny there is a shadow of artificial "records, pictorial or in writing," reaching back to within 10 centuries of the time whereof we are speaking. The sole evidence thereabout is geological, in rocks, gravel, or alluvium; so that when asked, "Why I say 5,000 years ago?" the sole answer is, "Because the gravel and alluvium testify to such catastrophe *about* that time ago," with no pretence to define to a century, but certainly between 45 and 55.

There are two independent questions that "Memnon" is constantly confusing—the physical one of whether there was a general Flood, and the literary one of whether its date and relics agree with the account in Genesis. He urges that one 50 centuries ago disagrees with "the regular Bible," which he says is Ussher's, and would have it but "4,235 years ago." But I utterly refuse to call what is well known to have its 20 chief dates corrupted "the *regular* Bible." This would be as bad as Ananias, calling a thing true that we know to be false. There has been, providentially, for many centuries, every evidence possible that the numbers were once as in the Septuagint, and were purposely altered therefrom, and when and why. On the other hand, our current Septuagint, by an obvious mistake, made one generation into two. Its Cainan and Salah were not father and Son, but one man (called in the other copies simply Salah); and where we find its MSS. with three readings—namely, Nahor living before Terah either 29 years, or 79, or 179, by taking the longest (also the most consistent with contexts), we get for the Flood the identical year (3102 B.C.) that two perfectly independent traditions, (for aught we know independent too of each other) have preserved—the Hindoo, and that of Abulhassan Kuschiar. Herschel's "Outlines of Astronomy," art. 926. This is a very evidential coincidence, not to be lost or neglected. The odds against its happening fortuitously were fully 3,000 × 3,000, = 9 millions to 1.

When "Memnon" asks why I regard "sons of Elohim," in Gen vi., as descendants of the Man of Eden, I reply that this is the only named individual, besides Christ, anywhere once called a "son of God." He is called so in the New Testament, at the end of Luke iii. On the other hand, the most natural meaning to put on "daughters of men" is the descendants of the men first mentioned—the Adam (without article) or Mankind of Chap. i. "Male and female created He them." After this, in Chap. ii., we read of a particular man, "Ha-adam, whom He had formed," and whom He then placed alone (without a female) in a garden, with warning that if he ate of a certain fruit he should die. Afterwards a wife is given him, who, though aware of this prohibition, induces him to break it; (an Apostle says, without being deceived, and so Milton has authority to represent). He is then expelled with her, and eventually dies, only after ten times the life of ordinary men. His heirs, for ten generations, have the same pre-eminent longevity, except one, the seventh, who leaves the earth without dying—presumably as his ancestor was to have done if obedient. But this ancestor, "Memnon" tells us, "brought by his sin all the woes and death on the world." Where does he read that? I cannot find it in Scripture. I can only find him bringing woe or death on himself. Bringing them on posterity I shall not accept on "Memnon's" bare word. The Book makes us all descendants of Enoch too, and nearer related to him than to his seventh forefather. But we do not inherit Enoch's immunity from death, (or, at most, only one prophet did). If we do not inherit goodness or anything good from the nearer ancestor, on what principle of justice are we to inherit death and all evils from the more distant one?

I do not imply, as to fauna, that it was not various in the quaternary age; but less varied in the different regions than now. All authorities agree that the earlier we go, without exception, the more it approached uniformity. Prof. Mivart has just said (*Cont. Rev.*), "horses, camels, elephants, and rhinoceroses, all of which now inhabit (the action of man apart) the Old World exclusively, were then" [in pre-gravel times] inhabitants of America. Something since then—indeed so recent as the gravel over which only 5,000 annual river deposits of alluvium have been made,—has blotted from both Americas their four hugest animals! And this though one of them, as soon as reintroduced, proved by overrunning the southern continent that no part of the Old World was ever so fit for it! "Yet they," he adds (the South American horses) "had become entirely extinct long before the time of Columbus, and the vast herds that now inhabit its southern plains are all the descendants of horses introduced—for the second time—by the agency of Man." There are other beasts (as the musk-sheep, that he mentions two pages later) that have "survived in America after having enjoyed a more cosmopolitan existence." In short, as I said, nothing like "survival of the fittest" has existed, in these last 50 centuries, on any land but the Old World. The merest accidents have stocked even America with fit or unfit at random.

Another problem that "Memnon" has to solve (having baffled all like him through the centuries) is, How did man get possession of the score or two of plants (wheat, cabbage, turnip, &c.) that have never been seen wild? and, more remarkable still, of one entire animal species, the larger (or Arabian) camel? How came every individual camel of that useful species, that historic man has ever seen, to be human property?

But nobody has ever supposed native American or Australian species to have gone from Noah's ark. Genesis itself perhaps alludes to animals otherwise saved at chap. ix. 10. Whatever the words meant to ancients, they were so devised as to bear such a meaning as I am suggesting now.

The Frenchman who investigated the Mediterranean deltas was Texier, and a memoir on them, published by the Academy, laid it down that all were of the same date, having begun 50 centuries ago. Of course the filling of that sea up to ocean level is not yet complete, or there would be no current at Gibraltar. But I should not, for evidence whether it had risen in historic times, have cited alluvial places, as Venice or Ravenna. Buildings in them need raising, not because of the sea, but of the soil growing higher. The "oldest building" mentioned in Ravenna was not Theodoric's Tomb, but the Baptistery. The quotation from Ruskin, about the tide at Venice, does not the least imply the mean sea-level to have remained constant. Some tides in our time have covered the Piazza pavement, which formerly none did, though it has, if ever altered, been raised, as those of all old cities are.

Asking "how the Ark could float five months, and only be caught on a new mountain," is just like asking how Magalhaen's vessel, on first doubling Cape Horn, could sail ten months and only see a particular island, quite the other side of the Pacific. Noah's vessel could not sail, but only drift; and it is very curious that the very Egyptians, who were the only nation to get the memory of the Deluge ignored from their legends, preserved in their worship of Osiris the most probable tradition of its very course. Osiris was the general Saviour, the nearest heathen analogue to Christ, the dying deity, or deified humanity. Now his death, by the treachery of a brother named Typhon (a name for storm or flood), was celebrated, says Plutarch, the 17th day of the second moon of autumn, when the sun is in Scorpio. Typhon, having induced him to lie in a wooden coffin, shut down the lid and secured it by pouring in melted lead. This was then launched from Thebes down the Nile, it issued to sea by the Tanitic branch (which was therefore too accursed to be named), and was carried to Byblus, on the Phœnician coast, but only recovered on inland mountains further north; and from the scattered fragments of the corpse did all foreign nations spring. Now the 17th of the second month of autumn could never correspond to any solar anniversary, nor even a lunar phase. The sole distinction you can find for that day is that it was the day, according to Genesis, that Noah, "because of the waters of the Flood," entered the wooden ark, "and the Lord" [by downpour] "shut him in." Again, the railway speed wherewith a vessel, from any part of any continent, must have been hurried by the directest river course to sea, would sweep any from the Nile by its north-east mouth, with an impetus and in a line that you will find to enter on Asia at Byblus and pass over it to Ararat. Why should not this be a true memory of Noah's course? If *Thebeh* (the very name Genesis gives his ark) was the spot where he built it, this being precisely that place in the Old World that *never sees a rainbow* (or has least chance of one), this phenomenon would afterwards be new to his junior companions, if not to himself. But, further, observe that in the time of Diodorus the Thebans paid divine honours to a cedar ship 280 cubits long, gilded without and silvered within. This capital of "the land of Ham" was the Diospolis, the city of Jupiter Ammon, who is Ham. Why should not this patriarch, when leading his tribe sunward up the great river, have recognised, or believed he recognised, the very plain where he had helped to build his father's vessel? If so, a full-sized reproduction thereof was the very thing wherein his idolatrous mind would embody the fetishism that his posterity kept up for all those ages.

May 3. **E. L. G.**

[And here ends the matter as far as our pages are concerned.—ED.]

NIBLETT'S SCREWING APPARATUS.

[27247.]—I THINK that Mr. Wenham is wrong in his conclusion that the above apparatus is imperfect in theory. If the uneven motion given by an ordinary swash-plate were corrected by making it into a portion of a screw, he would be quite right in saying that the correction would not hold good when the inclination of the plate is varied. But I understand, not only from "O. J. L.'s" articles, but also from "F. A. M.'s" statement in letter 27039, page 105, that the ring is plane, and that the correction is obtained by giving the edge a peculiar curve. In my letter (27138, page 178) I proved that this curve could be found, mathematically and practically, and that its correctness is not disturbed by inclination of the plate.

Mr. Wenham's problem is practically a restatement of that of "F. A. M." in the letter referred to above, and could be solved by the same method, the order of sequence being slightly altered.

I am not a mechanician, but it occurs to me that Niblett's apparatus, or a modification of it, might be used to manufacture cross-cut screw-cams. The straight portion of the ring would have to be diminished and rounded off into the rest of the curve. If the cutting tool in that case be not removed from the surface in the back stroke, it will trace out the proper curve for the cam with rounded ends.

Leeds. **H. C. Pocklington.**

[27248.]—I CERTAINLY did believe that no question could be raised after the mathematical demonstration of "Pocklington" had proved that the curve of the raised ridge of the disc when correct for one pitch was equally so for all; but, perhaps, I am unfortunate in my faith in mathematics. Anyhow, I shall not trouble the readers of the ENGLISH MECHANIC any further. I have put the invention before them, stating its merits so far as I know, and have proved them. I use the apparatus, and shall continue to do so, as I find it satisfactory; others must do as they please.

O. J. L.

LATHE MATTERS.

[27249.]—MR. NEWALL says he cannot understand why the round lathe band has survived so long for lathes. I have been told by master workmen that the disadvantage of the flat band is that it limits the number of speeds to three or four—i.e., 7 to 1, 6 to 1, 5 to 1, and 4 to 1. This number is quite sufficient for wood and light metal work; but on back-geared and screw-cutting lathes for heavier work two or three slower speeds are also required—i.e., 3½ to 1, 2½ to 1, 1½ to 1, and these, with a flat band, would be inadmissible, in consequence of the breadth of the driving pulley.

I remember, some years ago, in an optician's shop, cutting a screw tap in a screw-cutting lathe, fitted with a flat coned pulley. There were three speeds, the slowest about 5 to 1. This speed being too quick, there was nothing left to do but use the back gear, which was too slow. If this lathe had had a round belt, there would have been a speed of about 3 to 1, which was the speed required.

A. F. Shakespear.

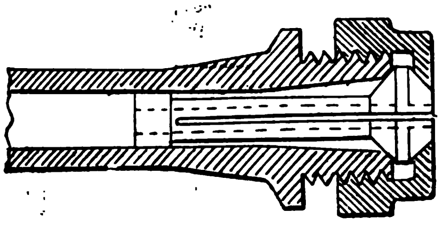
Lüttichaustrasse 14, Dresden, May 7.

[27250.]—I THINK I see the point made by "J. K. P." as to the buttress thread, though it is rather "unthinkable." I suppose if it has any centring power, it must be extremely small. I do not think there can be much difference in the strength of the thread; but at any rate the force tending to burst the nut would be eliminated, if that be an advantage. As to deformation by forming chuck-screws by a succession of taps, how would such deformation arise? and would it not be obliterated by the last tap? Should a chuck go on with as little shake as possible, or is it better to allow a little looseness? I have just been fitting some, and have made two long taps, one to mark the thread for chaser, and one to finish. They are made parallel, not taper.

To "A Novice" I would say that though it may be possible to chase screws flying with tolerable accuracy, it is impossible, except by chance, to get them really true and free from drunkeness, so that the lips of your box, &c., will meet exactly all round. You can deepen the threads till they meet, but then the threads are loose. When you have a bit of wood with a knot to cut upon, the chaser will play tricks if you have nothing but the hand to guide it.

I think Mr. Wenham has not noticed that there is another way of compensating for the irregularity that would be produced in screw-threads cut by the Niblett apparatus without resorting to the *cylindrical* spiral form for the swash-plate, which, as he rightly points out, could only be correct for one pitch. That other plan is to resort to a kind of *surface* spiral. If Mr. Wenham will look at the drawing of the roller which acts upon the swash-plate, he will see it is made longer than would otherwise have been necessary, owing to the shape of the plate.

Can anyone tell us how the split wire chucks of the American watch lathes are made? They seem to be the most accurate thing of the kind out, and to have no overhang. Could the Essex chuck be fitted into a bored mandrel if it had a true central hole? The sketch inclosed will show my meaning. Some means would have to be found to prevent the chuck from turning. Has anyone tried the plan? **F. A. M.**



A GOOD HAND DRILL.

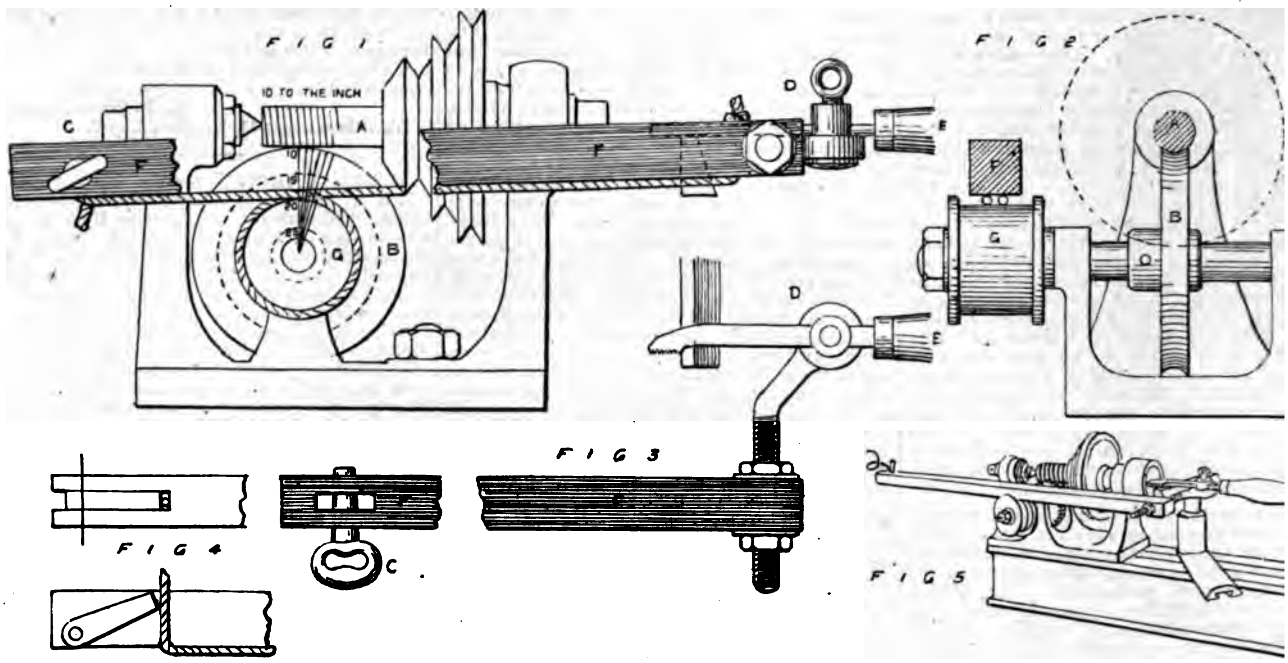
[27251.]—IN reply to "Silke's" letter (No. 27183, p. 201), if I am correct with his sketch, it is the sun-and-planet motion, patented by Mr. T. Haxton, Frenchie, Fifeshire, February 6th, 1885, No. 1682. It is not in the market yet, but will be in a few weeks. I can say, with "Silke," it is a better drill than any I have seen. Mr. Haxton has patented an egg-beater with the same motion, which is also in the course of construction. **Brace.**

CHASING SCREWS.

[27252.]—I SHOULD like to add yet another to the suggestions for chasing screws.

A worm is cut on the mandrel or otherwise attached to it as in Fig. 1. Below this worm a spindle runs in bearings at right angles to the mandrel, and carries a worm-wheel engaging the screw or worm. One end of this spindle (outside the bearing) is provided with collar, screw, and nut for holding brass rule. A cord passes once round the reel, and is fastened at each end to an end of a wooden rod; the rod carries at the end nearest the mandrel nose a tool holder, which allows the tool motion in horizontal and vertical planes. Provided with a long thread and two nuts and washers, the tool holder may be fixed at varying distances from the wooden rod and at any angle with same, or may be allowed to play loosely in the rod.

Let the worm be cut to 10 threads to the inch, then a reel same diameter as the worm-wheel would cause the rod with its tool to travel, making 10 threads to the inch. A reel one-half this size



would give the tool speed at 20 to the inch. One three-quarters this size would give a thread of 15 to the inch, and so on. The tool would lie on the rest, and the bent tool-holder would allow for inside and outside tools.

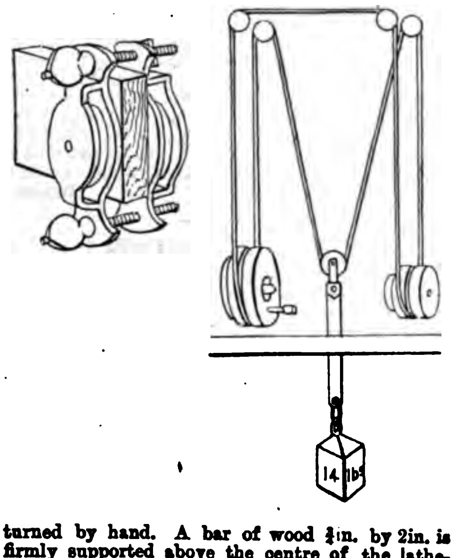
a, worm on mandrel; *b*, worm-wheel; *c*, peg or other contrivance on the wooden rod for tightening cord; *d*, tool-holder; *e*, tool, either screw-tool to match reel or single point only; *f* wooden rod (mahogany); *g*, reel.

Fig. 1, elevation of whole concern. Fig. 2, front elevation of spindle carrying worm-wheel *b*; reel *g*, section of rod *f*. Worm-wheel might be fastened on spindle by a pin or a set-screw, to allow of removal of spindle; K is a wedge passing through slot in spindle, and held by set-screw. Fig. 8, plan of tool-holder *d*. Fig. 4, another means of fastening cord quickly. Fig. 5, perspective of the whole.

Silke.

SCREW-CUTTING.

[27258.]—We have recently had several excellent screw-cutting appliances described, and as there are doubtless many others equally good in use, I hope the possessors may be induced to publish them. My own arrangement works very satisfactorily, and may be useful to anyone having a slide-rest, as it can be readily fitted up by anyone. By it a spiral can be accurately cut in wrought iron of the size of thread of a ½in. screw, of from 4 to 32 threads to the inch, after which the hand-chaser should be used. For wood, cutters driven by the overhead answer the best, the lathe being turned by hand. A bar of wood ¾in. by 2in. is firmly supported above the centre of the lathe-bed (my own is attached above and in front of the revolving shaft of the overhead), on each side of which a couple of side-pulleys are attached by window-sash screws above the nose of the mandrel, and a second couple above the handle of the slide-rest. A grooved wooden pulley is placed on the lathe-nose, and a second in place of the handle of the slide-rest. A pulley is screwed into the top of a short stick, to the bottom of which a 14lb. weight is tied, which hangs within a few inches of the floor at the back of the lathe. The inclosed diagram will show the arrangement.



The grooves in the pulleys require to be of the shape shown, and are all made alike by a tool formed of the end of a small file ground to the required section. The cord should be inelastic and well stretched. My own is of cotton of three strands, each being composed of 24 threads. It should be spliced, half the threads being removed for the whole length of the splice, and afterwards sewn. Crossing the cord gives right or left-handed threads. The lathe is run at a slow speed, and when the tool is at the end of the cut it is withdrawn, and the lathe run backwards until it is a little beyond the commencement of the cut, in order that when reversed any slackness of the slide-rest screw may be taken up; the tool is then placed into cut, and falls exactly into the first groove.

There is nothing new in the use of the screw of the slide-rest as a leading screw; but by the use of the heavy weight there is no chance of the cord slipping, and no lost motion.

The pulleys used as above and fixed at the proper angle over the driving-wheel, with a light weight, form a very efficient overhead for ordinary work.

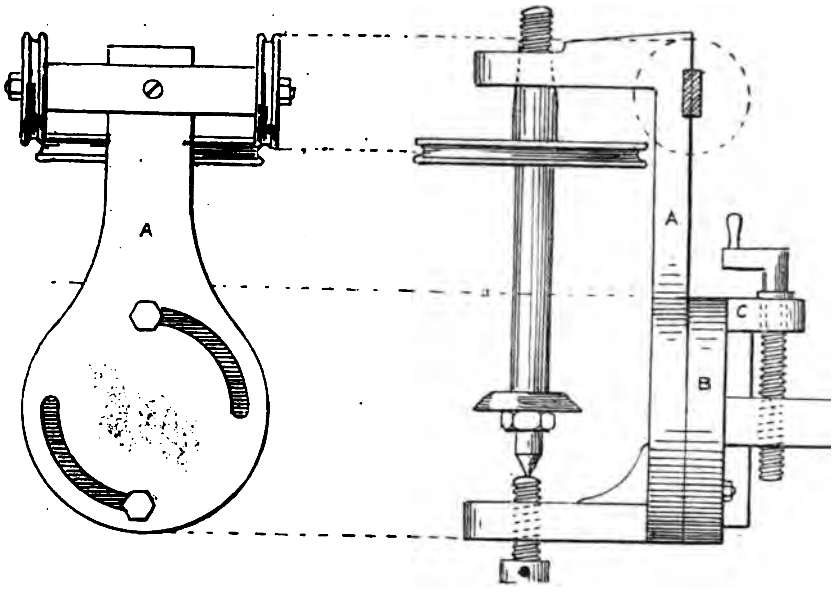
Opifex.

VERTICAL CUTTING AND DRILLING FRAME COMBINED.

[27254.]—Having been interested in reading the various attachments for lathe use in "E. M.," I send the above sketch, thinking it may interest other amateurs like myself, who may be make one similar for themselves.

The sketch, which is quarter size, will, nearly explain itself. The frame A is att two screw bolts working in radial slots, centre pin for graduating on flange plate has a sliding groove for raising to any hei the screw-handle working through C, into sliding in groove at B. The shank D is in slide rest.

The spindle is made of steel; its top



cone shape, working through the top a with a screw on its outer end for recei various chucks as required for a drillin worked with grooved pulleys in its positions, as shown.

Its lower end has circular cutter fi screw nut, and conical end working in through the bottom arm.

The whole frame may be had in malle iron, and any amateur desirous of makin himself, as described above, may have t ings from my patterns (which are suitabl lathe from 4in. to 6in. centre), by advertis usual column.

J.

THE EDMUNDS LATHE MANI

[27255.]—In No. 1151 there is a le Mr. Newall proposing a cone fitting as a substitute for the cylinder-base and bro Dr. Edmunds's mandrel, and as one which for the amateur to make.

Theoretically the cone fitting is pe under certain conditions it is so in practic conditions are—1, that the conical surf bear equally all over, or at any rate at ea the cone; 2, that the length of the cone shall be sufficient to insure the chuck taking up an axial position when screwed home, and retaining it under the stresses to which the chuck is subjected. The first condition is a question of workmanship, and speaking for myself as an amateur who has tried to make conical fittings, I confess to finding it much more difficult to make a perfect cone fitting without grinding the surfaces together than to make a good cylindrical fit. Of course for chuck fitting, grinding the surfaces together is out of the question. When I wish to make a cone fitting, I always take care so to arrange matters that both the internal and external cones are made at one setting of the slide-rest, and, if possible, avoid moving the saddle on the bed of the lathe. This plan is obviously inadmissible for general chuck-making. Of course it may be said that there is just as much difficulty in setting the top slide of the slide-rest parallel with the lathe bed as to any particular angle with it; but even if the top slide is not quite parallel, it only makes an unimportant difference in the cylinder-base of the Edmunds mandrel, whereas in the cone fitting the slightest difference will allow of angular variation. A slight want of parallelism in the cylinder-base only makes a difference in diameter at either end, and this so small, owing to the shortness of the base, that it would practically not be of any consequence. In the case of small chucks fitted to the inside of the mandrel, the first condition is complied with if the workmanship is up to the mark, and the second condition by the great length of cone admissible; but in the case of large chucks fitted on to the mandrel-nose, the cone cannot be more than 0·5in. long without making the chucks project unduly. With such a length of cone there would be more than a "suspicion of a wobble," as "Silke" says. A cone in combination with a cylinder as in the Ballon lathe would no doubt answer; but I see no advantage over the Edmunds plan, and there is the objection that the cylinder is more exposed to injury owing to its position.

In Mr. Newall's plan, the screw-nose would necessarily be depended on in some measure to insure alignment of the chuck and mandrel-axes, and consequently any wear of the screw-thread would impair the alignment, whereas in the plan I proposed of combining the "Edmunds" fitting with the buttress thread, wear of the screw-thread, or even its deformation, does not affect the alignment.

The plan of cone and face fitting mentioned by "Silke" in No. 1153 would, I fear, be extremely difficult to carry out in practice. Cones, cylinders, and flat surfaces can all be more or less easily fitted by careful turning; but combinations of cones and flat surfaces only by grinding, or by extremely slow turning with repeated trials. The trials, too, are not quite satisfactory, as though there may be no shake perceptible to the touch, yet there may be when in work.

Mr. Shakespear suggests the idea of a standard mandrel for each size of lathe. I do not think this would be necessary. All lathes from 4in. to 6in. centre might have a nose of the size I gave, and the same size would serve for light lathes up to 8in. From 2·5in. to 4in., a screw-nose 1in. diameter, 0·75in. long, and 1·5in. at the shoulder, with a cylinder base 1·125in. in diameter, would probably answer well. For larger lathes it would be easy to calculate the dimensions required, if the necessary data are provided.

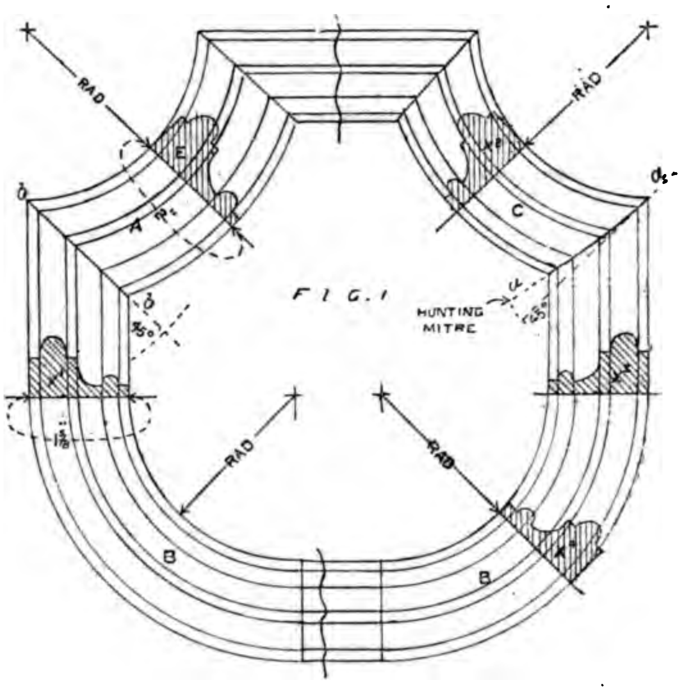
I quite agree with Mr. Shakespear that the size of nose I gave is "unnecessarily large." For strength, it need not be larger at the bottom of the thread than the diameter of the mandrel at the bearing; but for the reasons given in No. 1151, I think the size given advantageous, and do not see any objection to a nose of such dimensions.

In No. 1154, "J. K. P." says he is "completely opposed to the cylindrical fitting on mechanical grounds only." I should be greatly interested by any elucidation of this point with which he may favour us. He also thinks the cost of the cylindrical fitting will be prohibitive. This cylindrical fitting is the only addition of the Edmunds plan to the fitting in ordinary use; as regards cost, I doubt if it will add 15s. to the cost in any case. Mr. Newall can enlighten us on this point. It appears to me that it is far easier to make a good cylinder than an equally good screw-fitting, and far less expensive. If we have a good cylinder-fitting, the accuracy of the screw will be of comparatively no moment. Then, again, the screw-fitting is subjected to considerable wear, the cylindrical to very little, so that even if we have an accurate screw to begin with, it will deteriorate much faster than the cylinder-base.

A. Gray.

VARYING MITRES.

[27256.]—IN No. 1151 of the "E. M." was an extract from an American paper upon the subject of varying mitres. Would you allow me to carry the subject a step further? This portion relates to the intersection of curved and straight mouldings at varying angles.



F I G 2

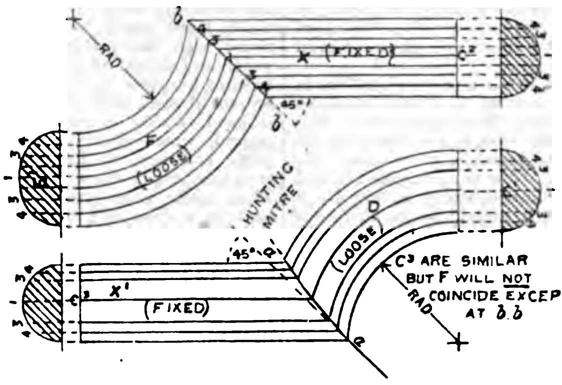


Fig. 1 is a diagram of an opening for a panel in a partition or door, &c., showing two methods of ornamenting the angles. The cross sections of the mouldings X⁴ are similar, but the shape of the opening would vary according to the arc used, whether internal or external. The circular mouldings B B C are similar, and are of the same section as the straight portions, but A is expanded to conform to the conditions laid down in the plan—*i.e.*, that all the intersections shall be at a true mitre (45°). B B joins the straight parts with a butt joint, C is the same section, and would intersect in the same manner as B if it were in that position; but following the plan it will be seen that it intersects not a true mitre. But the joint is not a right line, and it is impossible to make the joint in the ordinary manner—*i.e.*, with the saw and plane (for wood work). This joint is sometimes called a "hunting mitre," and it must be carved to its true shape. It will be noticed that it is formed of a pair of curves. This will perhaps be clearer from an inspection of Fig. 2, and to those interested in the subject (and it is a practical one) if they construct a model from that plan a curious result will be seen.

X, X′ are straight lengths of mouldings (any section—in this case semicircular for simplicity); but the principle can be seen better if a good bolection moulding be selected.

D is a quadrant of a circle, section as X, X′, joined so that the marginal lines intersect. The form of the curved joint *a a* is found by a series of straight and curved auxiliary planes parallel to the axes of D and X′.

F is an arc similar to D internally which intersects X at *b b* at an angle of 45°. The result is that the point where the angular line cuts the horizontal line is the position where the arc must join the straight line, therefore F is expanded; its true section is shown at E′.

This explains why many workers cannot get a turned moulding and a straight one to intersect at a true mitre, when both are similar in cross section. When the model is made, alternate the positions of D and F with X and X′.

In the last par of Scientific News, "E. M." 1153, *re* the Turners' Company's Competition, I think it quite possible, and very probable, that amateur turners could show professionals something which would no doubt be very interesting and highly instructive; but it must be borne in mind that the professionals are prohibited the use of other than hand work, and that they are restricted by some (apparently) rather contradictory conditions, while the amateurs are allowed *carte blanche*; therefore any comparison would hardly hold good.

The last subsection seems to me incomplete, and suggests a query—viz., Who does not "appreciate the efforts of the Turners' Company," and what is the cause of the dissatisfaction? Perhaps the compiler of the paragraph (or someone else) would oblige with an answer. It is an important subject, concerning (as I believe) the well-being of an interesting and important, though small, craft.

92, Cleveland-street, W. **W. G. Barber.**

ON PRIMARY BATTERIES AND ON CHARGING ACCUMULATORS FROM THEM.

[27257.]—LET me record my thanks to "M. S." and "A. N." for drawing my attention to a very serious mistake in my letter of last week. This mistake occurred in copying from the rough copy, and was owing to my having to do it in a hurry, whereby I skipped some words which were interpolated, but became blotted; at the time of copying my mind was running on other business, so I did it mechanically.

The sentence alluded to should run as follows:—"If we have a battery running one lamp well, and switch on another lamp, we halve the external resistance, and ought (by above law) to nearly double the current; but we don't, because, as more current is passing through the cell, the internal resistance rises, and the greater portion, &c."

Ohm's law has enough to answer for without being saddled with this extra burthen; but I only wish I knew some law to account for it. As a matter of fact, it varies with every cell. "A. N." has, from his letter, evidently noticed this.

The causes are partly thermal (i.e., heat generated by increased current and increased chemical action), and partly, I fancy, owing to a more rapid generation of hydrogen, and consequent back E.M.F. I doubt if they are purely chemical, unless varying density of the liquids has anything to do with it.

Will "M. S." let me know what he would like to learn about the battery I have said "so little" of? I regret I cannot give the composition of the depolariser, as it would interfere with foreign patents being obtained were I to publish them. "Nun. Dor." asks for this, and also for the zinc solution and the negative element. These I had already given.

I may mention these letters are written to supply amateurs with full particulars as to the construction and management of different cells, as I am constantly being asked questions of this nature, which shows there is a want of something of the kind.

Having touched upon the chemical side of the question, we are in a better position to consider the economical side, and to do this I propose first to touch on the different sources of waste in the cell.

First, *Internal Resistance* is an inevitable source of waste by reducing the E.M.F.; I have already said that this resistance varies with the current; in primary batteries it increases as the current, and so they are not self-regulating. Although we cannot avoid internal resistance, we can do many things to diminish it. Large surface of plates, high conductivity of solutions and of electrodes, and proximity of these electrodes, all tend to diminish this. In most cells it is also necessary to use porous cells, which offer very great resistance to the passage of the current. These should be of as large a surface as possible, and, within certain limits, as porous as possible. Unfortunately, if we make them very porous we offer facilities to the different fluids to mix, which we wish to avoid, and so the right density of porous pots can only be ascertained by experience. We can, it is true, to a certain extent check this mixing of the solutions by taking care that the two solutions are nearly of the same specific gravity; but even then other complications occur which limit the possibilities in this direction.

Local Action.—This needs some explanation, as, theoretically, such solutions as dilute sulphuric acid do not attack zinc. This, however, is only true of chemically pure zinc, and commercial zinc is far from this. For instance, it contains, *inter alia*, iron and arsenic. Now these metals are both negative to zinc, and consequently, as they are in electrical contact with it, and, if on the surface of the zinc, also in contact with the dilute acid, a small circuit is formed, and the zinc, being positive, is eaten away.

To avoid this, the zinc is amalgamated—i.e., covered with a film of mercury. This mercury combines with zinc, but not with iron, and forms with it an alloy' or, as alchemists first called it, an amalgam (an intermarriage). The zinc of this amalgam is floated out to the surface of the mercury quite pure, and so a film of pure zinc is exposed to the acid, which will not attack it unless the circuit is completed.

Waste of Oxidant.—As the oxidant or depolarising liquid becomes used up it loses its activity and becomes more sluggish in its action, as it is so largely mixed or diluted with the lower salts it forms after being deprived of its spare oxygen. It cannot then take up the hydrogen as fast as before, and so partial polarisation sets in. The only remedy for this is to add more cells, and then economy sets a limit to the number it is wise to add. The loss of depolariser averages 10 per cent. in the better forms of cells.

Increase of Resistance.—This is due to the fact that as a rule acids are better conductors than their salts. For instance, sulphuric acid is a far better conductor than zinc sulphate, besides being more active.

The only remedy is to use those solutions whose resistances change least. **Electrician.**

HARDENING AND TEMPERING STEEL.

[27258.]—WITHOUT knowing how the temper (mentioned by "Hobbin Mill") is accurately fixed, I should say it is between that of a saw and an ordinary chisel for wood, or between brown and dark straw, or that of the hardest possible spring. An ordinary chisel will just take this burr, which is by no means a "wire edge." A paring-chisel will make a wire edge on a hone; but will not take a burr. A wood-scraper is burred up as described, but is too soft a temper for "Hobbin Mill's" knife. I find in general the "feel" on a hone in setting is a good indication of the temper of a tool. There is much confusion about tempering, which many amateurs are unable to clear up through not understanding the principles, terms, &c. To begin with, there are two meanings to "temper." The commercial "temper" refers to the percentage of carbon in a steel. Thus, a high temper means a large proportion of carbon in the steel, quite distinct from the high temper produced in the process of tempering. Then there are two processes of tempering—one in which the steel is hardened and tempered in one act; the other in which the *steel is first brought to its greatest* hardness, and then "let down" to the temper wanted. Then, again, there are two methods of effecting the first. The steel may be heated to a high temperature, and plunged into a substance with a certain melting or boiling point, or the steel may be brought to a certain temperature by immersion in molten lead and dropped into cold water, the lead being not merely molten, but brought to the highest temperature it will take.

In the other process, which is in most common use, the steel is heated to red, plunged into water, and again heated to a certain temperature for tempering; the addition of salts, dung, &c., to the water being merely to produce quick contact of steel and cold water. So, given a piece of steel, the following are the practical ways in which it may be tempered (the steel, if for a cutting tool, must be cast, or so-called "tool-steel," as "mild steel" and "spring steel" are of too low a temper, commercially speaking).

1. Heat the steel to bright red, and plunge into a tin of grease. This gives a hard temper, the red, as pointed out before, is really red *in the dark*, and looks more like yellow in the fire. This heat must never be exceeded either in working or tempering; but it must be *fully* reached for hardening and somewhat exceeded for welding, for the grease, soap, sealing-wax, solder, or other alloy have been recommended in these columns as substitutes. Grease is, however, safe to stick to.

2. Put a ladle on a *good* fire and melt some lead in it. When the lead has reached a red heat (which can only be seen properly by holding the ladle in a dark corner) place steel in the molten lead and leave till it has acquired the same heat as the lead, then quickly plunge into cold water. In this case the steel should be bright *all over* before immersion, as black places sometimes cause twists and cracks by unequal expansion on reaching the water, being really bad heat conductors, as compared with the surrounding bright parts. The water used should by no means have been used for washing purposes, as any greasy substance prevents contact of steel and water. Cow-dung, I believe, is good, acting somewhat like ox-gall does on paper in water-colour painting; but rain-water is quite sufficient to insure success. 3. Heat the steel to a bright red and plunge into clean water. Then smear some grease on the steel and again heat in a clear fire, moving it continually and watching the grease. As soon as the grease flares off, plunge the steel into water; or the steel may be smoked after hardening and again put in the fire. As soon as the soot burns off the steel, it should be plunged into water. This gives a rather low temper, and is employed on mild steel for giving a spring temper. In the case of a tool which has been carefully shaped, the steel should not come in contact with the fire, as the surface would scale off. It must be inserted in a tube placed across the fire, and brought to the right heat in the tube. The heat required for hardening is such as can hardly be got in an ordinary fireplace, and I have no doubt many have been disappointed at not getting steel to harden, using the fireplace as the source of heat. 4. Heat the steel to bright red and plunge into water (this is the hardening), then grind steel on a dry grindstone and again heat, watching the colours gradually appearing on the ground parts as the temper is lowered. If a very hard tool is wanted, quench the steel as soon as the part to be used is of a yellow colour. For ordinary purposes, such as drills, taps, wood chisels, allow the colour to reach a brownish yellow, for chipping chisels a dark brown, for saws purple, for springs purple to blue. Large tools are commonly heated to bright red, a small portion is quenched and quickly rubbed on a bit of grindstone and watched whilst the heat remaining in the tool reheats the rubbed part. As soon as the cutting edge turns the right colour, the whole tool is quenched. In quenching such a tool for the hardening, it should not be held still in one place, but moved up and down in the water to avoid a marked boundary between hot and cold; otherwise the steel may snap at the junction as soon as it is put to use after tempering. **Silke.**

THEORY OF PERIODIC INUNDATIONS.

[27259.]—THE science of geology shows that at certain periods of the earth's history the northern hemisphere has been submerged, not once or twice, but many times, and for long periods. Whether these submergences are entirely attributable to local disturbances, or whether we may not take a much broader view, and assume that by a wise provision of the "Creator" all the low lands in each hemisphere may not have been completely submerged alternately ever since the earth possessed an ocean, is, I think, a subject worthy of the consideration of any student of nature.

Even in this, "our day," every care is necessary in cultivation to keep the lands fertile and prevent exhaustion; otherwise in course of time the soil would become too weak and poor to support life. We can, therefore, easily imagine that the "All Wise" would make this provision in order to remodel and refertilise the lands whose capabilities for sustaining His creatures have become exhausted. Thus so far from an inundation being considered as a "fearful punishment," it seems a necessary and effective means of keeping the earth fit for the habitation of those who shall succeed us in ages to come as we have those who lived in ages past—though possibly so far in the future that our races and countries may be long forgotten and lie buried deep beneath the sea.

I suggest that the increased motion of the earth at her perihelion passage, together with the "solar action," must necessarily increase and accumulate the waters of the ocean in that hemisphere where this force has its chief action—that is, where the perihelion lies.

When the perihelion is in a "southern sign," the southern hemisphere, "as now," would be submerged, and *vice-versâ*. The approach to, passage over, and departure from the Equator being the period of disturbance, accompanied, doubtless, by a fearful catastrophe at the climax when the perihelion followed by an overwhelming ocean crossed the Equator.

We are well assured by the astronomer that the apsides, and, consequently, the perihelion point, have a motion through all the signs of the Ecliptic, and completes the revolution in a known period. The geologist assures us equally well that the various strata and formations of the earth's surface are the result (except in local instances) of the depcsits of ages of submergence under the ocean, and combined they furnish us with dates, causes, and effects.

The last perihelion passage was on 2nd January, and if from this date we can fall back 12,895 years, we shall find the perihelion as far advanced in "Cancer" as it now is in "Capricorn"; in high north declination, when all the low lands in the northern hemisphere would be submerged, similar to the southern hemisphere at this time, though at that period dry. From "Cancer," the perihelion would pass on to the first degree of "Virgo" in 11° 45′ of middle north declination in 3,525 years, when the ocean would begin to descend and cross the Equator southwards—at first slowly, but gradually increasing in force as the perihelion approached the Equator, and reaching its climax as the perihelion entered "Libra," when the ocean would acquire overwhelming force, and overflow all the low lands of the southern hemisphere. From the first degree of Libra to the first degree of "Scorpio," when the perihelion would have arrived at a middle south declination of 11° 45′, the ocean would continue to flow southwards, though with a less, and continually decreasing, force; the whole period of disturbance would be while the perihelion passed through two signs in 4,800 years. As the commotion of the waters subsided, the Antediluvians would pass from the southern to the northern hemisphere, where the lands were becoming dry. This migration would take place 5,073 years ago, which, though not agreeing with our historical record by 837 years, yet may be taken to be a coincidence, since we do not know whether that record is of the actual end of the catastrophe that had occurred or not. The next time the perihelion and ocean will cross the Equator towards the northern hemisphere will be 5,673 years hence, though the ocean would begin to encroach on the northern lands 2,150 years earlier. If we could bring our minds to admit the earth's existence so far back as 483,000 years, we could imagine her then in an igneous fusious state, her axis parallel to the Ecliptic, and the minor axis of her orbit much shorter than now. Starting from the period of the Primary, or Plutonic formation, when the earth began to cool, we can count *thirteen distinct submersions* of the northern hemisphere, each extending over long periods, carrying us through all the formations of the Metamorphic, Transition, Secondary, and Tertiary periods to the earliest of our historical records. The close correspondence in the date of the one recorded inundation with the calculated date of that occurrence, should have some weight in the assumption that such catastrophes have occurred to alternate hemispheres at fixed intervals throughout all the remote ages of the earth's existence since the ocean was formed.

R. T. Metcalfe.

SCIENCE AND THE SUPERNATURAL.

[27260.]—MR. J. EATOCK (27190, p. 202), says he should like to "see what 'Sigma' or some other of our critical contributors have to say about the possibility or impossibility of the above reported occurrence." The occurrence is the "supernatural darkness of the first Good Friday."

Now, as I know no more about the subject than any ordinary reader of the New Testament, I should have said nothing of the subject but for the special appeal to myself to deal with it, I presume, from the scientific point of view; and I only propose to do so now because it serves the purpose of stating some general principles of more moment than the special subject.

First, then, the word "supernatural" would place the subject out of the province of science altogether,

science is nothing but the study of the
nature, of the sequence of the facts, and
eavour to trace out the relations of cause
ct among those facts; or, in other words,
over, to some extent, the laws of nature.
re let me point out that this very phrase,
ws of nature," is not only erroneous and
ling, but that while it is constantly used as
ing the possibility of any supernatural event
t, because this would be opposed to these
e laws, it none the less, if it has any mean-
ll, implies an agent outside nature imposing
's. As a matter of fact, too often forgotten,
ase, "law of nature," means nothing more
observed usual sequence of facts, or some
ical explanation devised to account for those

assuming that an event has occurred, or can
which is contradictory to the generally re-
d laws or ordinary sequence of events,
can deal with it only by the inquiry as to the
e of the actual occurrence, and then whether
ther law or sequence has interposed in the
sual course. As a rule, science is wholly
to deal with such asserted facts, which are
re called *miraculous* or *supernatural*. Now,
wo words, generally treated as synonymous,
two distinct principles. Miraculous
merely something wonderful or very un-
it merely expresses the fact: it is only a
addition to make it imply anything as to
se; but supernatural implies the operation
use beyond nature.
ience, then, is to deal with such a fact, it
so only by asserting that it may be
ous, but cannot be supernatural. I think
is in its rights if it absolutely denies the
tural. It would say: The thing has occurred;
have a cause. An effect produced by a
even though the cause be unknown is
, even if exceptional.
what do we mean by "natural"? Two great
tinct ideas are involved. One idea—I sup-
e must call it the orthodox—personifies
, and treats it as an entity. One can only
this conception as that of a machine, com-
l, yet moving only in a fixed, definite order.
aterialist says the machine is self-existent;
ted complex whole is the sum-total effect of
stituent parts. The infinite variety of
and wheels came together, and united by
nity of their several parts—the fortuitous
se of atoms of the Lucretian philosophy.
eologist says it was made and put together
xternal agent which he calls God, who by
e will ordained the working of the machine.
pernatural is the temporary interference
e working, and producing a separate result
external will. This is the usual orthodox
of the day, and is the outcome of the
y of St. Augustine and the teaching of

other conception treats Nature, not as a
e, but as a living existence, actively con-
by a will, not external, but within it.
the conception described by Pope as a
, of which Nature the body is, and God the
It is that which St. Paul embodied when
that "in Him we live and move and have
ng"; and while it is the theology of St.
stom and many of the earlier teachers, as it
oot of what is called the New Theology,
is gradually getting hold upon popular
it is also accordant with the scientific
evolution—of creation as a continuous pro-
stead of a spasmodic one. On this concep-
events of nature are the manifestation of
ine life; the laws of nature are simply the
s by which the Divine will guides and
all things. On this conception the *super-*
disappears, the *miraculous* remains.

it is a mistaken idea of science when it is
o overrule the possibility of a change in the
f events which we call *natural;* though it
ly overrule the idea of a capricious change,
terference without adequate object. All
ence, properly understood, can do in such
, is to treat them, not as involving prin-
out as requiring evidence; and this leaves
ery much to faith. The evidence which
tisfy one mind will not suffice to another
rent habits of thought. As to the parti-
bject, the evidence is two-fold. We have,
order to dismiss it, the statements which
en quoted, and which raised the subject;
e obviously absurd, and the clear product
miscalled "pious" fraudulent energy, freely
ily exercised by the early monks. Secondly,
ounts given in the Gospels. These cover
more than a local darkness, such as might
uced by many ordinary causes, but certainly
n eclipse. The discrepancies in the several
s, which have been pointed out, while they
the absolute exactness of the statements,
such as to discredit them; the difference
imes given by John might not improbably
o a clerical error. There is a much more
difference in the account of the behaviour
of the two thieves; but, as it is just such a difference as may be looked for in the accounts given by different people of the same event, it does not throw doubt on the general accuracy of the evidence, or on the actual occurrence of the darkness, and possibly of an earthquake.

Whether these were supernatural is an entirely distinct question: there are plenty of instances on record where the physical universe has appeared to be disturbed in sympathy with human events—as the tremendous storm at the death of Cromwell, happening, too, on the day which had often been the date of his successes. But those who, looking beyond the single facts, see in the whole series of events a great drama running through all human history, and in the Crucifixion discover the central point of human history, would have no difficulty in adopting the evident meaning of the Gospels, that the natural phenomena were due to a disturbance of the usual order of events in sympathy with the accompanying moral events.

All that I have to say, in answer to the question, is that science has no means of deciding whether such supernatural events ever occurred or can occur: it has no right to affirm, because it has no evidence; it has no right to deny, because it is not omniscient, and has no knowledge of the operative causes which underlie the apparent facts of nature. The limits of the realm of science are the known: the instant we pass that limit we enter on the region of philosophy, in which faith is a guide as potent and as safe, in judging the evidence of things unseen, as reason is in judging those which are visible.

Sigma.

MESSRS. SCHOTT AND CO.'s NEW OPTICAL GLASS.

[27261.]—I HAVE been unable for some months to resume my remarks on the new optical glass of Messrs. Schott and Co., of Jena. Dr. Royston-Pigott speaks very favourably of it in his interesting papers on "Microscopical Advances"; and I was very glad to see the letter (26878) of M. Victor Nielsen, informing us that several double o.g.'s have been constructed with it by Reinfelder and Hertel, of Munich. I hope that M. Nielsen will tell us what are the inner and outer focus appearances (or the "ring system") shown by the new o.g.'s with a high-power eyepiece. I have an idea that the chromatic correction will be peculiarly constituted in some cases, for a reason which I shall mention subsequently. In some combinations, if we may judge from theory, very nearly perfect achromatism seems attainable.

And here, in passing, I would also notice the very interesting papers on photographic lenses by Mr. Traill Taylor. In perusing them, many would, I am sure, wish that a little more definite data had been given as to the curves and kinds of glass found most suitable. In the absence of this, one cannot say what properties are most essential; but judging from the table of partial dispersions of the new glass, it would seem that Nos. 1, 2, and 10 will be found useful in wide-angle photo. lenses. With them I should expect to find very little scattered colour, and very little difference of chemical and visual foci; but it is not safe to rely too much on theory in such matters.

I will now proceed with my remarks on the table of optical data to be found on pp. 523 and 563 of the last volume of this journal. In it, a somewhat different arrangement of tabulation is followed, which may not be altogether understood without some explanation. It will be observed that the refractive index for the D line only is given; but this is quite sufficient, as those of the other lines can, if necessary, be found from this and the partial differences. Thus for No. 1, if the index of the A' line is wanted, we must subtract 0·00485 from 1·5159; or for F add 0·00515 to 1·5159; and then the index of the F line must be used in a similar way to obtain C and G'. But it is not likely that this process will be found necessary, as the partial differences supply the data for chromatic calculations. The fifth column is headed "Mean Dispersion C and F—that is, the numbers are the differences of the indices for the C and F lines. They constitute a measure of the mean dispersion of the different glasses, as the chief luminous rays lie between these two extremes, and the numbers may be considered to represent the magnitude of the chief part of the spectrum of each of the glasses.

The sixth column contains the reciprocals of the dispersive power. Each number is obtained by dividing the decimal part of the index for the D ray by the corresponding decimal part of the mean dispersion. This is contrary to the usual practice, and has no particular advantage over it that I can see. The glass with the *highest* tabular number has the *least* dispersive power, whereas it would seem natural to associate a high number with a highly dispersive glass. There is, perhaps, some gain in respect to the brevity of the numerical expressions, and this, of course, is an advantage in a table of data; but whether this method or the more common one be used, it is highly essential that the dispersive power be represented with considerable accuracy. We now come to the three columns under the head of "Partial Dispersion." It will be seen that two horizontal lines of figures are given for each kind of glass. The first of these contains the numerical difference of the refractive indices for the lines A' D, D F, and F G', and shows how the whole spectrum is divided. But, obviously, in this form the numbers are of little service, because the division of one spectrum of a certain length cannot be compared with the division of another of a different length. The second line of numbers supplies the want: they are ratios showing the proportion each partial space bears to the whole mean dispersion C F. They are obtained by dividing each difference by the corresponding mean dispersion; and if we suppose C F to be divided into 1,000 parts, then A' D will cover 658 of those parts; D F, 698; and F G', 552, in the case of glass No. 1, and similarly with all the glasses throughout the list. Hence by this process we reduce all the media to one standard, and can thus compare the effect of any two or more glasses. The distance between the C and F lines is considered alike in all cases; but the whole spectrum taken into account is evidently nearly double the distance C F. It varies slightly, as the following will show. Taking C F = 1,000, and adding together the three numbers in the second line of each, we find—

For No. 1 A' G' = 1,908
" 10 A' G' = 1,922
" 28 A' G' = 1,918
" 40 A' G' = 1,984
" 44 A' G' = 1,959

The variation is evidently most marked in the more dispersive flint glasses.

We are now in a position to compare the effects of the combination of two or more glasses. If the tabular numbers agree, it shows that the spectra are similar, no matter what may be the actual dispersive power; and we may reasonably infer that such a combination would be achromatic, because the glasses similarly disperse the light in opposite directions. But two glasses so combined must have considerably different dispersive powers, so that their combination for achromatism shall leave a useful excess of refraction in favour of one of them. We must, therefore, seek to combine one glass with another which is much lower in the list, or one with a low dispersive power must be matched with another of comparatively high dispersive power.

O. V.

(*To be continued.*)

SOLDERING.

[27262.]—As there is continually new interest in the matter of soldering, a few remarks on the same may be of use to new readers. Soldering depends on the property alloys or solders possess of melting at a comparatively low temperature, and of uniting in the molten state with the surfaces of metals in the solid state, this union only taking place when *pure* metal at the temperature of melting solder touches the latter. To keep a pure metallic surface at this heat it is covered with a so-called flux, which, owing to its affinity for oxygen, prevents oxidation for sufficient time to allow solder and metal to unite.

In cases where the soldering iron is not sufficient to heat one of two pieces to be joined, it (the piece) should be heated separately and tinned, after which a sound joint can be made with the soldering-iron.

To tin wrought and cast-iron, file and scrape the surface to be tinned until there is no speck of dirt left, then brush over with flux, and dip in molten solder or tin; or cover the iron with flux, heat it, and with a stick of solder dipped in flux rub over the surface until tinned. Should iron in this case not tin readily, take a piece of sal-ammoniac, and whilst hot rub the surface till all is tinned. Spirit of salts applied with a brush will also have the same effect. To tin copper and brass, clean with sand-paper; paint on flux; heat, and apply stick of solder dipped in flux, when the surface should tin readily. Or dip the copper or brass in spirits of salts, *wash off the chloride formed*, cover with flux, heat, and apply flux and solder.

Lead and zinc hardly ever want tinning. The former should be rasped and scraped perfectly clean, covered with flux, heated carefully (to avoid melting), and solder applied with flux. The zinc would be tinned by applying spirits of salts, heating, and tinning with solder dipped in the acid.

To tin the soldering-iron, when hot, file the end, and rub in a hollow formed in a piece of sal-ammoniac, touching with a stick of solder at the same time.

The best flux to use in all cases is chloride of zinc, made by dissolving bits of zinc in spirits of salts until the acid will take up no more.

For zinc, the flux is chloride of zinc, but is not directly applied in practice. The spirits of salts (being diluted hydrochloric acid) is further diluted with water and applied to the zinc, cleaning the surface, and forming chloride of zinc at the

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make them very por
different fluids to mix
so the right density
ascertained by experi
certain extent check
by taking care that th
the same specific grav
plications occur whic
this direction.

Local Action.—This
theoretically, such s
acid do not attack z
true of chemically pu
is far from this. Fo
alia, iron and arsenic.
negative to zinc, and
electrical contact wit
the zinc, also in conta
circuit is formed, an
eaten away.

To avoid this, the
covered with a film
combines with zinc,
with it an alloy' or, a
amalgam (an inter
amalgam is floated o
cury quite pure, and
posed to the acid, w
the circuit is comple

Waste of Oxidant.—
liquid becomes used
becomes more slugg
largely mixed or dil
forms after being de
cannot then take up
and so partial pola
remedy for this is
economy sets a lim
add. The loss of de
in the better forms

Increase of Resista
that as a rule acids a
salts. For instance,
conductor than zinc
active.

The only remedy
resistances change l

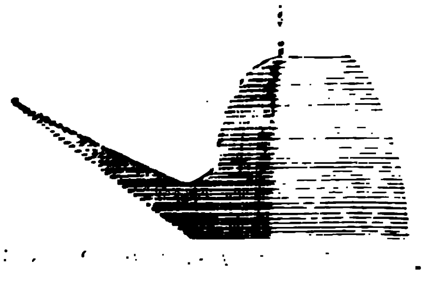
HARDENING

[27258.]—WITH
(mentioned by "Ho
I should say it is
ordinary chisel for
dark straw, or that
An ordinary chisel
is by no means a
will make a wire ed
a burr. A wood-sc
but is too soft a tem
I find in general t
is a good indication
is much confusion
amateurs are unabl
standing the princi
there are two mea
mercial "temper"
carbon in a steel.
large proportion o
tinct from the hi
cess of tempering.
of tempering—one in
and tempered in one
steel is first brought to

[illegible]

PRIMITIVE TOOLS AND WEAPONS

[illegible]



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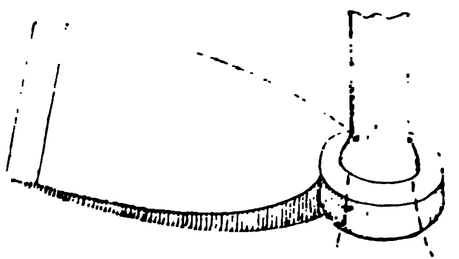


A WORKSHOP ADZE.

rubbing on a bit of broken millstone, always to be got where a hand mill is the inseparable utensil of domestic life. I have made a hone and circular stones of the same, and would not sell them for any sum. It is rare to see a workman cut himself with this specially dangerous tool, though he often uses his foot to steady light pieces of wood. He has perfect control over this seemingly clumsy cutting invention. The length of handle is 1ft.; the eye throughout the solid is gradually taper (as in a pickaxe), so that the handle can be knocked out when the workman requires to whet the edge. Sir

[illegible]

—[illegible] where the
The result is that th
oxygen in the atmos
the one hand; whil
of watery particles—
you wi[illegible] are bein
witness the condens
a room. These are
the case in question.
that large quantities
free in a room almos
percentage of oxyge
the hydrogen, if thu
with some other bod
pound?

If the former of t
my original answer
after all. I shou
"Kensingtonian" th

SH

[27266.]—ACTIN
in an article in the
three years ago, I b
to practise gazing
objects for several
sight prevented m
pages of the "E. M
13in. from the eye.

ɜm to make no further progress.
ghted reader offer any suggestions
ι this process? My sight is appa-
and strong, and I can read the
ith ease at a distance of 6in.

Brightonian.

FOR HOT-AIR ENGINE.

ɛ drawing inserted in last issue
:d the same size as I sent; it is
half the size, so all measurements
ed by 7½ instead of 4. The inside
.ter is 13in.; stroke of displacer.
orking cylinder, 4¼in.; stroke of
ιd for "five iron screws," fine iron
"the off cylinder," read the side

J. Seal.

ES TO QUERIES.

nswers, Correspondents are respect-
mention, in each instance, the title
e query asked.

st-Drill Apparatus.—In sketch
of above, the portion intended for
wn without a thread, and should
·" (not "fixed screw").—R. T. J.

ified Oil (U.Q.)—Before this
-vered, more details must be given
-e, kind of oil, &c.—HENRY J.
Sheffield.

ɔtro-Magnet.—I should think
't all events, try what he suggests,
k-covered wire, and winding on
B.

ambulator.—Stain the wicker-
iline of a suitable tint or with
stain the leather with ink, if
up with castor oil. N.B.—Damp
warm water first. Look through
r many hints on the subject.—

ɘ-Pipe.—The best place to keep
is under water; next best is per-
rth, as querist says he will have
if the soil is moist and contains
ature to injure the vulcanised
'OR.

ngement of Organ Pipes.—
most extraordinary queries that
d in your columns, where so much
at the construction of the organ.
see what the querist really wants
re goes. Pipes in an organ sound
respective stops are drawn and
l to them: hence the "arrange-
l is not the "ordinary" one
ndway is cut in the cap of the flue
being done by notching the edge
re the wind issues between block
the lip of the pipe. If "G. H."
little rudimentary information,
nite questions, no doubt he will
ng to answer him.—N. E. CHILD.

ronzing Statuary.—It is not
his question without knowing of
bronze" horses are made; but the
rocess is simply this: that they
ome solution which eats out the
n, and leaves copper. It seems to
fessional bronzer" did not receive
ı, for he would find no difficulty
DOR.

a Stone.—You may possibly be
me of the dirt by means of a jet of
jury to the carving; but *cui bono?*
paint the font, or coat it with
ith a solution of paraffin wax, or
preparations such as was used for
eedle on the Thames Embank-
er in New York; but it would be
ave it alone and let it get dirty,
e dust from time to time. If it is
illed, it can, of course, be washed
y; but again *cui bono?*—SAML.

nting Emery Wheels.—The
eels are exceptionally small; in a
the hole is about ⅛in. diam. If
ot central, the wheels should be
hen turned true with a cutting
e professional way. It is certainly
o true the hole while the wheel is
liamond would be required, which
If the wheels are composed of
h guttapercha or shellac, the hole
arged with a hot iron. The spindle
of steel turned to ⅛in. diam. be-
s; 6in. will be about as long as it
to have it without its springing while in use. I can't advise you to put more than two wheels on one spindle, because in taking the middle one on and off the screw threads get rubbed and filled with particles of emery, which soon wears the nuts loose. In a grinding shop, when three or four wheels are mounted on one spindle, the middle ones are of lead or leather. The wheels should be held between brass washers of a diam. equalling ⅓ diam. of wheel, a piece of leather or rubber ⅛in. thick to be interposed between wheel and washer. To prevent the spindle rusting it is best tinned, if screwed only at the ends.—A. F. SHAKESPEAR, Lüttichaustrasse, 14, Dresden.

[62124.]—**Sluice Gate.**—No dimensions given; but the querist can accomplish his desires with good hydraulic cement, or with a lining or stop of a cement made of guttapercha and pitch melted together. That can be moulded into any shape when warmed, and the door being pressed against the cement whilst warm, an accurate fit can be obtained. Or it might be possible to effect a cure by nailing on a band of oakum to the door; but it is useless to guess when querist supplies no particulars.—NUN. DOR.

[62125.]—**Pinny Brass.**—It would cost more to extract the iron filings from this metal than it is worth. Use it for some casting that will not require turning.—FOUNDER.

[62137.]—**Encaustic Cerate.**—It is to be regretted that querists, when asking questions, are at times so indefinite. Presumably "Amateur" means the material used in encaustic painting. If so, the powder or cerate is made by adding in portions at a time powdered mastic to melted white wax, until there are equal weights of the two. Pour into cold water and reduce to powder in a mortar. This powder is mixed with the desired pigment, and the mixture melted on the canvas or wood, or whatever it is desired to cover or ornament. When the picture or design is finished, it is coated with white wax, spread with the aid of heat and artistic taste, and finally polished when cold by rubbing.—SAML. RAY.

[62138.]—**Heliotype.**—This querist should look through the back volumes for many articles and notes on the modern photographic printing processes. Let him try No. 1081, "Photographic Printing Surfaces," p. 294, which will give him an idea of the principles and details sufficient to put them into practice.—J. H. J.

[62148.]—**Pyrotechnics.**—The following is a recipe for a blue Bengal light. Nitrate of barium 20 parts, sulphur 33 parts, oxychloride of copper 18 parts, sulphate of potash 17 parts, chloride of lead 2 parts; mix these well together, then add 21 parts of chlorate of potash. Place the composition in a pillbox, and on the top place a piece of tissue paper connected with quick match. A lance is a tube of paper ½in. in diameter and 6in. long, filled with a white or coloured composition.—C. H.

[62150.]—**Leaky Portable Engine.**—How can any one explain without knowing something of the size and shape of this engine or boiler? The best way would be to call in some one skilled in doing such repairs.—A. D. W.

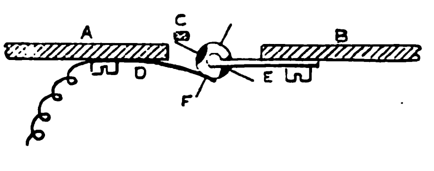
[62153.]—**Long Train-runs in the U.S.**—I think the longest run that is done in regular work is the trip from New York to Philadelphia, 89 miles, on the Philadelphia and Reading railroad. That is the line on which the famous 84 miles an hour was supposed to have been done—vide p. 516, No, 1011, and the comment on p. 539 of the following number.—NUN. DOR.

[62174.]—**Sparrows.**—This is a difficult matter. It might be got over by washing or rather laying on two or three coats of the following:—Lime thoroughly slaked with salt and water, beat into thick pasty state; let this stand for two hours, and then add skim milk and well mix. First coat thin, so as to run well into the thatch, and don't put second coat on till the first has dried. This is permanent, and also fireproof to a certain extent. If this won't answer, fine wire netting pegged over the entire roof should keep them off.—E. F.

[62176.]—**Measurement of Surface.**—Seeing that "P.'s" interesting query has not yet drawn a better solution, I modestly offer an alternative method; not because of its fancied merits, but because he says he can think of only *two*. I do not know of the existence of any *supermeter* in any form; and it is certainly no light matter to readily conceive of a practical one. The method which occurs to me, and which I shall term the *bath method*, consists in immersing the body in a bath of suitable liquid, and upon withdrawal noting the quantity of liquid subtracted. The obstacle herein is, of course, the capillary attraction which would be asserted in surfaces of such extreme irregularities as ground glass, &c.; but this same cause would, undoubtedly, in theory as well as practice, defeat the possibility of the application of "P.'s" light-interception method. Of the gas-occlusion theory I will not venture to say much. It appears to me that the obstacle cited would equally apply in this, which I consider the least practical method of all. The bath method would, I think, be fairly practicable in cases free of excessively fine and intricate irregularities of surface, and if prosecuted it would be necessary to construct a table of coefficients of adhesion of fluid on inert areas of different materials; and corrections for temperature, and, possibly, atmospheric pressure. I fear trespassing unduly on the valuable surface of the ENGLISH MECHANIC whilst treating of other surfaces; but if desired and permitted, I shall feel much pleasure in going further into this subject, and in furnishing a sketch of the instrument which I conceive might accomplish the purpose in question, on the principle I have indicated.—E. ST. EDMUNDS.

[62181.]—**Lunar Clefts, &c.**—TO "F.R.A.S."—I am aware that the smallest I see are about 1,000 yards wide; but there are hundreds smaller than this which I cannot reach. Their size, I admit, goes much against giving them a meteoric origin; but, due to the small mass of the moon, the surface matter would be much easier to displace than the same material would be here, say, in proportion of 5 to 1. The surface is probably much disintegrated if the matter resembles our rocks, even if we only allow for the wide range of temperature to which it has been exposed monthly for ages. The surface may in many cases be composed of sand or cinders. Proctor, to whom you referred me, suggests, not very probably, I think, that not only the small but the largest craters may be the result of meteoric downfall at an early stage of the moon's history.—TAU.

[62182.]—**Electric Clock for Factory.**—To H. AUSTIN.—I think "Manufacturing Electrician" will find this sketch to answer his purpose. A and B are part section of dial; C, hour hand; D, contact spring insulated; E, bearers in metallic connection with one of the rings on dial; F, wire arms on brass roller which has two pieces of ebonite fastened on as shown. This piece of mechanism is placed between the V and VI. The sketch shows connection just made ready for ringing at five minutes to six in the morning.—H. AUSTIN.

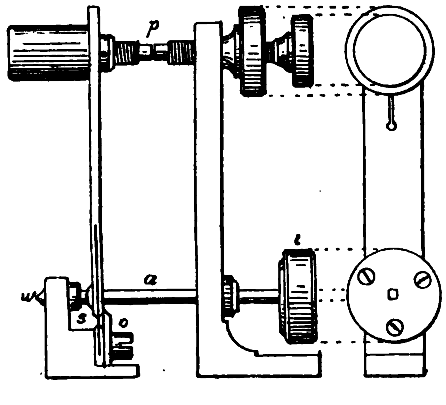


[62183.]—**Wooden Pendulum.**—To "A. W." and "W. J. R."—I should be greatly obliged by your sending me your addresses: mine I advertise now, as I may be able to help you in your demand for a cheap pendulum. For the moment the only suggestion I have to throw out is to gild on the top of the paraffin, and that is Beckett's. "Sm." appears at any rate to have got a good house-clock.—W. A. S. B.

[62183.]—**Wooden Pendulum.**—In reply to "A. W.," allow me to say that the rod was thoroughly saturated with paraffin by heating the two together in an iron tube. I did not consider compensation for temperature necessary, as the clock is kept as nearly as possible to Greenwich time, and it can easily be made to gain or lose, as circumstances require. It is only necessary to alter the rate when the temperature varies considerably, such as summer versus winter. During spring and autumn the clock keeps very good time. The great enemy of wooden rods is damp, which affects the rate of the clock more severely than a change of temperature.—SM.

[62185.]—**Steam.**—In the original query area of h.p. cylinder was one-third that of l.p. cylinder, and it was assumed that steam was admitted to the latter the whole length of stroke, in which case it would of course be expanded three times. This neglects all consideration of loss between the cylinders, and which in practice is considerable. Neither in the case was condensation in l.p. cylinder taken into consideration. I presume you are taking a case from actual practice and from indicator card; but I answered what to my mind was one of the many examination questions which appear about this time.—T. C., Bristol.

[62208.]—**Contact Breaker.**—TO MR. HIGGS.—The vibrating spring, as should be seen in sketch, is cut in two at base. A tongue of hard and tempered steel let into the two parts. A rigid stop at *o*, extending slightly beyond lower end of upper part of spring. This principle is not essential, being required for special purposes only—viz., that of photographing spectra of gases, &c., and its full explanation might be uninteresting to "Holland." A is a hard and tempered steel arbor, turned down so as to leave a flange near *s* for a double shoulder, beyond which at *w* is a check-screw cut in a lathe, threads of which are highly polished to prevent subsequent wear. P are the so-called platinum points silver-soldered on to copper bits which fit accurately into holes ⅛in. deep of iron screw of armature and brass screw of upright, finished with a taper countersink, and easily removable when worn out. These precautions are found unnecessary, however, from the fact that the platinum has not perceptibly burnt away since first put on. At *i* is a brass disc screwed to steel arbor,



and a milled ebonite nut fitted on to a square ⅛in. long on end of arbor, and screwed to disc as shown. Ivory or any other non-conductor may, of course, be used. All other matters, it is hoped, are self-explanatory. Scale nearly ⅛in. to the inch.—GEORGE HIGGS.

[62228.]—**Algebraic Geometry.**—A person with a knowledge only of Euclid and algebra can apply algebra by a general method to prove propositions on geometrical magnitudes—whether they be linear, superficial, or angular magnitudes—but not to propositions relating to geometrical form; however, it will first be necessary that he is expert at working out algebra with literal coefficients, and not merely with numerical coefficients, for it is the former only that can be applied to investigate the properties of geometrical figures. On the other hand, there are only two propositions in Euclid on which the application of algebra to geometry really depends, for as Lardner, in his edition of Euclid, says: "It is by the influence of this proposition (I. 47) and that which establishes the similitude of equi-angular triangles (VI. 4), that geometry has been brought under the dominion of algebra, and it is upon these same principles that the whole science of trigonometry is founded." The method of proceeding algebraically is, indeed, a method of measuring or surveying the geometrical lines and surfaces, and though no standard of measurement is denoted contrary to what at first might be expected, yet that is because whatever be the assumed unit of measurement (which, theoretically, may have any finite value), it always disappears whenever different magnitudes of the same kind are compared together. Proving equality by mensuration, according to the algebraic method, is quite as satisfactory as proving it by superposition, according to the purely geometrical method, and, indeed, it has been objected against superposition that conceiving one figure placed upon another, and the corresponding lines to coincide is a mechanical operation, but this objection is altogether groundless. It may be asked, What are the advantages of applying algebra to geometry? Without entering fully into this question, it will be sufficient here to point out that in the purely geometrical method we carry on our deductions mentally, whereas in algebraic geometry we write down the several successive stages of our operations, and just as written arithmetic is a far more powerful means of computation than mental arithmetic, so in many cases the algebraic method is far more powerful than the geometrical method. But, moreover, the algebraic method possesses uniformity of process, which the other does not. I should think, however, that the only practical way of giving a distinct idea to the uninitiated on this subject is to give some examples in explanation of it, and if "J. K." and such others will work out for themselves the four following propositions, and consider well the meaning of the results they obtain, they should then have a tolerably good insight into the methods of algebraic geometry of the simpler kind, and ought to be enabled thereby to extend considerably their powers over questions on geometrical magnitudes. Let A B C (Fig. 1) be a triangle right-angled at C, and let the hypothenuse A B be divided into two equal parts at E; it is required to prove algebraically that the line C E is equal to half the hypothenuse A B or C E = A E = E B. Draw the perpendicular C D. By considering the figure, we may easily perceive that if the lengths of a certain number of these lines be supposed to be given in numbers, we should be enabled thereby to find the lengths of all the other lines in numbers. Thus, we may consider a certain number of the lines as independent or arbitrary quantities, and the rest of them as dependent or determinate quantities. It is requisite, in the first place, to observe what is the least number of these lines that may thus serve as data for fixing the lengths of all the lines in the figure. If we imagine the length of only one line, such as A C, to be given, though we could then determine the position of the line C B, the angle C being a right angle, still there would be no data to determine the point B, and, consequently all the other lines would have no determinate lengths. But they would have determinate lengths if both A C and C B—or, indeed, any other two lines in the figure—be considered as given. It thus appears that two is the least number of lines that can serve as the required data, and also that it is optional which two of them we employ, and so it would be a determinate problem, if the lengths of any two of these lines be given in numbers to find the lengths of all the others in numbers. Accordingly, in working out the present theorem, we are to consider any two of these lines as independent or arbitrary quantities, and all the others as dependent upon these two alone. In other words, we may consider two lines as known quantities, and all the others as unknown, and the method of operation will then consist in expressing the unknown in terms of the known. Now, what are sufficient data to determine all the lines geometrically must, of course, be sufficient to determine them algebraically. Wherefore, if the problem were proposed, "given A C $= a$, and a right angle at C, find the algebraic expression for the length of C E," that problem could not be solved, unless another quantity, such as C B $= b$, were also given, and then, since the length of C E could be determined geometrically, it should also be expressible algebraically in terms of a and b. Now, the algebraic method of demonstrating propositions of this kind depends upon the following simple principle:—If any geometrical magnitudes be equal to each other, the algebraic expressions which denote them must each be the same, provided those expressions contain only the same independent quantities. Indeed, to suppose otherwise would in effect be supposing that though those magnitudes are geometrically equal, still their measurements may not be equal—a supposition manifestly absurd. Not only equality of magnitude, but any similar relation of magnitude, can be established in the same manner. To proceed now with the demonstration. Let A E $= x$, C E $= y$, C D $= s$, D E $= v$, also A C $= a$, and C B $= b$. Since the angles at C and D are right angles, we have from Euclid C E² = C D² + D E² (I. 47) and C D² = A D . D B (VI. 8), thus we obtain from the figure the two equations $y^2 = s^2 + v^2$ and $s^2 = x^2 - v^2$. In these two equations there are four quantities involved, x, y, s, v, and since we are at liberty to consider two of them as known, there will thus remain two also as unknown. But those two unknown quantities can be determined, since there are two equations to determine them, and the demonstration resolves itself into the algebraic problem of finding x and y in terms of s and v. Doing this, we find $x = \sqrt{v^2 + s^2}$ and $y = \sqrt{v^2 + s^2}$; and thus we see that the algebraic expressions for x and for y are each the same, as they should necessarily be, since if the lines themselves are equal, their measurements ought also be equal. To perform the demonstration, however, in a more thoroughly algebraic manner, we should not pass beyond the first book of Euclid, and instead of v and s let a and b, the two sides of the triangle, be assumed as the two independent quantities. Then x can at once be expressed in terms of a and b, for we have $x = \frac{1}{2}\sqrt{a^2 + b^2}$. But in the equations for finding y there will be six quantities involved, a, b, x, y, v, s, and as two only are allowed as known, so four must be considered as unknown, and therefore we must take four equations from the figure in order to determine y. Let us then take the four equations $4x^2 = a^2 + b^2$, $a^2 = s^2 + (x - v)^2$, $y^2 = v^2 + s^2$ and $b^2 = s^2 + (x + v)^2$, from which we shall find $y = \frac{1}{2}\sqrt{a^2 + b^2}$; so that now, as before, the algebraic expression for y is the same as for x. By thus performing the demonstration of the same proposition in different ways we can verify our results. In performing it in one way only, as we have the choice of the independent quantities, facility of operation will generally be afforded by a judicious selection of them. It should be particularly observed why algebraic expres
senting equal geometrical magnitudes
be the same, provided they contain on
independent quantities. The reason is
expressions were not the same when fir
they could not afterwards be made
strange anomaly would then occur
algebraic results would lead us to a f
sion; for, as each of the quantities invol
independent of any other of them, there
means of obtaining sameness by subs
one quantity any value in terms of anot
with regard to the lines A E and
algebraic expressions, in terms of a a
we have obtained for these two lines, d
out the same, and if we thought of m
the same by giving to b some particular
regard to a, or *vice versâ*, such a tho
imply that the value of b depended up
such limitation exists geometrically, a
be of any length whatever without an
the length of A C. Only one thing m
to be noted for fully comprehending thi
If two algebraic expressions are eq
other for an infinity of particular value
be identical expressions. Now, the for
obtained for representing the lines A
require to be equal to each other for an
values, consequent on the infinity
lengths that C B may have with
A C, and the only way that they
this condition is that they must
the same algebraic expression.
example, let M N and L H (Fig.
two chords of a circle which inte
other at right angles, thus forming of
the four segments M B, B N, L B, and
required to prove algebraically that
described on these four segments, whe
gether, will always be equal to the sq
diameter. Consider first the data nece
the lengths of the four segments geome
the radius of the circle and the length
pendicular C A on M N be considered
would enable us to fix the chord M N; b
chord L H would be indeterminate unl
line, such as C D, be also considered giv
proposition, therefore, it is lawful to em
independent quantities for performing
stration. Let the radius $= r$, C A =
$= b$. The method of proceeding now is
the four segments in terms of r, a, and b
equations from the figure, and then to fi
of their squares. If, geometrically, the
squares of the four segments be always e
square of the diameter, then, algebra
sum of the squares of the algebraic
that denote these four segments must
vided those expressions contain only the i
quantities r, a, and b. A proposition, ap
a different kind, is the following one:-
three angular points of any trian
(Fig. 2) three lines are drawn perpendic
opposite sides: prove algebraically that
perpendiculars intersect each other in
point. Let M be the point where A E
D C, and N be the point where B E inte
(supposing it to be a different point), ; t
line D M can be shown equal to D N, t
tion is evidently proved. It woul
here to draw a separate figure for ea
order to avoid unwarrantable as
Since A B C may be any triangle wha
evident that three independent quantiti
introduced into the demonstration; fo
to determine any triangle by means of i
the three sides must be given. Instea
of the three sides, let us take the three
$= a$, D B $= b$, D C $= c$, and assume D
D N $= y$, then the demonstration is
finding x and y in terms of a, b, and
figure the triangle A M D is similar
and to C D B; wherefore we have the
D M : A D : : D B : D C, and conse
obtain the equation $cx = ab$. We ha
triangle D N B similar to E N C and
wherefore we have the proportion D
A D : D C, and consequently the equatio
In these two equations there are five
involved, a, b, c, x, and y; but as we ar
to employ three of them as known, the
only two for the unknown; and since w
two equations, we have got what must b
to find x and y, and therefore to
theorem. In fine, since x and y ar
equal to each other, the three perpendic
therefore meet in one point, as was req
proved. If the three lines from the ang
instead of being drawn perpendicul
opposite sides, were drawn to the middl
those sides, and we proceeded to as
that case, whether the three lines woul
in the same point we would find $x =$
$y = \frac{1}{3}$ D C. Since the values of x an
same, the lines do intersect thus;
mains to be explained why it is that
quantity appears in this value instead
which are necessary to determine the wh

FIG. 1

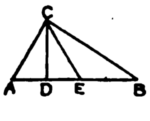


FIG 2.

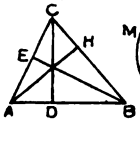
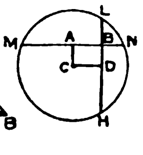


FIG 3



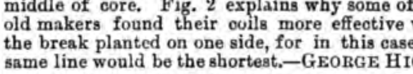
cases such as this, where some of the inde-dent quantities disappear of themselves from final result, without being eliminated by us, it icates a peculiar property in the geometrical re itself, by which the magnitudes that those lts denote are quite independent of the ntities that have disappeared. Thus, since value of x or y contains two quantities less n what is sufficient to determine the figure, it ws that this value is independent of two exist-magnitudes in the figure. Hence, in the solu-of this problem, the algebraic result is to be terpreted" geometrically as follows:—In the t place, the three lines intersect in one point; moreover for any fixed length of D C it will ays be in the same point on D C that the three s intersect, even supposing, firstly, that the gth of the base A B be varied indefinitely, and ondly, that the inclination of D C with the base varied indefinitely. The method of proving blems on the intersection of three straight lines, given in these two last examples, is quite dif-ent from that given in books on analytical geo-try, where it is done by finding the equations the intersecting lines, and in the higher analysis is not done at all so succinctly by Cartesian co-linates as by the use of trilinear co-ordinates. e method I have given, however, is just as prac-able as any other, besides presenting greater nplicity of principle. It is to be observed roughout the operations which we have per-rmed that all the algebraic results are homo-neous when freed from fractions and surds. By is it is understood that the number of literal ctors in each component term is always the same r any one result or equation. Conversely, every gebraic expression admitting of geometrical con-truction must be homogeneous in all its component arts, for otherwise it would be only absurd to ink of equalling or combining a line with a sur-ce or a surface with a solid. In conclusion, it ay be said that algebra is a valuable instrument r investigating geometrical propositions, even hen such require to be performed in a purely ometrical manner, for it is often convenient, in e first instance, to prove the problem algebraic-ly or analytically, and thereby to guide oneself the geometrical proof by deducing from each ep in the algebraic operation the corresponding ometrical relation. Such, indeed, was the course ich Newton followed in the production of his eat work the "Principia."—VLADIMIR.

[62235.]—**Honey.**—Can "J. L. S." tell me of y simple test? I have not a microscope. Some ne ago some stuff was given me which was as rd as soap, and smelt of paraffin, and it tasted e nitric acid and treacle. Surely this was an tificial article.—A. F. SHAKESPEAR, Lüt-haustr. 14, Dresden.

[62264.]—**Duodecimals.**—Twelve is a very ach better number than 10 as a base for counting, e reason being that it is divisible by more tors without a remainder. 10 is only divisible 2 and 5 without a remainder, while 12 is divisible 2, 3, 4, and 6. It must be borne in mind that 12, ssessing 4 as one of its factors, can be halved d halved again without a fraction—a very useful operty for practical purposes. 90, the number degrees in a right angle, has not this advantage, r though it is divisible by 5 digits it cannot be artered. With regard to numbers, the human nd has a natural aversion to two things, and a tural bias towards two things. It has an aver-n to, first, large numbers; secondly, fractions. has a bias towards, first, facilities of halving d quartering; secondly, ease of manipulating ncrete numbers (i.e., addition, subtraction, multi-ication, and division, &c.) Now, unfortunately, e whole world has a decimal notation. It will be en as a consequence that if it by any system cures ease of manipulating concrete figures, it s to put up with large numbers, fractions, as ell as losing the facilities of halving and quarter-g; *vice versâ*, if it secures the last three benefits, loses the first. The metrical and the decimal stems consist in dividing the units by which we easure or assign values to things into 10 or multi-es of 10 parts. This system does not correct the il inseparable from a decimal notation, as we all presently see, for while it facilitates the anipulation of numbers, it introduces fractions, ves large numbers, and is not suited for halving d quartering. Let us examine a few cases and e if this is so. A countryman will tell u that a hare was shot at a distance 10 rods, experience having taught him to e a large unit in estimating distances. A towns-an would have estimated it in yards, and would obably have been wrong. A great mistake is rpetrated in the army by attempting to get men estimate the range in yards. The unit is too all. If the men were practised in the use of a ger unit, the shooting at unmeasured ranges uld be more accurate. A sailor will estimate e height of a building in fathoms, and will terly beat a shore-lubber, who will try to do it in st. In money, notice the contrivances used to t rid of the inconveniences experienced by those countries where a decimal system has been adopted. Take a new country—viz., Brazil; there the unit is ridiculously small, 1,000 of them being equal to about 2s. In Portugal the unit is twice the size, 1,000 reis being equal to one dollar. In America the dollar is divided into 100 cents. In an advertisement before me I see an article quoted at 60 cents. What idea does that present to an American's mind? Does he think of it as $\frac{3}{5}$ of a dollar or as 60 cent units, or as six 10-cent units? How much simpler is 2s. 6d., being 2½ of our shilling units? The greater part of the business of the world consists in buying and selling—not as the merchant who buys several thousand boxes of tea at one time, but as the consumer, who buys 1lb., ½lb., or ¼lb. I think it will be evident that such transactions, involving sums of one to five shillings, are more conveniently carried on with 1 shilling units than with ½ penny ones. With regard to the metrical system of linear measures, I have on the table a German pamphlet, where those measures are used throughout. As an instance of high numbers used, let me quote 400mm. as an example. A length of 400 units, where each unit is equal to $\frac{1}{25}$in., is a great pill to swallow. Suppose anyone said a house was 400in. high, what idea would it convey? Which conveys the best idea, 400mm. or 15½in.? It will be said this is only a matter of practice; if one had always been accustomed to the metrical system, it would have conveyed as concise ideas as the other. This is not true. A high number never conveys as clear an idea as a low one. Note very carefully the 400mm.; it ought to have been 4dm. It is evidently inconvenient to use the dm. Why? Because, of course, it is not easy to break it up into factors, therefore the smallest possible unit is chosen. Thus, the half of a dm. is 5cm., and the half of that, 2·5cm., which is objectionable; so, to get out of the difficulty, the dm. is suppressed and 100mm. put in its place—a number, please observe, which can be halved and quartered without a remainder. In the same way metrical people measure distances of about 10ft. in ½in. units; thus they will call a thing 325cm. long; the mètre is suppressed for precisely the same reason that the dm. was above. We have no occasion to read feet in inches or one-tenths and suppress the foot. Our foot is too useful, as it can be halved and quartered, besides being broken up into other factors. You may educate people as much as you like, but you will never get them to ask for ·25 of a pint of gin. In like manner you cannot suppress the yard with its 36in., which can be divided by 2, 3, 4, 6, and 9 without a remainder. The manner in which the metrical system is commonly used is the best proof of its inefficiency. It shows that of the two evils, high numbers and fractions, high numbers are chosen as being the less objectionable. These sacrifices are made to secure ease in manipulating figures. On the anti-metrical system side you have small numbers, facilities of division, absence of fractions; in consideration of which you have to put up with a difficulty in the manipulation of figures. Let us examine this so-called difficulty. The principal difficulty the world meets with in accepting the anti-decimal system is undoubtedly to be found in the addition of money. Is this real or only apparent? If one adds up the pence column in pence, and divides the sum by 12, he will certainly experience some difficulty; but if he adds up the pence column in shillings, and the shillings column in pounds, he will meet with no more difficulty than when doing an ordinary abstract addition sum. Of course, I am not speaking of those professors in the art who, by glancing up the page of a ledger, can add up £ s. d. all at once with unfailing accuracy. To such a one it would matter little whether the figures were abstract or concrete. But I was speaking of those who, like myself, not being in the habit of doing addition sums, find they require a certain amount of effort. With regard to all other calculations in the business of the world, they are only worked out by schoolboys and men in for exams. The sums are all done by table. Interest, present values, annuities, &c., are all done by tables, let the system be decimal or otherwise. The other day I saw some eminent actuaries giving evidence in a law court as to the present value of some property. The problem required a complicated interest calculation, which they did not work out, but referred to their tables. We have now seen that each system has its faults; the metrical with its difficulties of division, its high numbers, and its fractions; the anti-metrical its difficulty in manipulating figures. Now if we could only have a duodecimal notation, we should secure the advantages possessed by each system without any of their disadvantages. It is nothing more than a popular mistake to suppose that a metrical system can cure the errors of a decimal notation. If you would have a correct system of weights, measures, and money, you must alter the notation table, and have a duodecimal system. A duodecimal system means one that has eleven digits instead of nine. Therefore, we must invent two new digits. For the sake of example, let us adopt two Greek letters, θ and ϕ. Our notation-table will run as follows:—1, 2, 3, 4, 5, 6, 7, 8, 9, θ, ϕ, 10, 12, 17, 1θ, 1ϕ, 20, 29, 2θ, 2ϕ, 30, 50, 90, θ0, ϕ0, $\phi\phi$, 100, &c. This would be somewhat novel at first, for ·6 would be ½, ·9 = ¾, and 100 would be the equivalent of our present 144. 2θ twenty theta, $\theta\phi$ theety-phi, and $\phi\phi$ phity-phi, would certainly sound strange. The present year would be changed into 1113 A.D., and the three score years and ten into 5θ. If a duodecimal system were adopted I believe the confusion resulting from it would pass off more quickly than any of us are aware. The chief difficulty experienced would be in the reduction of astronomical work, logarithms, &c. Some will say that this proposal is quite absurd. To which I reply, Is it more absurd than the metrical system, which just as much upsets and confuses existing arrangements without curing the evil? The duodecimal system would certainly make a confusion for a time; but it would remedy all defects and supply an easy method of calculation, while not injuring the practical values of our weights, measures, and money.—THETA PHI.

[62272.]—**7in. Spark Induction Coil.**—TO MR. HIGGS.—As the old Polytechnic is now broken up, "Engineer" might procure core which would be about right for a three-sectioned coil to give 7in. spark with three cells. Being desirous that those who seek my advice should meet with absolute success, the replies will be the same as if four or six sections were intended. (1) Supposing ⅛in. each for paraffin and ebonite coverings, projections ¼in. will give the size as 1in. more than diameter of sections. (2) Use the same measurements as supplied in my letters of recent issue, as I doubt the possibility of accomplishing what you want with much less. (3) $\frac{1}{16}$in. (4) Close up to ends, not forgetting to screw on a small soft Swedish iron pole-piece at far end of core, slightly convex at end. This is important if you wish for the very best results. A diagram will explain this. In Fig. 1, where extra pole-piece is used, the longest line which can be drawn is along the middle of core. Fig. 2 explains why some of the old makers found their coils more effective with the break planted on one side, for in this case the same line would be the shortest.—GEORGE HIGGS.

1



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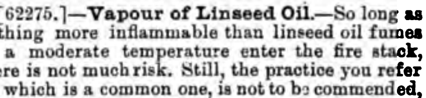


[62275.]—**Vapour of Linseed Oil.**—So long as nothing more inflammable than linseed oil fumes of a moderate temperature enter the fire stack, there is not much risk. Still, the practice you refer to, which is a common one, is not to be commended, many accidents having arisen through its adoption. It is preferable to construct a double flue, taking the fire up one, and the fumes up the other or if this is not obtainable, you can fix iron piping above your varnish pot.—DANDIE DINMONT.

[62277.]—**White Shellac Varnish.**—You have simply to put your shellac and spirit together into a glass bottle and agitate occasionally. When the lac is dissolved, allow the varnish a week or more to subside, and use the upper portion. If you desire a strong gloss use half lac and half gum sandrach.—DANDIE DINMONT.

[62281.]—**Valve Gearing.**—I have seen radius links struck with a radius longer than that from centre of shaft, but never with a shorter one. I don't think it can affect the working of slide valve.—A. F. SHAKESPEAR, Lüttichaustrasse 14, Dresden.

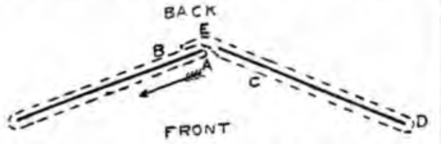
[62283.]—**Water Power.**—Perhaps "Humble Inquirer" is not so humble as he pretends, and is laying a trap for humbler responders. The aperture of smaller column is indistinct in the print. Suppose it to be 1in.; then, as there is a pressure of 1,120lb. on a surface of 254·47sq.in., which equals 4·4lb. per square inch; surely the pressures on the smaller pistons simply equal their area × 4·4lb.? i.e., on the 1in. diam. piston the pressure would = 0·7854 × 4·4 = 3·4557lb., and that on the 3in. piston, 3^2 × 0·7854 × 4·4 = 31·10lb. If this is not so, I am at a loss to reconcile the problem with the law of equality of pressure in fluids. His last question, viz.: "would it force the same weight up on B if it were connected?" &c., is incomplete —connected with what? Why entitle his query "Water Power," when it treats only of a tank filled with air?—E. ST. EDMUNDS.

[62291.]—**Legal.**—Certainly not; you only had one vehicle with six wheels.—HENDON.

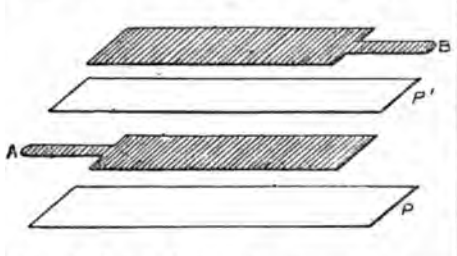
[62292.]—**Wood-Turning and Staining.**—"Amateur" should use Stephen's ebony stain and Judson's gold paint. Don't varnish, but rub with the hand when dry. In Nos. 1084, 1087, and 1088, "Amateur" will find letters which may help him.—COPEAUX.

[62293.]—**Vice Repairs.**—The remains of the old thread must first be removed by heating the socket sufficiently to melt the solder. Next get a piece of square iron wire same size as thread, and wind it round screw; then push the whole into the socket, having previously cleaned both the inside of socket and outside of wire with a file; the screw or pin will now be screwed out, leaving the wire thread in the socket. Now take brass wire about ½ the size of thread and wind it round the screw, then take it off and screw it into socket by the side of iron thread. Borax mixed with water into a paste will now be smeared on the threads in the socket. The whole is then to be placed in a clear fire, sufficiently hot to melt the brass wire. A greenish flame is given out when it runs; keep turning the socket while hot, or brass will set on one side.—A. F. SHAKESPEAR, 14, Lüttichaustr. Dresden.

[62294.]—**Folding Screens.**—Make thin frames of 2in. by ½in. pine, taking care that longitudinal pieces come flush with top and bottom. Nail on thin canvas on each face, after the manner shown on sketch—viz., beginning at A, cover face of screen A; continue round back to B, intersect the apex or joint as shown, coming round face of second screen by C; proceed and lap again at D, finishing off at E, to strengthen the hinge, which, as seen, will be composed entirely of the covering, effectually shutting off draught. Size the canvas, and stick your Christmas cards, &c., on with paste; or, if desired, it may previously be strengthened with a coating of thin cartridge paper pasted on to the canvas. If "Amateur" wishes to proceed economically, he can buy a kitchen clothes-horse (folding) for about 1s. 6d., which a little ingenuity would adapt to his purpose.—E. ST. EDMUNDS.



[62298.]—**Condenser, ½ and 1 Micro-farad.**—Take 37 sheets of good tinfoil 7in. by 6in., having a projection about 2in. long and ½in. wide, projecting from the middle of the narrowest side, as shown in the figure at A and B. Now procure about 76 sheets of very thin, hot-pressed paper 9in. by 8in., such as is used for banknotes (or similar). Choose it leaf by leaf, free from holes or blemishes. Soak it leaf by leaf in hot, melted paraffin wax, drain, and blot off with a hot iron between good blotting-paper. Now lay on a perfectly smooth and flat iron plate two sheets of this paper, as shown at P, then one sheet of tinfoil, quite in the middle, having the projection to the left, as shown at A. Now place over this two sheets of paraffined paper, as shown at P′, then a sheet of tinfoil, with the projection to the right, as shown at B. Proceed in this manner, laying the sheets of tinfoil, with the projections alternately to the left and right, until all the 37 sheets have been used up. Now subject the whole, in a press, to a pressure of about half a ton; solder all the 19 ends on the left-hand side together to attach to one terminal, and the 18 ends on the right-hand side to attach to the other terminal. Place the condenser between two flat boards kept together by screws, so as to maintain one invariable pressure (as the capacity varies with the pressure). Two binding-screws must be in connection with the two soldered ends of the tinfoil. Of course, the instrument should be tested against a known capacity to insure exactitude. If too small, add more tinfoil leaves, or increase the pressure; if too great, remove a leaf or two of tinfoil. The capacity of the above will be very nearly 1 micro-farad. With half the number of leaves, its capacity falls to ½.—S. BOTTONE.

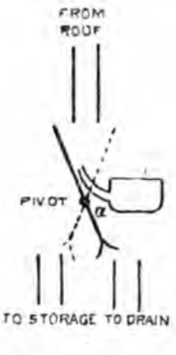


[62313.]—**Wood - Turning.**—Consult numbers given in answer to (62292). "The Lathe and Its Uses," or "Turning for Amateurs," both by a valued correspondent of this paper, would help you greatly.—COPEAUX.

[62315.]—**Cylinder.**—I think "Trinity Hall" must have made a mistake. The cylinders of firm mentioned are 2in. by 3in. (not 3½in.), which would make yours right with a ¾in. piston.—A. F. SHAKESPEAR, 14, Lüttichaustr. Dresden.

[62316.]—**Storage Cell.**—TO "ELECTRICIAN."—Thanks for reply to my query. Will you kindly tell me what the non-fuming solution is? One of the chief reasons for desiring storage cells in preference to primary batteries is because they can be so nearly sealed, and therefore not liable to spill with the oscillation of the boat. I do not mind the trouble and cost necessary to make these small secondary cells (it cannot be so much for three cells), and if "Electrician" will give me instructions, he will confer a great favour. I cannot very well use lamps in series whilst forming cells, because the dynamo is lighting some 150; also, I thought these secondary cells required a certain current according to the surface of the plates. If "Electrician" will kindly refer to my query and tell me how many plates to use in each cell and other instructions and information desired, I am sure he will benefit others than—ELECTRIC BOAT.

[62317.]—**Rain-Water.**—I inclose sketch of simple apparatus for allowing first few gallons of rain-water to run to waste. The whole of *a* is supported on pivot; a shallow vessel is connected by a small pipe to the tilting division, and is placed in position shown. On rain falling the vessel is slowly filled by the pipe, and tilts the division over. Rain then runs down the other side, as shown by dotted lines.—S. BEECHING.



[62317.]—**Clean Rainwater.**—The apparatus described by "A Cottager" on p. 230 is no doubt very efficient; but if I mistake not, the querist would prefer some simple device which he could construct for himself for a few shillings. I think it quite unnecessary to use electricity for this purpose, as advocated by "Provis Emsworth," when a simple mechanical contrivance will do much better, since the nice adjustment it would require is quite unsuited for outdoor work. Connect a flexible tube to the spouting, and allow the end to hang over a small cistern provided with a float similar to the ordinary ball-valve used for w.c.'s. To the lever near the pivot fix a light rod, and connect it to the flexible tube in such a manner that when the rod is nearly horizontal the flexible tube is tilted or deflected so as to be over the storage cistern or the conduit leading to it. The tube being in the first position, the water will run into the small cistern (an old petroleum barrel will do nicely) until the requisite quantity (say two gallons for every 100ft. roofing) is obtained. The float will continue to rise until that point, when the rod will be almost horizontal, and will accordingly push the tube across to the storage cistern, allowing the clean water to be stored. The dirty water can be emptied afterwards by a stopcock, the float sinking with the water will pull back the tube to its former position, thus "setting" the apparatus for the next shower. A neater device would be to have a two-way cock connected with the spouting (to "waste" and "storage") and worked as an ordinary ball-valve arrangement.—REYMOND.

[62319.]—**Driving Washing Machines.**—I advise "Icthium" to procure a gas-engine, say a five-man vertical, second-hand if he can. A steam-engine and boiler requires too much attention; he would have to employ an attendant for the boiler. The gas-engine is perfectly safe, and would repay its cost, as anyone can manage it when shown how, and he could stop it at dinner-hour, or at any moment, and start it again, whereas the boiler would have to have steam up all day.—A. R.

[62322.]—**Utilising Waste Suds.**—If "G. C." will advertise his address, I shall be pleased to show him two simple apparatus we have in daily use for utilising waste washing liquid, and effecting a saving of 50 per cent., or would send him a description of the same.—J. M. S.

[62327.]—**Boiler and Engine.**—Boiler, say, 2ft. by 18in., worked at 60lb. and run at 200 revs.; cut-off at three-quarter stroke; lap ⅛in., of valve ⅜in.—T. C., Bristol.

[62329.]—**Perpetual Motior**
Stephenson's study of perpetual motion
in the earlier years of his life while l
working as brakesman at Willington Q
Tyne. For a workman, he was, even at
more than ordinarily speculative, *ofte*
strange theories, and trying to sift out the
was in them. He constructed a machin
he thought he would secure perpetual r
consisted of a wooden wheel, the periphe
was furnished with glass tubes filled wit
As the wheel rotated, the quicksilver p
down into the lower tubes, and thus a s
acting motion was kept up in the appar
however, did not prove to be perpetual.
wards used to lament the time that he ha
perpetual-motion experiments, and saic
enjoyed the opportunity that most youn
have of learning from books, &c., wh
experimenters had accomplished, he w
been spared much labour and mortifica
"Life of George Stephenson," by Sam
Permit me to commend the latter parag
special notice of all who contemplate
motion.—ENGINEER, St. Mary Church,

[62330.]—**Boiler.**—The boiler is
make it 2ft. diameter, and carry a tul
1ft. in diameter. You need not have enc
if you have suitable mudhole. It woul
safe at 80lb. to 90lb. of $\frac{5}{16}$in. plate as abo
as you suggest, at 60lb., and flanged ou
½in. bolts 4in. apart and ends dished
be safe without stays.—T. C., Bristol.

[62331.]—**Dynamo.**—TO MR. BC
Either you have not hit upon the right q
wire, or else there is leakage somewh
the E.M.F. of the machine is sufficient
by the lighting of the one lamp; but it i
from its inability to light four in paralle
current is leaking at some badly-insulat
S. BOTTONE.

[62332.]—**Bisschop Gas-Engine**
makers of the "Bisschop," Messrs. A
Co., of Stockport, supply a small appar
a pressure raiser, intended to overcome th
complained of by "Hopeful." It is driv
engine, and so far as I have seen them
quite effectual. I know of no other
Write to the firm for particulars.—ENGI
Mary Church, Torquay.

[62332.]—**Bisschop Gas - Engin**
"Hopeful" tried enlarging the burn
engine so as to produce a longer flame s
combustion? If this is of no assist
makers supply an apparatus for raising
sure of the gas, by using which the gas in
bag of engine can be maintained at cons
sure of $\frac{18}{13}$ths; and by employing this i
the power of the engine is much augme
a reduced consumption of gas.—PHASIS
Sydney, 2 V.

[62333.]—**Legal.**—If the trustees ha
perly dealt with the trust property, a su
execution of the trusts would lie in th
Court if the trust property was under £5
ceeding that sum, then in the Chancery
of the High Court.—KAPPA.

[62333.]—**Legal.**—"C. S. W." must fi
tain if the trustees who have "sold an
by deed of gift and appropriated the sam
own use" have acted out of their rig
copy of the deed, go with it to a respectabl
and get his opinion. He will also advise
the method of action, if any.—B.SC., Ply

[62333.]—**Legal.**—The person interes
the trust brings an action in the Chancer
of the High Court against the trustees, cl
order that they should administer the
perly. If there is a trust, which would
out in the course of the proceedings, th
would be ordered to fulfil it and accou
purchase money, &c. I gather that "
would have some difficulty in establishin
and that he only suspects there is one.
because no purchaser would have bought
if the will or deed of gift disclosed such
on a sale of it such will or deed must n
have been shown to him; a person who
trustees knowing that they are committin
of trust, and is therefore liable together w
is a somewhat rare animal.—MAZZAROT

[62336.]—**Microphone Coil.**—A co
necessary on a *short* circuit: you simp
the microphone battery and telephone
One large or two small Leclanchés are
On *long* circuits connect microphone a
with the primary coil. The seconda
joined to line wires, or line-wire and e
the telephone at the receiving-station.—S

[62341.]—**Bottone's Medical Coi**
you give me some details as to the mode
constructed the clapper and platinum bre

l, I cannot assist you much. You will also kindly nember that as long as the brass tube is over the n core, you will get little or no effects; but how your battery made? Have you connected or mped your carbon plate in contact with the c? If so, of course the battery cannot work the l.—S. BOTTONE.

62345.]—**Blacking Cast-Iron Frames.**—One y of doing this nicely is to paint the iron slate our (oil-paint), and when dry, sand-paper, and ly black carriage-japan, obtainable at all paint ps. Brunswick black will give a fairly good face.—HENDON.

62348.]—**Civil Burial.**—Stocks in the name of eceased person are only transferred on production of the probate or administration: burial tificates are of no use whatever for this purpose. KAPPA.

[62348.]—**Civil Burial.**—Public companies do transfer securities standing in the name of a eased person on a burial certificate, but on a ree of the Probate Court. So this need not der anyone from directing that he should be ried in a field of his own. Civil burial in France not this, as "Hamlet" assumes, but merely the sence of a clergyman from the funeral.—B.SC., ymouth.

[62349.]—**Rhubarb.**—If the water contains lime, e oxalic acid will precipitate it as an insoluble alate before it enters the stomach, and this ould remain as a fine sandy precipitate at the ttom of the dish, and even if it were taken into e system, it would neither be redissolved, or re-ecipitated.—S. BOTTONE.

[62349.]—**Rhubarb.**—Over-indulgence in rhubarb does cause crystals of oxalate of lime to ppear in the urine, and may cause "gravel" or n oxalate of lime calculus in the kidney or bladder. n excess of sugar or alcohol in the diet appears o favour its production. I should say that for a ealthy temperate man there is no danger.—REYMOND.

[62350.] — **Dead Black on Brass.** — Rub up ampblack with gold size, and then with turpentine. —HENDON.

[62352.]—**Antiseptic Dressing.**—I once had a inger crushed in a shaping-machine, which was kept four or five months without taint by the use of carbolic acid in water. This I have also seen sed in German and Italian hospitals, both for bandages and as a spray during operations. It is lso the best disinfectant. Only the medicinal cid should be used, thinned with 80 to 100 parts ater. A bottle of this solution should be kept at and in every place where cuts and bruises are kely to occur.—HENDON.

[62352.]—**Antiseptic Dressing.**—I have found oracic ointment and lint (B.P.) very useful for nall cuts, &c., combined with iodoform for very ul wounds. The boracic lint may be applied ther dry (scalp wounds), or moistened with water, 1 in 20 carbolic-acid lotion. It is a very good irritating preparation, and quite harmless in e hands of amateurs, which is more than can be id of some other antiseptics. Three or four mbers of the "E.M." might easily be written on is subject.—REYMOND.

[62352.] — **Antiseptic Dressings.** — When I ppen to cut myself, which, like most amateurs ho work at machinery, I often do, I sop a bit of ool in Friar's balsam (Tr. Benzoin co.), and ply it to the wound, leaving it there until healg has taken place. When I intentionally make wound in my surgical practice, I apply absorbent licylic wool dry, and only remove it when the scharge comes through. The former method is itable for slight wounds, the latter for serious es; but adhesive plaster is the very worst application to put to a breach of surface on the skin.—OCTOR MEDICINÆ.

[62352.]—**Antiseptic Dressing.**—Dry dressgs are getting much into favour. "Bedouin" commends filtering paper (disinfected at 120° C., eeped in an antiseptic solution, and dried owiy); eight sheets are superposed on the wound, d slightly bandaged. "Maylard" cleanses with chloride solution, then dries as much as possible, rinkles with iodoform, and applies a loose pad of sorbent wool, previously dipped in weak biloride solution and dried. On this a layer of Game tissue, similarly prepared, and on this a further yer of great strength; bandage with muslin so at the edges of the wound are under most preste. My old master, Lücke, surgeon-general of e German army, uses now powdered sugar ¼in. ick, and extending 4in. beyond the wound, spread , and folded in muslin free from grease.—B.SC., lymouth.

[62352.] — **Antiseptic Dressing.** — No "cuts d minor accidents," if properly treated as soon they occur, ought to reach the stage where antiptic dressing is necessary. But if not immeately attended to, or are carelessly or ignorantly eated, suppuration may require antiseptic remedies. If the blood is in a tolerably healthy condition, and the patient is not a hard drinker (this makes a lot of difference), the wound ought to heal in about four or five days. The sooner it is tied up after the accident happens the better. Do not use any cold water if it can be avoided. If any dust or dirt happens to get in, it is better to wipe it out with a sponge or soft cloth. Do not tie in a hurry. Bring the edges together, and bind them up with ordinary darning-cotton, leaving the threads about ⅛in. apart; then the surface may be cleaned with a wet sponge, and well dried. Have ready a teaspoonful of Friar's balsam; paint the wound over several times with a feather or clean finger, till the parts are as brown and shiny as mahogany. When quite dry and no blood escaping, place over it a piece of dry lint, and secure it with tape or a fold or two of white, soft paper, with a little more pressure than at first. Do not remove the darning-cotton till the wound is quite healed. If it is allowed to gape open afterwards, and does not heal on its "first intention," it suppurates, and the cure is much delayed. Every workshop should have a bottle of this old-fashioned but most invaluable preparation, a roll or two of lint, and several pieces of common unbleached tape. Many and many a poor soldier has bled to death when only a yard of tape in his pocket would have saved his life, or that of a disabled comrade. It takes up no room, and no man should think of travelling without it.—J. H.

[62356.]—**Intensity Coil.**—If I understand "Sloper" aright, he has room for seven sections of secondary wire on his coil, and five of these have been already wound, taking 1oz. each. He has now room for only 2oz. more in two coils. The only thing for him to do is to content himself with 7oz. of wire instead of 8, for if he attempts to wind over any of the other coils, he is pretty sure to have a mishap, and find that the insulation will be injured and a short circuit occur. I should have preferred Nos. 38 or 40 for such a small coil, which would have given a longer spark. The rule is that for every mile wound on the coil about 1in. of spark is obtained.—ELECTRICIAN.

[62359.]—**Illuminated Fountains.**—"Gerion" will find the most complete and exhaustive description of the mode of effecting the illumination of fountains, &c., in a series of articles contributed to "Ours" by Mr. Lewis Wright, which he will find in the ENGLISH MECHANIC for the year 1880, Vol. XXXII. No. 819, p. 295. This same work has been published by Macmillan under the name of "Light: a Course of Experimental Physics, Chiefly with the Lantern," by Lewis Wright, price 7s. 6d.—being the best value for three half-crowns I have seen for many a year.—S. BOTTONE.

[62360.]—**Beam Engine.**—Put on drain cocks, and leave them open when starting, for a few strokes. The cause is, the cylinders being cold, condense the steam, and the piston meeting this on the down stroke gives a blow to the whole engine. Start slowly, and with cocks open.—T. C., Bristol.

[62362.]—**Soda Ash and Bleaching Powder.** —I do not know for certain the method used in works for the analysis of the ash, but suspect that they merely ascertain the amount of standard acid it will neutralise. Black ash is a rather complex mixture, and its analysis by no means an easy task; soda ash is, I conclude, purified black ash, but it is still a mixture. The value of bleaching powder depends upon the amount of chlorine set free on treatment with acid, and there are numerous methods for ascertaining that amount. One of the best is titration with a solution of arsenite of soda until it ceases to turn blue iodised starch paper. The arsenic solution is made by dissolving 4·436grm. pure As_2O_3 and 13grm. Na_2CO_3 in 600cc. water by the aid of heat and diluting when cold to 1 litre. 10grm. chloride lime is dissolved in water and made up to 1 litre; 50cc. of this is titrated with the arsenic solution. Each cc. of the As solution corresponds to 1cc. of chlorine gas at 0° and 760mm. If 40cc. have been used, the 50cc. of lime chloride = 40cc. chlorine, and therefore 100grm. of the bleaching powder = 80 litres chlorine.—SM.

[62362.]—**Soda-Ash and Bleaching Powder Analysis.**—I suppose by "percentage strength" "Perseverance" means, in the case of soda-ash, available alkali (alkalimetrical degree), and in the case of bleaching powder, available chlorine. Anyhow, I will assume that this is what he requires. Available alkali in soda-ash: weigh out 15·500 grammes of the well-sampled sample, place in a half-litre flask, dissolve in water, and make up to mark. For each test take 50cc. without filtering, and titrate with normal hydrochloric acid (36·5 grammes HCl per litre), using methyl-orange as an indicator. Each cubic centimètre of standard acid used represents 2 per cent. of available alkali (Na_2O). Available chlorine in bleaching powder: Weigh out 7·100 grammes of the sample (which must have been previously well mixed), place in a mortar, add a little water, and grind until a completely homogeneous cream paste is obtained; add more water, transfer to a litre flask, and make up to mark with water. For each determination take 50cc., which equals 0·355 gramme of the sample, shake up the flask immediately before each 50cc. is withdrawn. Titrate with deci-normal sodium arsenite solution in a porcelain basin. The end of the reaction is indicated when a drop of the solution in basin gives no colouration when placed on a piece of moist iodised starch paper. If much chlorine is left, a brown stain will be produced, whereas if only a little remains a blue spot will result. Each cubic centimètre of the arsenite solution used represents 1 per cent. of available chlorine. Preparation of the deci-normal sodium arsenite solution: Weigh out exactly 4·9500 grammes pure, dry, re-sublimed arsenious acid (As_2O_3) add it to 200cc. of a solution of pure sodium bicarbonate containing 10 grammes of the salt, and boil until dissolved. When dissolved, add 10 more grammes of sodium bicarbonate, cool, and make up to a litre with water. Preparation of the iodised starch paper: Grind up 5 grammes of wheat or potato-starch to a homogeneous paste with water, pour this gradually into about 250cc. of boiling water contained in a porcelain basin, stirring meanwhile. Boil until a clear solution is obtained. To this solution add 2 grammes of potassium iodide previously dissolved in a small quantity of water. Strips of filter paper are now immersed in the solution, the superfluous liquid being removed by placing between two other pieces of filter paper. The paper is used whilst moist.—HENRY J. HARDY, F.C.S., Sheffield.

[62363.]—**Legal.**—Income-tax can only be deducted from rent at the time of payment; if not deducted then, it cannot be recovered from the landlord afterwards.—KAPPA.

[62363.]—**Legal.**—Property tax can only be deducted from the rent payable next after the payment of the tax by the tenant. As the tenant did not claim the deduction at the proper time, the landlord is not "liable to a penalty of £50." The tenant may, however, recover the tax by an action at law; see case of Spencer *v.* Parry, 3 Adolphus and Ellis's Reports, 331.—B.SC., Plymouth.

[62363.]—**Legal.**—Section 60 of Act 35 of 1842 says that the tenant must deduct the tax from "the first payment thereafter to be made on account of rent." This probably appears on F. Korner's paper if he reads it carefully. By the law of England, if a person makes a payment to another voluntarily, and with full knowledge of the facts, though in ignorance of his legal rights, he cannot recover it back. This very case of F. Korner's was decided in 1818, in the case of "Denby v. Moore" (1 Barnwell and Anderson's reports).—MAZZAROTH.

[62364.] — **Billiard Cushions.** — If your cushions have become hard through cold weather, they may be softened by applying a tin of hot water; tins are sold for this purpose by the makers of tables. If the rubber has perished through age, nothing can restore it.—SM.

[62366.]—**Spiral Wheels.**—Being of equal size and at right angles, the teeth are at an angle of 45° to the direction of their motion. The power will be decomposed into $1500 \div \sqrt{2}$, acting at right angle to surface of tooth, and the same also along the tooth whose width is increased $\times \sqrt{2}$ owing to its angle. The friction being taken at ·08 will amount to $1500 \div \sqrt{2} \times {\cdot}08$lb., which has to slip the whole width of tooth. Therefore power required additional $= 1500 \div \sqrt{2} \times {\cdot}08 \times \sqrt{2} = 1500 \times {\cdot}08 = 120$lb.—T. C., Bristol.

[62367.]—**Small Dynamo.**—TO MR. BOTTONE.—So small a machine, if series-wound, will certainly not light a 6c.p. lamp. If the voltage of the lamp be not too high (not exceed six volts), you may light it well, if you wind the machine as a shunt machine, with the following quantities of wire—viz., field magnets, 12 to 14 of No. 14oz., No. 24, single silk-covered, soaked in paraffin wax; armature, 2oz. No. 24 single silk covered, likewise treated with paraffin after being wound. Please remember that you can effectually upset the working of a Siemens dynamo by running as a motor, as you will very likely reverse its polarity. Also, please note that the direction of rotation of a Siemens series-wound dynamo is just the reverse to the direction in which it runs as a motor.—S. BOTTONE.

[62369.] — **Silk Underclothing** — is more healthy than merino, which is a mixture of cotton and wool; but the underclothing made on Dr. Jaeger's principle is better far than either. It can be had as light as merino, and is made of pure wool.—B.SC., Plymouth.

[62370.]—**Beam Centre.**—I have taken the brasses out, after removing caps, both by blocking the crosshead and then barring the engine back, or by fixing flywheel and then turning steam on gently and lifting beam, then blocking under crosshead, the crank being up in the latter case.—T. C., Bristol.

[62373.]—**Photo.**—Halving a double lens doubles the focus and increases the size of the image. The depth of focus is likewise increased. It is a good plan to use but little ammonia at first, and increase it after the image is out, so as to secure density. —SM.

[62373.]—**Photo.**—TO MR. BOTTONE OR OTHERS.—Practically there will be but little difference in the effect, provided an appropriate stop be used in the right position with the front lens of the ¼-plate. There will be a trifle less light in the corners, and perhaps a little more distortion; but altogether the picture will have more depth. The rapid rectilinear is more adapted to close views, interior, and groups, than to distant views. The veiling seems to depend more upon the pyrogallic acid than upon the ammonia. It is possible to develop a perfectly clean, though faint picture, with ammonia only; but the addition of pyro, especially if the action be prolonged, will surely give rise to veiling and staining in the long run. Hence, my preference for ferrous oxalate, with which you have perfect control over the development, and can go as slowly or as fast as you desire, without ever staining or veiling the film.—S. BOTTONE.

[62374.]—**Spark Coil.**—TO MR. BOTTONE.—A coil to give 1in. spark should have about ¾lb. No. 18 in the primary coil, and about 1lb. No. 38 in the secondary. The latter must be silk-covered. It will be better if built up in two sections; but this is not absolutely imperative. To work it to the full, six pint bichromates will be needed. I should not advise the use of the regulating arrangements in so large a coil, as they would detract from the size of spark. Besides, no one who cared for his nerves would care to take a shock from a 1in. spark coil.—S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, H. J. Hardy has replied to 62060.

61838. Photographic, 19.
61843. Old Violin, 20.
61846. Engine, 20.
61851. French and English Locos., 20.
61853. Painting, 20.
61856. Model Screw Steamer, 20.
61858. Sectional Induction Coil, 20.
61872. Perished Vulcanite, 20.
61874. Sawing Logs, 20.
61879. Colliery Lamps, 20.
61880. G.N.R. Locomotives, 20.
61884. Arc Lamps, 20.

62090. Estimation of Nitrogen and Phosphoric Acid in Manures, p. 112.
62095. Midland Single Engines, p. 112.
62111. Medal, 113.
62128. Rear-Driving Safety Bicycles, 113.
62135. Gas Engine, 113.
62136. Cutter Frame, 114.
62152. Coins and Tokens, 114.
62156. Sub-sizing Paper, 114.

QUERIES.

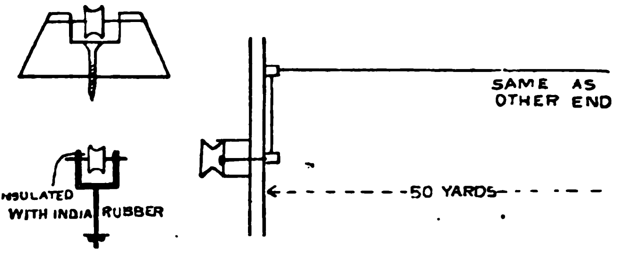
[62375.]—**Eight-Wheel Rolling Stock.**—Will anyone give a few details of the length, weight, wheel-base, carrying capacity, &c., of the 6 and 8-wheel radial axle carriages in use on the G.W., G.N., and L. and N.W. Railways? I wish to ascertain the dead-weight per passenger of these as compared with bogie carriages. Some mention as to position of the radial axles would also oblige—SPECTATOR.

[62376.]—**Accumulators.**—How many storage cells will be required to light six 20 volt 10c.p. lamps for four hours, and which is recommended as most suitable for a novice to use? My dynamo gives 35 volts and 7 ampères. Please mention size and cost of cells formed ready for use. —ORMOND.

[62377.]—**Inhalent.**—TO "B. SC., PLYMOUTH," OR "DOCTOR MEDICINÆ."—Will you kindly give a list of the principal inhalents used in bronchitis and irritation of the throat and air passages, with the quantities and mode of inhaling. A relative has lately had acute bronchitis, which threatens to become chronic, and I think the inhalation remedy would probably be the best.—BRONCHITIS.

[62378.]—**Medical Battery for Neuralgia.**—Will Mr. G. Smith kindly give particulars how to make a medical battery, same as he speaks about on page 100, No. 1,149, and oblige a sufferer with neuralgia?—H. DEAN.

[62379.]—**Acoustic Telephones.**—I made a pair of these according to instructions sent me by Mr. E. Conry, who, I am given to understand, has left England. He said wooden pulleys (as shown sketch), the axle insulated from wood bracket with indiarubber. I fixed it and tightened wire with a strainer, but could not hear what was said, although I could hear whistling and shouting, so I tightened up more, and have broken the brackets. These brackets were tolerably large, and larger ones would look very bad. Can I use iron ones, put through wall with a nut and plate on back provided, and insulate the axle as before (as in sketch)? Would it sound all right? The wire is No. 18 gal. iron, and the distance is 50yds. in one stretch, and passing over four insulators (as in drawing). I had a great strain on the wire before, but it would not speak. When the wind blew it made a noise in the instruments, so that you could not hear anything. Should this be so? Shall be grateful for any hints as to where I am wrong, and also whether the iron holders for pulleys will do?—W. E. ROGERS.



[62380.]—**Achromatic Condensers.**—I should be much obliged for any information upon the subject of achromatic condensers for use with the microscope. I am at present using a "Webster," with wheel of diaphragms and stops, and this affords me very good results up to a point; but I am desirous of securing the very best performance of, what I believe to be, a first-class immersion 1-10, and it is information of the best piece of apparatus to co-operate with this and still higher powers that I now ask for. My stand is a first-class full size, and with the 1-10 in question and very oblique light (the substage being entirely removed), I can, by very careful manipulation, occupying a longer or shorter time, resolve "Rhomboides," but the process is primitive in its character and uncertain, and therefore unsatisfactory as to its result, and as I am without any personal experience of any of the high-angled condensers produced by the various makers, any information of a practical nature from any of your numerous readers who are experts in microscopic illumination and the resolution of the severer "tests" will be of infinite service to me, and, I doubt not, to many others. The information should, in addition to the capabilities of the instrument described, include the maker's name and the price.—F. R. B., Exeter.

[62381.]—**Eyepieces.**—I have a telescope, 2¼ aperture, 33in. focus, the barrel of which is 34in. Will some reader kindly inform me what lens will be necessary to make two eyepieces with powers something like 120 and 150 respectively? I have an astro. eyepiece, but cannot focus it on the instrument. The lenses are 1½in. and ½in. focus. What should be their distance apart and the power?—REX.

[62382.]—**Deliquescency.**—Will any of our chemical friends kindly say which is the more deliquescent—viz., calcium or magnesium chloride, and give the relative strengths in this respect? Also say which is the higher priced for commercial purposes when in the solid state?—NIORELY.

[62383.]—**3in. Refractor.**—I have a 3in. refracting telescope, by Solomon, of fair defining power; but, on looking at bright objects, such as the moon and Jupiter, a fringe of diffused light is seen all round. This increases by using high powers. Can any reader kindly inform me of the cause of this, and suggest a remedy?—FOREST GATE.

[62384.]—**Turbine.**—I should feel deeply obliged to any kind friend for an answer to the following query. I have a pipe, 1in. dia., constantly full, bringing water from a height of 60ft. down a field at an angle of 60° with the horizon. What force does the water exert at the bottom of pipe? Is it sufficient to work a turbine giving ½ or 1H.P.? If so, kindly state name of it, or maker.—H. G.

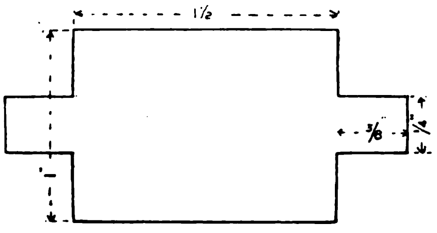
[62385.]—**Drawing.**—Would anyone kindly tell me, with name of author, if there is a good work published on the Engineer's Drawing Office, embracing colouring and finishing of drawings, with general hints for the above, and is there one also on high-speed engines for driving fans, dynamos, &c.?—H. G.

[62386.]—**Moulder's Mineral Blacking.**—What ingredients are used in the composition of the above, and the method of its manufacture?—BLACKING.

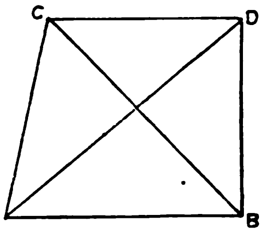
[62387.]—**Stirrup Leathers.**—I am pleased with the description of the safety saddle, and consider it the most rational method of stirrup hanging to prevent accidents to riders and sore backs to horses. I should like to know the particulars of the contrivance of the stirrup-leather latches to release a rider if thrown with his foot in a stirrup.—THOMAS WITHAM.

[62388.]—**Lentils.**—TO "EOS."—You say you frequently partake of this dish. Will you do me the kindness (and many others, I believe) of stating precisely how it is prepared?—ATZ.

[62389.]—**To Die Makers.**—I should like to be assisted with the following: I want to make a tool to cut pieces (see sketch) from sheet steel, No. 26 B.W.G. I have not a stamping press, and therefore shall be obliged to devise a tool that will stamp these out by the aid of a mallet. I have made a tool to stamp out small square pieces about ⅝in. The tool being held between guid am rather doubtful about applying the above principl this, owing to the greater cutting surface. The die m break when hit by a mallet. What is the best steel to for the dies?—G. H.



[62390.]—**Trigonometry.**—Could any reader g me the formulæ for calculating the following:— = 1,000yds., angles B A C and B A D = 76° 30′ and 44° and the angles A B D and A B C = 81° 12′ and 46 respectively. What is the distance from C to D?—L

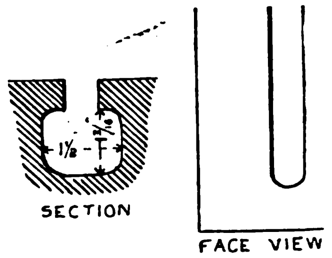


[62391.]—**Engine Query.**—The cylinder of a s engine, 3ft. 6in. in diam., the stroke 5ft., and the st cut off at ½ of the stroke. If steam be admitted at pressure, and work done in one stroke—(1) theoret (2) by log., 3 = 1·0986. Show work in full.—ONE FIX.

[62392.]—**Planing Thin Boards.**—I have a l quantity of ash and oak boards, about ¼in. thick, to up both on the faces and edges. They require a good face, as they have afterwards to be French polished. someone kindly tell me the best machine, or machine this purpose?—E. C.

[62393.]—**Pump Chucks.**—TO "A. O. S." OTHERS.—I should be greatly obliged if any of " will give me full instructions, with drawings, of a r oil pump. Please give full particulars, with all meas ments. Will "A. O. S." give us a few of the han chucks suitable for a 3in. lathe, that an amateur c make himself? If he would give us exact measures I shall be obliged.—LEARNER.

[62394.]—**Planing Casting.**—How is this planed out? It has to be smoothed and enlarged so admit of a nut running easily up and down it. My culty is that the hole is blind—i.e., has an opening at end only, therefore the planer tools will not lift out a end of the cut. ⅛in. has to be taken off in the under as the hole has become too small in casting. The fini size of hole is 1 9-16in. by 1 5-16in.; the slot is ⅝in. total length of hole, 18½in. Material is iron, with a skin.—A. F. SHAKESPEAR, Dresden.



[62395.]—**Dynamo.**—Will some electricians k help me with their advice? I have a small dy which wants altering, as it will not produce any cu when driven by engine power, but will run as a when a current of about 26 volts is put through believe it is half-size of Siemens's smallest dynamo. total height is 9in. The cores of field coils measur wound, 2½in. high, 3in. broad, wound with six lay No. 20 d.c.c. It has three pairs of field magnets, m bar iron ⅞in. by 3-16in. Armature, 2½in. dia., wou ten sections, each section having two layers of No. 18 It is coupled up so that the current travels first terminal through top field coils, armature, b field coils, to second terminal. Is size of wire and n of layers right? I should like it to light a few lamps. What power can be got out of such a ma and what engine power will it require to drive it required speed?—HOLLAND.

[62396.]—**Mercury.**—How can impure merc cleaned? I tried with dil. HNO_3 for four weeks w any result.—HOLLAND.

[62397.]—**Size of Boiler for Compound En for Steam Launch.**—TO "T. C., BRISTOL."— nearly completed a single tandem c.s.c. engine of t lowing sizes: h.p., 2in. dia.; l.p., 3½in. by 4in. str have a copper vertical tubular boiler, 24in. high, 22 twenty 1½in. metal tubes, water all round fire, furnace bars 18½in. by 11in. high, and am think ne into 18ft. boat to drive a 12in. propeller, 6in. or 3ft. pitch. Will you kindly give me ical experience, and say if boiler is large and ugh to stand a pressure of 60lb., and what revs. get at that pressure, and pitch of screw being ay? The boiler is well stayed and riveted, and roughout.—PRESTO.

—Fluorine Isolated.—I saw it stated about hs ago that fluorine had recently been isolated. ader inform me how this was effected, or tell I can find a description of the process? What operties of free fluorine, and in what sort of it be kept?—T. W. I.

—Tallow.—What will prevent tallow going n cooling, so that it will set firm and hard?—

—Large Field Eyepiece.—Will "F.R.A.S." e instructions for making that double convex say, out of plano-convex lenses with their plane emented together, and state their foci, that of the c eyepiece being —in. I have one 2¾in. plano-it that would be too high, however, say 2¼in. for of eyeglass. Perhaps he would not object first "Rob. Crus." in "E. M.," 13 Nov., 1885, p. 225, biconvex Field Lens"; also Sir G. Airy in Royal *nthly Notices*, Vol. XXIII. p. 70, "A Meniscus s."—ANOTHER CORONA.

—Thermo Battery.—Will someone kindly the best way of constructing a good battery, at ts, E.M.F., using oil, not gas? Full particulars ly oblige—E. J. C.

—Model Locomotive.—Will "E. L. P.," or reader, kindly send the chief dimensions of firebox, with cylinders 1in. by 2in. and driving n. diam.?—CHEMIN DE FER.

—Speeds for Crank Shaft.—Will anyone ie size of the speeds on the crankshaft of a 6in. ting lathe, as the sizes of the speeds on the head-6in., 5in., 4in., and 3in. diam., 1¼in. broad, and centre of the spindle to shaft 25in., and which the easiest way to make one in the rough con-A. S.

—Oxygen Gas Tank.—I am about con-small tank, portable, simple in action, and equal when in use. I have searched the file of "E. M." Feb. 13th, 1885. I found the description of one J. T. F." Would he oblige with sketch of the entions reduced in bulk by one half? Does any-of any improvement on this one capacity, about re dimensions.—AMATEUR.

—Colouring Copper.—I have some articles opper, which I want to finish with the deep colour, seen on medals, &c. Can any reader practical kint on the subject?—W. J. R.

—Pulleys.—I have a 36in. pulley, driving a), the distance between the two being in a direct , and the small pulley being about 6ft. lower than one. Theoretically the small pulley should n times faster than the large one, but I find it nake more than eight revolutions to one of the nd increasing the speed of the latter seems to lifference. Perhaps some kind reader will help ve tried rosin on belt with no benefit, and have as it will go. The belt is not crossed. Would ove matters, or does the fault lie in the short disproportion between the pulleys? I cannot he length of belt, but I could substitute a smaller the 36in. one, and drive it at higher speed?—MEDICINE.

—Davis' Interlocking for Signal Arms. correspondent gives a diagram of this apparatus, s none given in Mr. Stretton's "Safe Railway " and I cannot understand his description? Its o prevent accident, should a fracture occur in rods or wire.—REYMOND.

—Dynamo.—Will Mr. Bottone please state at of iron used in the dynamo in his book? Please ght and gauge of wire for small Siemens dynamo, , 2in. by 1in.; fields in one, 12in. by 1½in. by 1in. TE.

—Galvanising.—I shall be glad if any of our n furnish me with the instructions necessary for g this process in a bath of about 3 cubic yards I want to galvanise buckles; also iron out 6ft. by 3ft. What ingredients would it be to provide, and how manipulate? I should e glad of the formula for tinning iron "bright R. K.

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additional eight words	0	6

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ERTISEMENTS in EXCHANGE COLUMN—for

	s.	d.
-four words	0	3
ry succeeding Eight Words..	0	3

ISEMENTS in the SIXPENNY SALE COLUMN.

	s.	d.
words	0	6
ry succeeding Eight words	0	6

ast be borne in mind that no Displayed advertisements in the "Sixpenny Sale Column." All advertisements epaid; no reduction is made on repeated insertions es where the amount sent exceeds One Shilling, the ould be grateful if a P.O.O. could be sent, and not amps, however (preferably halfpenny stamps), may be it is inconvenient to obtain P.O.O.'s.

ss is included as part of the advertisement, and charged

ments *must* reach the office by 1 p.m. on Wednesday to tion in the following Friday's number.

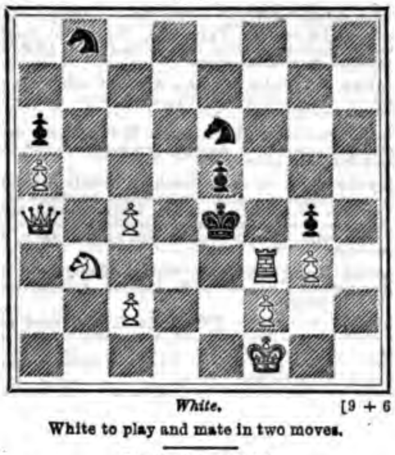
way's Pills.—These Pills cleanse the blood ontaminations, and by that means strengthen and the whole system, healthily stimulate the sluggish ess over-excited action, and establish order of circula-retion throughout every part of the body. The balsamic olloway's Pills exercises marvellous power in giving ilitated and nervous constitutions.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXLIII.—BY T. H. BILLINGTON.

Black.



White. [9 + 6

White to play and mate in two moves.

SOLUTION TO 1,041.

White.	*Black.*
1. B-B 7.	1. K-Q 3 (*a*).
2. Q-B 3.	2. K moves.
3. Q B 7, mate.	
	(*a*) 1. K-B 4 (*b*).
2. Q takes P, &c.	
	(*b*) 1. P-K 6 (*c*).
2. Q-Kt 4, &c.	
	(*c*) 1. P-R 6.
2. Q-Kt 3, &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,041 by A. Dean, A Beginner (but main play after first move wrong, and other variations not given), J. Palmer (but 1. $\frac{\qquad}{\text{P-K 6}}$ wrong), E. C. M. (Ipswich), Major (very pretty), T. H. Billington, F. Krasser, H. Hosey-Davis (very neat), G. A. A. Walker, Snowdrop; to 1,040 by H. Hosey-Davis, G. A. A. Walker, T. H. Billington, Black Pawn, Snowdrop, J. Mackenzie, and A. Bolus.

PROBLEMS received with thanks from Onyx, I. M. Brown, and Anon.

BLACK PAWN.—We should rather have said that the solver has no right to assume that Black's last move was two squares with his P; it might have been one, or he might have moved another piece, in which case White's first move is inadmissible.

W. HEWSON-KILBEE.—In 1,041, if, as you propose, 1. $\frac{\text{Q-R 5}}{\text{K-K B 4}}$, 2. $\frac{\text{Q-Q Kt 6}}{\text{K-Kt 5}}$. In 1,040, if 1. $\frac{\qquad}{\text{K takes K Kt}}$ 2. $\frac{\text{Q-B 7 (ch)}}{\text{K moves}}$, 3. Q or Kt mates.

Imitation Rosewood.—Boil one-half pound of logwood in three pints of water till it is of a very dark red; add one-half ounce of salt of tartar. Stain the work with the liquor while it is boiling hot, giving three coats; then, with a painter's graining brush, form streaks with the following solution: Boil one-half pound of logwood chips in two quarts of water; add 1oz. of pearlash, and apply hot.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

6s. 6d. for Six Months and 11s. for Twelve Months, Post Free to any part of the United Kingdom. For the United States, 13s., or 3 dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-office Order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 4d. each to cover extra postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. IV., VII., XXVI., XXVIII., XXX., XXXII., XXXIII. XXXIV., XXXV., XXXVI., XXXVII., XXXVIII., XXXIX., XL., XLI., XLII., XLIII., and XLIV., bound in cloth, 7s. each Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.).

Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 11, and unacknowledged elsewhere:—

W. F. STANLEY.—R. Keith.—F. Munro.—Cuttriss and Co. —H. H. Holt.—T. Inwood.—S. Bottone.—J. W. Simbold. —Henry Carter.—Jack Cade.—36.—S. B.—Rafter.—Learner.—Halifax.—Lens.—Ivy.—Student.—Dr. Terby. —J. B.—Enquirer.—J. Hy. T.—G. Fryer.—F. G. Helmore.—Samuel Davies.—John W. Hillier.—Copeaux.—P. W. Baldwin.—Eos.—Joseph Rawlins.—A Fellow of the Royal Astronomical Society.—A.M.I.C.E.

W. TUNBRIDGE. (Of course it is of use to others; that is the reason we have so often repeated the directions since Vol. XXIX. The latest occasion on which we have given the recipe will be found on p. 209 in answer to "Copyistical," and if you refer to the indices, you will find a number of modifications.)—FISHER LAD. (If, as you say, the accident was due to defective gear, compensation might be obtained; but it would be advisable to settle the matter by mutual agreement.)—INQUIRER. (As soon as she arrives at "years of discretion.")—M. B. R. (We do not remember.)—B. WREN. (See indices of back volumes. The usual method is to dip the insect or flower into an alcoholic solution of nitrate of silver, and when the spirit has evaporated expose to the fumes of phosphorus under a bell-glass. That reduces the nitrate of silver to the metallic state, and the object is ready for immersion in the plating bath. Others use a solution of albumen containing 3 per cent. of nitrate of silver. You will find a method described in this number.)—INCUBATOR. (From 100° to 104° Fahr., but 102° is the standard.)—P. H. SANDERS. (Trouvé's solution is made up of 150 grammes bichromate of potash, 450 grammes of sulphuric acid, and one litre of water. See p. 941, p. 105, or No. 945, p. 192. The elements are zinc and carbon.) — T. P. (They can be magnetised by placing in a coil of wire through which a current is passing, or by drawing a permanent magnet over them. The method has been frequently described, and is explained in every text-book of the science.)—H. K. (You should have added spirit—say two fluid ounces of rum to the pint of rosemary decoction. It did not produce the "white scales." A good mixture as a hair-wash is made by mixing half an ounce of carbonate of ammonia and once ounce of carbonate of potash in a pint of water, to which is added five fluid ounces of tincture of cantharides and three quarts of rum. N.B.—The last-named may be omitted; but after using the solution the hair should be well rinsed in cold water.)—YOUNG BOILER-MAKER. (The address was Blackpool, we believe; but at any rate, you can obtain the book through Mr. Calvert, Great Jackson-street, Manchester, price 7s. Courtney's "Boiler-Makers' Assistant," published by Crosby Lockwood and Co., Stationers' Hall-court, E.C., price 2s., might suit you.)—N. J. B. (There is no work on the subject. You will find practical instructions in back volumes—especially Vols. XXXVI., XXXVII., and XXXVIII.)—J. S. (Such a material would be of considerable value, and would certainly be patented by any one who invented it. As to the celluloid, see No. 1143, p. 534, and the indices of back volumes.)—WOODWORKING MACHINIST. (Send two penny stamps to the Secretary, Emigrants' Information Office, 31, Broadway, Westminster, S.W., and ask for the New Zealand Handbook and Circular. Opinions differ as to the climate; but it is certainly as healthy as that of these islands.)—VICAR. (Provided it is only for the purpose of experiment, he may; but not if he is going to derive any benefit from its use.)—J. D. R. (Your questions were answered as soon as possible after their receipt—on p. 186, number for April 22. The second question is varied now, and the answer is Yes.)—GAS FITTER. (Procure the book published by Gent and Co., Leicester, advertised on the front page.)—MUDDLED. (No. The other questions are incomprehensible, or have been frequently answered.)—Q. (By the smell or taste. The wood spirit added has an offensive odour and taste. If you mean pure methylated as distinguished from that to which shellac has been added to make finish, by allowing a little to evaporate on a piece of paper. 2. It was refilled partly by the water from land springs in its bed, but mainly from Chelsea Waterworks at a time when heavy rains had produced floods.)—WILLIAM BENET. (Messrs. Lancaster and Son, Birmingham, supply materials and instructions.)—F. W. B. (What is it you mean? The simple answer would be—Size or fill the pores with polisher's stopping, and coat with varnish or French polish.)—J. C., Somerset. (You can obtain the ordinary pigments ground in oil, and can thin them with boiled oil and turpentine to suit the work. Davidson's "House Painting," published by Crosby Lockwood and Co., 6s.)—REEDER. (It must be printed in proper transfer ink if impressions are to be taken from the stone.)—HARDWARE. (You can obtain what is called provisional protection for little more than a sovereign, and that will give you ten months in which to look for a capitalist. A complete patent costs only £4 in stamps, and lasts for four years.)—ONE WHO WANTS HELP. (Such a query coming from Birmingham is surprising. We do not know of a japan which "will by no possible means come off again"; but you can procure japans in your town which you can apply with a brush and hold over a gas-jet or a fire until they dry hard or flame. For any further information, see a number of articles and notes in back volumes.)—IN A FIX. (Colour the leather with ink or with acetate of iron, and dress with cod oil or castor oil. See many recipes in back volumes, or procure Watt's "Art of Leather Manufacture," published by Crosby Lockwood and Co. Two articles on dyeing leather in Nos. 1110 and 1112.)—NON-ELECTRIC. (They are made in several forms. For instance, of little strips of copper and zinc separated by canvas, or of little cylinders of zinc, covered with canvas and bound round with copper wire; but they are of little, if any use. See "Electricity in the Treatment of Disease," by J. R. Tunmer, London, E. W. Allen, or the author, Imperial Sanatorium, Harrogate.) — G. F. (Such a query is against the rules. You will find them advertised, and no doubt can hire them on trial.)—F. SMITH. (Presumably you mean what is known as the Cartesian diver, described in almost any textbook of physics. The little figures are made hollow, and weighted so as to float upright. The top of the tube is covered with rubber or bladder, and pressure on that forces a little water into the figure, which sinks. On relieving the pressure the air expands and the figure rises.)—CYCLIST. (You should refer to any good treatise on arithmetic—article, Permutations; or to the back volumes under various headings, such as Change Ringing, Chances, &c.)—L. B. LINCOLN. (Similar question answered last week. You will find many hints on the construction in back volumes, and can procure sketches by sending for the catalogues of dealers. See Hints No. 4 above.)—ARTHUR MEE. (We should not be able to make much of the drawing as an illustration, so have not used the letter.)—STEEL. (Many good second-hand machines are advertised in these columns; but at your distance it would be safest to put yourself in the hands of a good maker. You may depend on the Centaur Company, Coventry. See their advertisement and write them for prices.)—S. WITHERS. (If private communications of that kind are wished, they must be established through the Sale Column.)—J. J. ALLINGHAM. (Go along with you! What have we to do with the east wind, &c.? Or has your strange epistle been sent to us by mistake? Your candour as regards ourselves is, at any rate, very refreshing!)

A New Washable Truss.—An Important Invention.—Harness Xylonite Truss is the most perfect appliance ever invented. It gives complete comfort and support without irritation. It has a beautifully smooth, flesh-coloured surface, and is guaranteed to last a lifetime.—Address: MEDICAL BATTERY COMPANY (Limited), 52, OXFORD STREET, LONDON, W.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Micrography.—Rare and beautiful specimens by the late Dr. Farrants, President of the Royal Microscopical Society, London. Exchange.—H., 49, Handfield-road, Waterloo, Liverpool.

A 4½in. Screw-cutting **Lathe**, 4ft. 6in. gap bed, cost £25, only been in use one month; will exchange for 3in. treadle lathe and cash.—THOS. CATHERALL, Dunstable-road, Luton, Beds.

Dynamo, laminated armature, 4½ by 5½, splendidly made machine, good as new. Exchange. Photo.—E. THORNTON, Hindpool-road, Barrow-in-Furness.

Second-hand Lathe wanted in exchange for **Bicycle** or Lock-stitch Sewing Machine.—Wellesley House, Colchester.

What exchange for Coventry Rotary pattern **Tricycle**, cost £15, only ridden a few miles.—As above.

Gentleman's **Gold Ring**, stamped 15 carat, with handsome shield-shaped blood stone, good heavy piece of jewellery, also 15 carat Gold Locket. What offers up to £3 15s.?—JOE BLAIN, Carlisle.

"**English Mechanic**."—Wanted, back volumes, clean, unbound preferred, complete set or odd volumes. State lowest value and wants.—ZERO, 24, Tintern-street, Brixton.

Two Coventry **Bicycles**, 50 and 54in., both in thorough good condition. Offers for both to £7 value, or single.—17, Newland-street, Kettering.

Wanted, 4½ or 5in. Screw-cutting Lathe, chucks, &c., foot power, must be good machine. Exchange Royal Meteor Sociable, or offers.—B., 35, Tranquil-vale, Blackheath, S.E.

Wanted, good Field and Marine Glass. Exchange ENGLISH LEVER, 4in. O.G., Jewellery, Books, English Concertina.—WARDELL, 67, Thomas-street, Aston, Birmingham.

Medland's New **Pentaphane**, 5-wick Lanterns, a number of slides, cost £7. Good exchange offers.—W. S., 5, Gladstone-street, Battersea.

What offers for 60 numbers of "**Knight's Practical** DICTIONARY OF MECHANICS," clean, good as new.—MARRIOTT, Fleckney, Market Harborough.

Powerful new **Induction Coil**, in perfect working order, on mahogany stand, with condenser. Exchange Electro-Motor, value 12s.—E. FISK, Queen-street, Ipswich.

Model **Launch Boiler**, horizontal, 10in. by 6½in., lagged, quite new and complete, without fittings, internal firebox, brazed. Wanted, small Tricycle.—STANLEY, 17, Wood-street, Old Brompton, Chatham.

Tricycle, ball bearings, Coventry make; photo, 3 stamps. Exchange 4 or 5in. back-geared slide-rest Lathe.—M., 14, Church-street, Oldbury.

Offers wanted for a Pair of **Patterns** for 6 back-gear Head Stocks and Mandrel, fitted with cone bearings and barrel with left-handed screw, by Cunliffe and Croom.—23, Lloyd-street, Warrington.

Large **Barrel Organ**, 8ft. high, 33 tunes (sacred). Wanted, Lathe or small Gas Engine.—J. L., 37, Trafalgar-street, Brighton.

52in. **Bicycle**, in good condition. What offers for exchange? Value £3.—W. T. BARKER, Fleetwood, Chepstow-road, Croydon.

¼-plate **Rolling Press**, nearly new, cost £3. Exchange.—W. T. BARKER, Fleetwood, Chepstow-road, Croydon.

Wanted to exchange, **Vertical Boiler**, with necessary mounts, about quarter horse-power, for chain-geared Bicycle.—Address, T. V. BOND, Engineer, Church-road, Ramsgate.

Exchange for modern **Tricycle**, Horizontal Engine, 3in. by 4in. cylinder, flywheel 15in. by 1in., about ¼H.P.—P. ROBERTS, 145, Berry-street, Bootle.

Pocket Aneroid, in case, with altitude scale and compass, London made, cost £1 10s., almost new. Offers.—S., 2, Hayburn-terrace, Glasgow.

Pair **Morse Sounders and Keys**, well made. Offers in useful or Electrical Apparatus.—GEORGE PEERS, Little Hulton, Bolton, Lancashire.

Bicycle, 50in., splendid machine, fitted with latest improvements, suspension saddle, ball bearings, detachable cranks, dust-proof head, King of the road lamp, dropped handles, hollow forks, &c., spoon brake, ridden only few weeks; will sell outright or exchange small Steam Launch or Boat.—MACDONALD, New Mills, Stockport.

Tennis Racquet, new Guinea Champion, 13oz. Exchange Mechanic's Requisites.—W. ARNOLD, 8, George-street, Villa Cross, Birmingham.

Very good whole-plate **Portrait Lens**, good compound microscope, in rosewood case, mag. about 200 dia.; first thirty-six parts "Cassell's Encyclopædic Dictionary," for Lancaster's half-plate Instantograph set, with extra dark slides, or offers.—T. COLLINS, Bervie, Kincardineshire.

"**English Mechanic**" last six volumes, XXXIX., XL., XLI., XLII., XLIII., XLIV., complete, with indices, unbound clean. Offers.—315, Manchester-road, Bradford.

No 2 breechloading **Saloon Rifle**, worth 20s. Exchange good Cyclometer, to suit 40in. wheel, or offers.—C. K., Lady Cross, Gayton-road, Harrow.

Wanted, a Suter's 3A or 3B Lens, also Suter's Wide angle 5½ and 6½ lens. Exchange.—W. NEWBOULD, Eyre-lane, Sheffield.

56in. **Bicycle**, light roadster, double roller bearings, hollow forks, adjustable pedals and step, new long distance saddle, spoon brake, alarm, spanner, pouch, &c., in good order, and very safe riding, by Keen, will exchange for watch, value £3 10s.—SCHOFIELD, 396, Whally-road, Shuttleworth, near Bury, Lanc.

A large Black and Tan **Bitch**, splendid watch-dog. Will exchange lathe tools, or cash 10s.—33, Vine-street, Tyne Dock, South Shields.

"**Chambers' Journal**," 2 volumes, well bound, in good condition. Will exchange for good 5in. Leg Vice, or offers.—TAYLOR, junr., 17, Wakefield-street, Warrington.

Dynamo Castings, turned and bored for fitting, Lamp, and 12 yards of covered Wire. Exchange.—GALE, Bank-street, Melksham.

Bicycle Breeches, 18in. fork, horizontal Slide-valve Engine and Boiler, 3 vols. of "Boys' Own Paper." Exchange for Banjo, or offers.—LAWSON, Mold.

Salvo **Tricycle**, ball bearings throughout, lamp, &c., cost £26. Exchange offers.—9, Wellington-place, Bowdon.

Wanted, Lathe and Parallel Vice. Give in exchange new Photographic Apparatus, large Musical Box, Wringing Machine, and Cuckoo Clock.—A. B., 107, Chatham-street, Walworth, S.E.

Will exchange vertical riveted **Iron Boiler**, 13in. by 9, all fittings and firebox; burn coal; works up to 100lb.; also Horizontal Engine, 1 by 1⅞in., for good Lathe.—C. WATSON, Blyburgate street, Beccles, Suffolk.

Facile Bicycle, 4¾ Screw-cutting Lathe, "Engineer," "Engineering," bound and unbound, half price. Watch Glasses. Offers.—H., 164, Euston-road.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Patent Heat Conductors for cooking, save one-third time and firing, and one pound of meat in every ten pounds cooked, retaining all nourishment.

Roasters and Bakers, 2s. 6d.; Boilers, 2s. Of all ironmongers. Pamphlet free.—TALLACK, 25, Hatton-garden, London.

Wimshurst Influence Machine.—Sole manufacturers of new and improved pattern. Inn. from 30s.—KING MENDHAM, and CO., Bristol.

Deposition of Smoke—Complete Apparatus to perform this never failing experiment with static electricity, 5s. 6d and 10s. 6d.—As above.

Standard Ohm, in boxwood cylinder, guaranteed correct to ten thousandth of ohm, 15s. 6d., with copper poles, 21s.—As above.

Galvanometer Cards for tangent and ordinary combined, vertical, astatic, reflecting, and unmounted compass cards.—As above.

Variable Resistance Incandescent Lamp STAND, invaluable for battery power, vide ENGLISH MECHANIC Oct. 16, 1885, price 3s. 6d.—As above.

Morse Sounder, for learners, practical instrument, with battery and instructions, with exercises, 21s.—KING, MENDHAM, and CO., Bristol.

Write for **King, Mendham, and Co.'s** large new and reduced Price List, post free, 4 stamps.

Fretwork.—Catalogue of every requisite, with 600 illustrations, free for 6 stamps.—HARGER BROS., Settle, Yorks.

Carbon Plates, best quality, cut and moulded, plain and capped; quality cannot be surpassed.—GEO. G. BLACKWELL.

Pebble Carbon.—Graphite for Leclanche cells, splendid conductor; price very low.—GEO. G. BLACKWELL.

Manganese Oxide specially prepared for Leclanché, batteries; high strength and purity, greater E.M.F., constant action; been in use 15 years with immense satisfaction; 7, 14, and 28lb. packets. Prices on application.—GEO. G. BLACKWELL, 26 Chapel-street, Liverpool.

New Illustrated Price List of **Screws, Bolts, and** NUTS for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Wheel-Cutting to 12 inches diameter in brass only.—CLEGG, 18, Belinda-street, Hunslet, Leeds.

Planing to 12in. by 12in. by 8in. Boring, Turning, Screw-cutting, Slide-rests, &c.—CLEGG, as above.

Odd Spiral Springs to order. Cast Steel Wire in coil and lengths.—J. PARISH, Park, Sheffield.

Mica or Talc.—RICHARD BAKER and CO., 9, Mincing-lane, London.

Electric Depot, 10, Deansgate, Manchester.—Handiest shop in the trade. Largest stock. Greatest variety. Lowest prices.

Silvered Glass Specula.—LINSCOTT, Ramsgate. Gives truly parabolic figure. Moderate prices. Stands, Eye-pieces, and Flats.

"**Beginner's Guide to Photography**," one shilling. Wholesale of the publishers, [illegible] and [illegible] Hatton-garden, London.

"**Beginner's Guide to Photography**," one shilling. Free from abstruse technicalities. Retail of Opticians and Booksellers.

Walker's Sulphur Sal-ammoniac **Battery**. Half gals. 3s. Quarts, 2s. 3d. each. Liberal discount to the trade.—[illegible] WALKER and OLLIVER, 196, Severn-road, Cardiff.

Gut Band (Lathes), best, per yard, ⅛, 6d.; 3-16, 8d.; ¼, 1s.; 5-16, 1s. 4d.; ⅜, 1s. 11d. Hooks and Eyes (Steel) to ¼, 6d.; 5-16, 7d.; ⅜, 8d.; 7-16, 1s.; ½, 1s. 6d. Postage extra.—LUNT'S.

Saws, Disston's American, agent for same. Planes, new, London, malleable iron and gunmetal, every description.—LUNT'S.

Vices, bench, parallel steel jaws, to open 3½, 8s. 6d.; ditto 4, 14s. 6d.; ditto 4¾, 20s.—LUNT'S.

Taps (Engineers'), Whitworth, plug and taper, 3-16, ¼, 5-16, each 6d.; ⅜, 8d.; 7-16, 10d.; ½, 1s.; ⅝, 1s. 3d.; ¾, 1s. [illegible].—LUNT.

Tools every description. Sixth edition, 84 pages illustrated reduced price catalogue free—A. S. LUNT, 297, Hackney-road, E.

Piles cured first application.—Palmer's Indian Ointment, 13½d. Fifty years' celebrity.—Chapel-terrace, West Auckland, Durham.

"**Micro-Fungi: When and Where to Find It.**" By Thomas Brittain. Boards, 1s., illustrated.—ABEL HEYWOOD, Oldham-street, Manchester.

Silvered Glass Specula.—Mr. With offers his choicest reserves at nominal prices.—Apply, G. WITH, Hereford.

The **Lantern Microscope**, new optical arrangement by W. Leach; pamphlet, 2½d.—ABEL HEYWOOD, Oldham-street, Manchester.

Technical Schools.—BRITANNIA CO. secured prize medal for lathes and tools.

Technical Classes in various towns.—Those who are competent to conduct classes, please give address to BRITANNIA CO., Colchester.

Britannia Co., 100, Houndsditch (2 minutes' walk from Broad-street or Liverpool-street). Correspondence to Colchester.

7,000 square feet **Floor Space** available for the Exhibition of Tools, &c.—BRITANNIA CO., 100, Houndsditch.

Notice.—Inventors and Manufacturers of Tools and Machinery can secure space for exhibiting in above.

Buck's Patent **Lathe Planer** is on view at BRITANNIA COMPANY'S New Warehouses, 100, Houndsditch, London.

Hot-Air Engines, Hand Planing Machine for iron, Haseland's Patent Planer for Wood.—BRITANNIA CO.

Bench Universal **Milling Machine**, strongly geared, treadle or power, for machinists and amateurs. Photo, 4 stamps.—G. ALLSOP.

Portable Engine, 6-horse, good condition, by Shuttleworth, cost £145, accept £45. Room wanted.—HILLSDON, Sandgate.

Thrashing Machine, by Ransome, good working order, cost £195, accept £50.—HILLSDON, Army Contractor, Sandgate, Kent.

Breech-loader, 12 bore, single central fire, [illegible] kill 75 yards, 27s. 6d., carriage paid.—HILLSDON, Sandgate.

Gramme Dynamo, 100c.p., new, splendid machine, £6. Also Wood-turning Lathe, 5ft. bed, 6½in. centre. Double Crank, 3-speed pulleys, 2 circular saws, grindstone, polisher, sundry chucks, quantity tools; 30s.—EGGLETON, 53, Livingstone-road, West Brighton.

Brass **Model Engine Castings**, rough and finished, best quality; list, stamp.—WOOD, Dalley-street, Broughton, Manchester.

Baby Carriage, unsoiled, bicycle wheels, carriage springs, reversible hood, handsome rug, 30s. Cost £4. Never used.—91, East-road, City-road, Moorgate-street.

Safety Bicycle Fittings, "Rover," "Ivel," and "Psycho" patterns, frame, lugs, steerings, brackets, tubing, chain wheels, ball hubs brazed up.—LLOYD, Clyde Works, Weaman-street, Birmingham.

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The English Mechanic
ND WORLD OF SCIENCE AND ART.
FRIDAY, MAY 20, 1887.

LECTRIC MOTORS AND ELECTRIC RAILWAYS.*

THE progress which is being made with electric railways in the United States nders any work that gives a description of em valuable; but in this handsome quarto, e title of which we give below, the authors ve provided us with a text-book that covers e whole ground, and deals with every rm in which electricity is used for the rpose of transmitting motion. Considering at the early motors are only of historical terest, and are generally described in the andard works on dynamo machines, the ithors have limited the space allotted to em, but at the same time give illustrations f the most notable, and also of others little nown outside the archives of the American atent Office. In the chapter on "Early lotors and Experiments in Europe," we ve a brief mention of Barlow's experiment in 1826, and also of the machine deised in 1830 by the Abbé Salvatore dal legro of Padua. The Jacobi motor is lustrated, and, amongst others, the now amous Pacinotti. In the chapter on "Early lotors and Experiments in America," some teresting and, we believe, little known acts are given about the motor devised by Thomas Davenport, blacksmith, of Brandon, ermont, which was patented in 1837. avenport is described as a man far ahead of is time, and the first to make an electric ailway and to print by electricity. In 1833 e saw a magnet employed in extracting on from pulverised ore, and purchased it, aving "jumped" to the conclusion that he ould apply magnetism to the propulsion of achinery. In 1835 he set up a small circular railway at Springfield, Mass., and orked it by means of an electro-magnetic ngine. From 1838 several electro-magnetic ngines were devised in the United States, ut the most celebrated was that of Prof. C. G. Page, of the Smithsonian Institute, hich was next in importance to that of Jacobi. The authors describe and illustrate everal of the motors invented in America, hich are, however, of little interest, for achines quite as useful have been devised nd forgotten in many laboratories—forotten when it was discovered that electricity s not exactly a motive power, and that oal is the cheapest source of energy xcept where such natural forces as waterfalls wait utilisation. Full honour is given to Dr. Pacinotti, who was too far ahead of his ime to meet with a full recognition of the alue of his researches, but was undoubtedly he discoverer of the principle of reversibility, n which the electrical transmission of mehanical energy depends. Who was the first to emonstrate the possibility of transmitting ower by electricity is a matter of dispute, ut the honour is claimed for M. Hippolyte ontaine, although it is stated that the very rst case of actual transmission was brought bout by a workman at the Vienna Exhibition f 1873 accidentally placing some cables or ads to the terminals of a machine to which hey did not belong. At all events, M. Fonaine was the first to exhibit the effects and he first to publish an account, but he states imself that M. Gramme had told him that he ad worked one dynamo by another. The uthors give illustrations of the exhibit of arcel Deprez at Munich in 1882, of the ortrush turbines, of the Vienna electrical ailway, of the Paris lines of 1881, and of the more simple and more suitable lines at Brighton and Blackpool. To Mr. Stephen D. Field the United States Patent Office has awarded priority of invention in electric railways in America, for a combination of an electric motor operated by means of a current from a stationary source of electricity conducted through the rails. The Field and Edison interests were combined, and the Electric Railway Company of the United States came into existence in 1883, and at once determined to exhibit an electric line at the Chicago Exposition. In spite of the shortness of time available for preparations, the Chicago Electrical Railway, the first constructed in America for business purposes, was a decided success, and although operated for only 118¾ hours it carried 26,805 passengers. Some time before, in 1880, Edison had laid down a track at Menlo Park, and other electricians had been hard at work in developing electric locomotion. The satisfactory reports about Edison's experiments and the public trials at Chicago gave an impetus to electric traction, and capitalists were found not only ready but anxious to invest money in the schemes. Towards the close of 1883 the experiments of Mr. Leo Daft began to attract attention, and in 1885, so well had his first lines done their work, orders were received to fit up a branch of the Baltimore Union Passenger Railway. In carrying out this undertaking an insulated centre rail was used as the outgoing "lead," while the two outer rails, having had their joints perfected, served with the ground for the return. The dynamo at the station has a maximum capacity of 300 ampères at 125 volts, and the motor named after Prof. Morse is carried on a frame measuring 12ft. 6in. by 6ft. 6¾in., constructed of ash, bolted together and braced with angle iron. The wheels are standard car wheels, with deep flanges and wide treads. The electric motor is a compound series machine, capable of delivering eight horse-power, and weighing about half a ton. The compound nature of the field permits of a wide range of resistance—hence of magnetic strength of field—and as the armature speed depends, in a certain sense, upon this field, a perfect control of the speed is obtainable. The armature shaft carries at each end a 3in. phosphor-bronze gear, which engages with a spur wheel 27in. diameter keyed to the axle of the driving wheels. The speed permitted is limited to eight miles an hour, which gives 610 revolutions of the armature per minute. In 1886 more powerful motors were added to the equipment of the line, which is now being extended with overhead conveyance of current; but more recently Mr. Daft has been engaged in experiments on a portion of the elevated railway of New York. Another system which promises to play an important part in electric railways of the future is the Bentley-Knight, first experimented with in 1884 at Cleveland, Ohio. The conductor in this case was placed in a conduit between the rails, a brush passing through a slot and making connection between the motor and the conductor. For some time schemes have been drawn up for running an underground railway along the Broadway, New York, and several page plates illustrating the proposed electric line are inserted in this work. The Mayor has recently appointed a Rapid Transit Commission to consider the various schemes, and there is not much doubt that, after the experience already gained, the majority of Americans who have formed an opinion are in favour of electrically-worked lines, while the electric companies are prepared with the working drawings of motors capable of carrying on the traffic. Another system which has found quite extensive use in America is the invention of Mr. C. J. Van Depoele, in which the current is taken from an overhead conductor; but others, such as the Sprague and the Henry systems, are coming to the fore. A method of attaching the motors to existing cars has been devised by Mr. J. M. Pendleton, of New York, which promises to be of more than ordinary value. The motor is suspended from the floor of the car, and the revolving armature carries a coiled spring extension at each end, terminating in a worm or screw pinion-wheel held by journals on each side. The worm gears with the top of the worm-wheel on one axle, and with the bottom on the other, an arrangement which equalises the thrust on the motor. The coil-springs relieve the machinery of sudden strains due to rapid starting or stopping, and also allow for any distortion of the car with varying loads. For some time a full size standard passenger-car of the elevated railroad has been placed at Mr. Sprague's disposal by the Manhattan Company, and it has been fully equipped. The weight of the trains and the distance over which they are hauled on the elevated roads necessitate in the electric circuit currents of high potential, and the experiments carried on by Mr. Sprague have been with an E.M.F. of 600 volts, or 670 volts at the terminals of the generators. Such a potential is altogether exceptional for electric railway work; but the system is being carefully completed in details, which are, as much as possible, explained by the authors of this work. So far, we have referred only to systems in which the current is conveyed or transmitted to the motor by means of an overhead conductor or an insulated rail; but in many places the use of storage batteries will, no doubt, be found to yield the best results, especially in connection with ordinary tramway cars. The main argument against the use of accumulators—a very important one, too—consists in a demonstration of the large loss of power which a number of transformations entail. There is first the loss, common to both systems, in the process of converting mechanical into electrical energy in the dynamo; then there is the special loss from the conversion of electrical into chemical energy in the accumulator, followed by the reconversion when the battery is placed in the tram-car; and, finally, the transformation of the electrical energy into mechanical work by the motor. Obviously there must be considerable loss in these transformations; but it is asserted that by good apparatus and economical management these losses are reduced to a percentage which is less than the loss experienced with other systems, while there are many advantages peculiar to the arrangement in which storage batteries are used. Thus the authors say: "Looked at from the standpoint of convenience and applicability, the propulsion of tramcars through the medium of accumulators must be conceded to be second to no other. The batteries occupy no valuable space, being stowed under the seats, while the motor can be placed under the car-body," as shown in several illustrations of cars and motors which have an actual existence, and have undergone practical trials. The chapters on the industrial application of electric motors in Europe and in America are full of interesting information; but, for obvious reasons, there is little chance of electric motors being used, except where it is impossible to drive direct from a mechanical motor, or where power is distributed from a central station by means of electricity. In this country—in Birmingham—power is distributed by means of compressed air; in London power is laid on in certain districts by means of water; but in the United States we find already a considerable development of the system of electrical distribution. In parts of the United States, for instance, printing machines have been driven by current for more than two years, with, it is stated, a saving of more than 33 per cent.—the "power" being rented from a company, who supply it in much the same way as gas or water is supplied here. In this connection we find a curious statement, that the business manager of a certain paper "found the printing to compare very favourably with that done on a press directly actuated by steam"—as if the motive power employed to drive a printing machine could possibly have any effect on the quality of the work turned out. The chapter on electric motors in marine and aërial navigation is rather short, but the authors give illustrations of Tissandier's balloon car and the batteries, and also of the Krebs-Renard balloon. In another chapter telpherage is fully illustrated, the Fleeming Jenkin, Chandler, and Van Depoele systems being described. In a concluding chapter the "latest American motors and motor systems" obtain a place, and there are two appendices dealing with matters of interest in connection with the subject, so that we may fairly say of the work that it is the best descriptive account of electric motors and their applications which has yet been published. Of considerable utility to electricians and engineers, it will also be found valuable by capitalists and those who are interested in the working of tramways, street railways, and telpher lines; for, although it may come slowly, the distribution of motive power by means of electricity will form an important feature in the mechanical world in a not very distant future.

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* The Electric Motor and its Applications. By THOMAS OMMERFORD MARTIN and JOSEPH WETZLER. New ork: W. H. Johnston; London: E. and F. N. Spon.

THE THEORY OF MACHINES.—X.

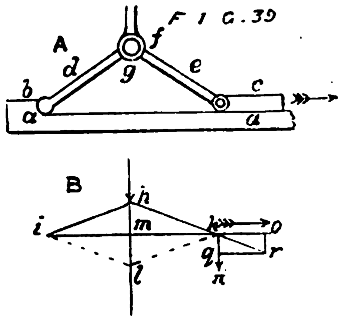
By FRANCIS CAMPIN, C.E.

Link Movements.

IN this article will be treated some forms of combinations of bars or links jointed together, and to parts of the general framework of machines, such as are used for parallel and other classes of motions.

We will first deal with the "toggle," a mechanical power of great value which belongs strictly to the group of link movements. This element is shown in Fig. 39 at A. *a a* is the bed, or base-plate, having a socket-piece at *b*, solid with itself; *c* is a sliding block representing the working point of the machine; *d* and *e* are two links jointed together and to the rod *f* by the pin *g*. The rod *f* moves at right angles to the bed *a a*, and through it the power is applied to the machine.

FIG. 39



At B is shown a diagram by means of which the relation of the force to the resistance may be determined. Let p = the force in pounds acting in the direction $h\,l$, its amount being represented by the length $h\,l$. Let $h\,i$ and $h\,k$ be the links through which the force is to be applied to overcome the resistance at the point k, the link $h\,i$ moving on a fixed centre at i.

Complete the parallelogram $h\,i\,l\,k$, then will $h\,k$ represent the thrust upon the link $h\,k$, of which the actual value will therefore be $= p \times \frac{h\,k}{h\,l}$. The line $i\,k$ is assumed to be at right angles to $h\,l$. At k the thrust upon $h\,k$ is again resolved into two others; one acting in the direction $i\,k$, and the other at right angles to this line, and in the direction $k\,n$.

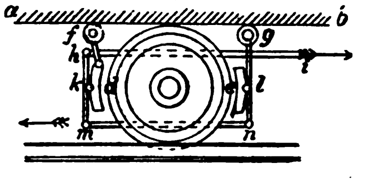
Produce $h\,k$ to r, making $k\,r = h\,k$, and complete the parallelogram $k\,q\,r\,o$: then will $k\,q$ = the pressure on the bed of the machine at k, and $k\,o$ the force to overcome the resistance at k in the direction of the arrow.

The line $o\,r$ being parallel to $k\,n$ is also at right angles to $m\,o$, and the angle $k\,o\,r$ is a right angle; but the angle $h\,m\,k$ is also a right angle, and therefore equal to $k\,o\,r$; also the angles $h\,k\,m$, $r\,k\,o$, being vertical angles (Euclid Bk. I. Prop. 15) are equal; therefore the remaining angles are equal $m\,h\,k$, $k\,r\,c$, and in the two triangles $h\,m\,k$, $r\,o\,k$, the angles are equal each to each; these triangles are therefore similar. By the construction $k\,r = h\,k$, hence the other sides of the triangles will be equal $m\,k = k\,o$, and $h\,m = o\,r = k\,q$. The resistance at k corresponding to the force p acting at h will, therefore, be calling it R; $R = p \times \frac{h\,k}{h\,l} \times \frac{k\,o}{k\,r} = p \times \frac{k\,o}{h\,l}$; but $h\,l = 2\,h\,m$, therefore, $R = p \times \frac{k\,o}{2\,h\,m} = p \times \frac{m\,k}{2\,h\,m}$. Let $i\,k = L$ the length of the toggle measured on its base, and $h\,m = v$ the rise of the links at the centre h; then $R = p \times \frac{m\,k}{2\,h\,m} = p \times \frac{\frac{1}{2}L}{2\,v} = \frac{p\,L}{4\,v}$.

When this apparatus is in action with a constant pressure at h, so long as motion is continued the force exerted at k continues to increase, for it is evident that L will be increasing as v diminishes, until, as the links $h\,i$ and $h\,k$ approach that position in which they they would lie in the same straight line, the force at k approaches the infinite.

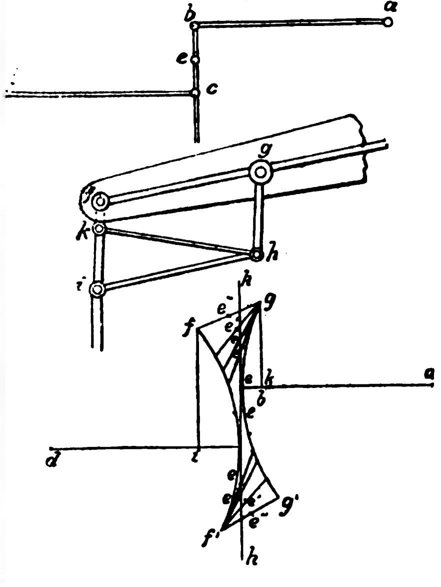
In Fig. 40 is shown a link arrangement used for putting a pair of brake blocks upon the wheel of a vehicle. *a b* is the bottom of the frame of the carriage, *c* one of the wheels, *d* and *e* are the brake blocks suspended from pins *f* and *g* (fixed to the frame *a b*) by links *f o* and *g l n*; *e* is pivoted to *g l n* at *l*, and *d* to the link *h k m* at *k*; *h i* is part of the bar by pulling which the brake is applied.

FIG. 40.



As soon as tension is put upon *h i* in the direction of the arrow *i*, the block *d* is pressed against the wheel *c*, and then acts as a fulcrum through the pin *k*; *h k m* then acting as a lever, puts tension on the link *m n* in the direction of the arrow *m*, and then draws the brake block *e* against the opposite side of the wheel, each block forming a reaction for the other.

FIG. 41.



In some classes of steam-engines and also machines of other descriptions where it is necessary to preserve the rectilineal movement of certain parts, this is effected with sufficient accuracy for practical purposes by means of combinations of links.

In Fig. 41 are shown two forms of motions in common use.

a b and *c d* are two links of equal len nected by a third link *b c*, to which is the element of which the motion is to fined to a rectilineal direction by th The links are so arranged that when *c d* are horizontal, *b c* is vertical. Th is in the centre of the length of t *b c*.

It is evident that as the pin *e* rises a the action of the link *a b* will draw tremity *b* to the left, and that of the will draw the extremity *b* to the right. the pin *e* would, if the points *b* and *c* d equal arcs, move in a straight line ab This, however, is not exactly the case. be seen by reference to the diagram B.

f f, *g g'* are the arcs described by th and *b* of the links *c d* and *a b*, the ends working on fixed dead centres. *h h* straight line in which motion of the required. The varying positions of *b c* are shown, the position of the pin marked for each.

When the extreme position *f g*, or reached, it becomes evident on inspect the arc *b g* is much less than the arc *c*

In the position *a b c d*, *b c* is a comm gent to the arcs *f f'*, *g g'*, and for an i small distance after motion has com the arcs described are equal, and the m *e* rectilineal; but as the position of *b c* inclines from the direction *h h* the come unequal, and the point *e* deviat the straight line, as shown at *e'' e''*, t of the link travelling upwards and more than the end *b*, and downwards more s

If upon the horizontal lines *a b* and pendiculars *g k* and *f i* are let fall f point *g* and *f*, then will *b k* and *c i* r respectively the lateral travel of the en *c* of the link *b c*.

These travels can never be *exactly* eq during the centre part of the stroke sufficiently nearly so to give the pin *e* a closely approximating the rectilineal, an is adopted as such in practice. It will that the movement is almost straight the positions between *e* and *e'*.

The longer the bars *a b* and *b c* are, th will be the movement of the pin *e*; but always be remembered that althou enough to accuracy for some practical p this is not a true parallel motion. links *a b*, *c d* are of different lengths th must not be in the centre of the link at a point dividing it in proportion to th of the links *a b* and *c d*.

A more satisfactory arrangement is by the links *k h*, *h i*; *i* represents th whose motion is required to be rectil is a dead centre, upon which the end link *h k* works; the vibration of the brings the point *i* to the right, but is balanced by the vibration of the link *h* ing the point *h*, and with it the link *h* left. The links *i f*, *h g* complete the motion by connecting it with *f g* one the beam of a steam-engine or other This form of parallel motion is generally for steam engines in English practice.

The most perfectly parallel moti those produced by guides; but they l disadvantage of being attended by mu friction than the link motions.

There have been a great variety of motions designed at different times various purposes; but we have not dilate further upon them, nor do we would be of any practical utility so Whenever they are encountered the stu analyse them by making diagrams ac to the method shown above.

We shall now proceed to describe so motions that have been used, or may be to actuate various collateral elemen machine from its primary movement. are almost innumerable, but two or t amples will serve to illustrate the prin which to design them.

In some cases it is required to obtain revolving shaft a vibratory action, may be derived by the arrangement s *a b c d*, A, Fig. 42. *a b* is an arm or cra a shaft which is revolving continuous the centre *b*, and *c d* a crank fixed on a to which a reciprocating motion is req be communicated.

FIG 42

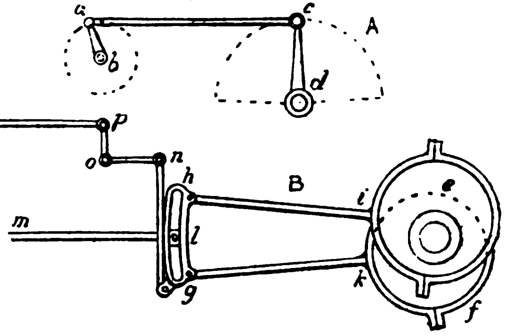
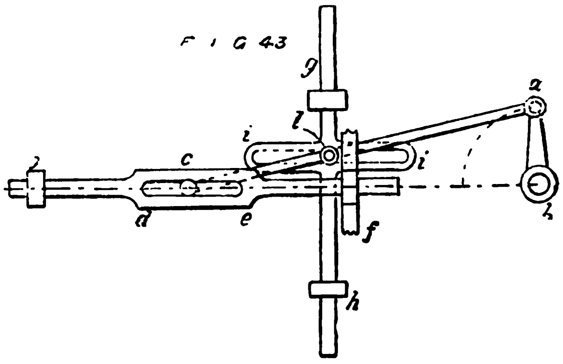


FIG 43



arm *a b* will make a complete revolution cated by the dotted circle, while the arm l vibrate through the dotted arc described the centre *d*. The extreme positions of nt *c* will occur when *a b* and *a c* are in the traight line, and at these points no force e passing from *a* to *c*. At B is shown a rangement for reversing the motion of a engine.

d *f* are two eccentrics so set that one work the valves for a forward, and the for a backward, motion. These eccenave straps and rods *g k*, *h i*, of which the and *g* are jointed to the extremities of a slotted link, in the slot of which is a block *l* connected by a pin with the alve rod *m*.

curved link *h g* is supported by a link nted to it at *g* and at *n* to one arm of the *n o p*, which is carried on a dead-centre at s a rod running from *p* to a lever conby the attendant. In the position neither eccentric acts upon the valve; the rod *q* be pulled until the end *g* of the opposite *l*, the valve will be actuated eccentric *f*; if, on the other hand, the relaxed until the end *h* of the link comes e the block *l*, the eccentric *e* will be in operation.

tting out any description of link motion novel, it is a good plan to make a model tol board or good cardboard, and so prove ally that the desired motion is obtained. ig. 43 is shown a double movement; *a b* ving crank revolving upon the centre *b*, runs a connecting-rod *a c*, having at its ity *c* a pin working in a slotted bar *d e*, in guides *f f*. During part of the travel pin *c* the slotted bar *d e* will be at rest, will only be at each end of the stroke will be moved.

e is, as shown, a bar *g h* at right angles though it may be placed at any angle d), carrying a transverse slotted piece *i i*, h works a pin *l* fixed on the connecting-. This pin will impart to *g h* a motion t angles to that of the bar *d e*. These ed movements may be used for various es. For instance, for light stamping or work the bar *d e* could be made to feel terial, and during its interval of rest rked by the bar *g h* to operate upon it. first movement described is available r actuating the valves of prime movers.

the foregoing remarks it will be d that a great variety of movements y means of links, be obtained from one but they are not generally suited for work.

e it is required to vary the stroke or of an element from time to time, a crank is useful, the connecting-rod end being then carried on a pin which can be secured in the slot at any required distance from the centre, upon which the crank revolves; the travel of the other end of the connecting-rod will then have a stroke equal to twice the distance of the pin from the centre, which is the effective length of the crank for the time being.

Instead of using, as in former times, separate cranks and eccentrics, and sometimes intermediate shafts for working the pumps of steam engines, we now frequently take the motion by means of links and bell-cranks direct from the piston-rod head, or in some instances from the connecting-rod; or where oscillating cylinders are used, from the motion of the cylinders themselves.

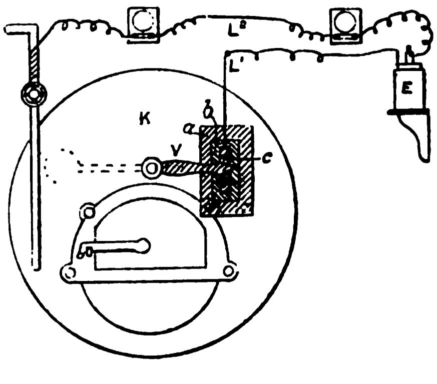
(*To be continued.*)

COLOURING RUBBER FABRICS.

A RECENT action for infringement of a patent has drawn attention to the practicability of improving the manufacture of rubber or waterproof fabrics by printing upon them patterns or ornamental designs—an art that has been carried out successfully only during the last two or three years. Every one is familiar with the macintosh, and though it would perhaps be of little advantage if coloured patterns could be readily printed on that, there are many articles made in rubber, both pure and vulcanised, which can be vastly improved in appearance by the addition of a little colour, or a pattern of some kind worked in the fabric. More than twenty years ago attempts were made to print upon rubber fabrics, just as calico is ornamented with designs; but the colours were not fast, and the designs were not clear. A certain measure of success was attained when a fabric with a pattern already printed on it was coated with clear rubber, and a more satisfactory article was, perhaps, produced when some one hit upon the idea of placing the waterproofing between two pieces of fabric, on one or both of which the pattern or design was printed. These latter productions were rather expensive, and were moreover too heavy; but towards the end of 1883 a Mr. Moseley, of Manchester, obtained a patent for a method of producing ornamental designs on rubber waterproof goods, which seems to have been so useful that it was soon infringed. In Moseley's process the fabric is rendered waterproof by one or more coatings of rubber, which may be coloured or not as desired, and it is then covered with a film of farina, on which it is possible to print in colours by methods similar to those adopted by the calico printers. According to Sir H. Roscoe, the farina prevents the pattern from "running," while it readily takes the colour, and is in short the secret of the success of the invention. When the farina is applied to the rubber-coated surfaces it adheres readily, and after a slight vulcanisation is found to be firmly fixed; but if the vulcanisation has been carried too far, or been performed too rapidly, the farina is easily rubbed off, and of course takes with it the colours of the pattern. Mr. A. Parkes, who invented cold vulcanisation about 1846, thinks that water-colours applied to an indiarubber-coated fabric covered with farina will always remain "fast," provided the vulcanisation is completed, and it appears from experiments that water-colours printed on rubber coated with farina are faster than those printed on a surface without farina, and that if the colours are dissolved in media which act on the rubber, they become still more "fast." The use of the farina is indeed the foundation of the process, for it combines readily with the rubber, and the colours fix well on the farina, the success of the patentee's process being due to the fact that the printing of the design is done on the farina, and not on the rubber. The infringers had to send the prepared fabric away from their works to be printed, and accordingly they partially vulcanised it before sending it away, in order that the farina might not be rubbed off. The designs are printed in water-colours, and subsequently a thin film of clear rubber is spread over, farina is dusted on, and the fabric is passed through rollers, which give the complete vulcanisation. Dr. Burghardt, who made a microscopical examination of the infringer's product, agreed with Sir H. Roscoe as to the absorbent action of the farina. It does not make the colours absolutely fast; but it has a very "fixing" effect on them, really inclosing the dye and acting much like a mordant. The case was settled in the plaintiff's favour, the validity of the patent being fully established. The attention drawn to the process by the action will probably lead to its more extended utilisation, for vulcanised rubber in certain conditions has a very long life, and if it can be ornamented with designs of a durable character, the extra cost will not prevent its adoption for many purposes.

WATER-LEVEL INDICATOR FOR STEAM-BOILERS.

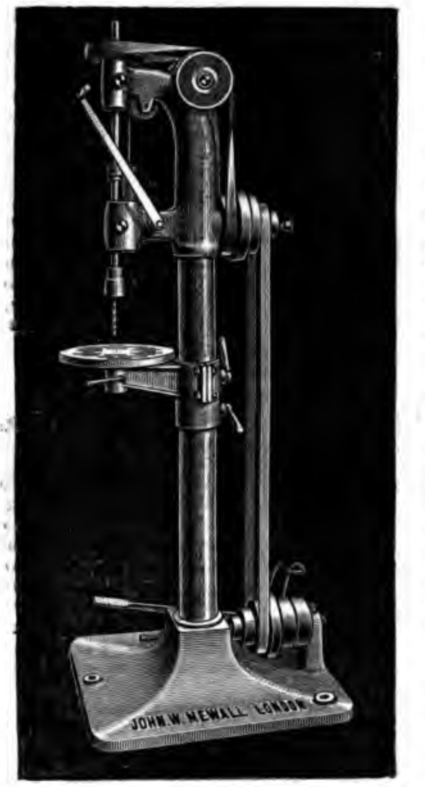
MANY devices for indicating the water-level in steam boilers and for giving a warning signal have been constructed, but for obvious reasons those which depend on electric action yield the best results, as the signals can be made in several places at once. Amongst recent patents we notice that Herr J. L. W. Olsen, of Copenhagen, has devised a simple apparatus for the purpose which has many features to recommend it. His invention relates to a controlling apparatus for the water-level in steam boilers and the like, which apparatus gives an audible signal at any distance from the boiler when the water-level is either too low or too high. In this manner the bursting of the boiler in consequence of an excessively low water-level is guarded against, as also the consequence of an excessively high water-level. Fig. 1 represents



a front view of the apparatus, which consists of a flat metal plate or metal box *a* in which is arranged a non-conducting material *b*, such as glass, ebonite, or the like, on to which is fastened the contact strip *c*, provided on both ends with slanting contact pieces, and on one end with a suitable terminal to be connected with the wire L 1 of an electric battery E, the other wire L 2 of which, passing through suitable signal or bell apparatus, is in connection with the boiler K. The box or plate *a* is arranged behind the water-level indicator V, which, when in its normal position, stands exactly in the middle of the strip *c*, without, however, being in contact with it, while the distance between the slanting contact pieces of the strip *c* is calculated in such a manner that the indicator V comes into contact with one of them if the level of the water is getting either too high or too low. Thereby the circuit is closed and the signal is given. By constructing the contact pieces slanting, and sharpening the edge of the indicator V, a good contact is always assured, as the sharp edge would remove any dirt or other matter from the slanting contact piece.

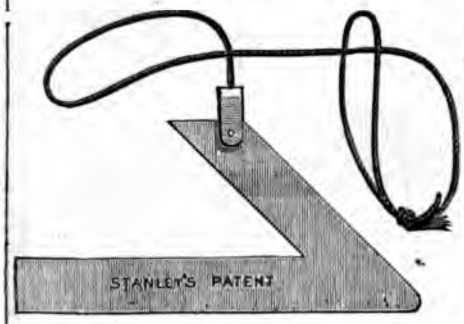
NEWALL'S IMPROVED MACHINE DRILL.

IN the annexed engraving we illustrate an improved machine drill constructed by Mr. Newall, of Bow, E., which is especially adapted for working with small drills, as it is driven by belts instead of spur gearing, and all jar is thus avoided. The spindle is counterbalanced, and works through the driving pulley in such a way that there is no side strain on it. The feed is by a hand lever, so that the exact amount of force applied is felt. The drill spindle is of fine tool steel, ground true, and all spindles and bearings are reamed and ground. By these means breakage of drills and wear of the machine, even at high speeds, are reduced to a minimum. Several improvements have lately been made in this machine, and it is now believed to be practically perfect. Among other things, flat belts have been used throughout, whereby the power has been very considerably increased. The spindle is bored for No. 1 Morse taper, or turned to fit chuck shank, as preferred. A cup, fitting the table, is provided for drilling centres in pieces up to 28in. long, and an index is engraved for setting the centre of table in line with the centre of drill. A stand is affixed, when a set of drills is ordered with the machine, for holding all sizes of twist-drills, from $\frac{1}{16}$in. to ½in. by 64ths. The drill is started by a foot lever, and cannot be left running, as it stops so soon as the foot is removed. Holes up to ⅜in. can be easily drilled at one cut; above that size it is necessary to put a small centre hole down first, as a "sensitive" feed is not powerful enough to force in a ½in. drill. The amount of feed is 3in. A stop is provided by which a series of holes can be drilled to the same depth. All bearings are fitted with Stauffer's Patent Lubricators, which we illustrated in No. 1003. An automatic feed, with automatic knock-off, can be attached to this machine, for use in repetition work.



STANLEY'S PATENT ARTIST'S CLINOMETER.

IN sketching landscape or the figure every artist knows the value of an extemporary plummet to get vertical range of parts, but for the horizontal he has generally to guess by holding his charcoal or pencil as level as he can by his eye. By the simple portable "Artist's Clinometer" here shown the vertical and horizontal are seen at a glance. This Clinometer has also 45°, which will be occasionally found useful for pitches of roofs, angles of mountains, &c. The price in case is only 2s. 6d. It may be had of Mr. Stanley's agent, Mr. H. T. Tallack, 28, Hatton-garden, E.C.



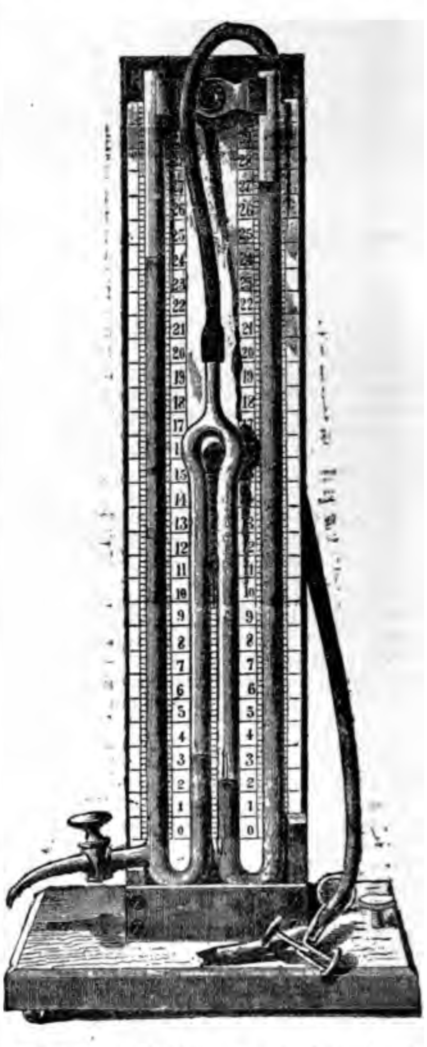
APPARATUS FOR DETERMINING THE SPECIFIC GRAVITY OF LIQUIDS.*

THE determination of the specific gravity of solids and liquids is one involving many precautions, if accurate results are to be attained, Water is the basis, its temperature being placed at 4° C. In practice it is the actual standard, the substance being generally compared in weight with an equal volume of real water. The water used should be distilled, and if not recently prepared, should be boiled and allowed to cool. This is necessary in order to be certain that it contains no dissolved gases. It may be said that reliable determinations of specific gravity have, as a rule, involved the use of a delicate balance. This condition has prevented accuracy in cases where no balance was obtainable, or where its use was inadmissible. The great family of hydrometers of Baume, Twaddell, Nicholson, and others, are far from exact, but have been devised to meet this want—an accurate method not requiring a balance.

The hydrometer is, for several reasons, an unsatisfactory instrument. Its accuracy depends on the invariable volume of a solid. If made of metal, it may become indented, and so destroyed. If made of glass, unless allowed to stand for a long time before graduation, its volume may slowly change. Such alteration of cubic contents is often observed in thermometers. From this cause one radical defect attaches to the system. To make them sensitive, the stem on which the graduations are marked has to be of small diameter, and, consequently, of great length in proportion to the range of its scale. Accordingly, to cover the cases of liquids of varying specific gravity, to which branch of the subject these notes are especially directed, several hydrometers are found necessary. Capillarity introduces another source of error. In the same liquid the same hydrometer will give different readings, according to the way it is manipulated. The liquid adhering to its stem, where it emerges from the surface, pulls it down to a greater or less extent. If the hydrometer is pressed down and allowed to rise slowly, it will give a lower reading than if just allowed to settle to a position of rest. In different liquids the error of capillarity is still more serious, and cannot be avoided or allowed for. Finally, as a mere matter of practice, it is impossible to read the instrument with any accuracy, the intersection of the liquid surface with the hydrometer stem not defining a sharp line.

The apparatus here illustrated obviates these objections. It gives a definite reading. One apparatus can be used for liquids of all specific gravities, and errors due to capillarity are completely avoided. It is based on the law of the pressure of liquids, which states that the height of two columns of fluid that are in equilibrium is inversely proportioned to their specific gravity. This principle was the basis of Dulong and Petit's method for determining the coefficient of the absolute expansion of mercury.

A glass tube is bent into the shape indicated, and provided with a nozzle at the central bend for the attachment of an indiarubber tube. A pinch cock is used to close the latter. As shown in the cut, one of the lower bends is provided with an outlet cock, also of glass. This may be omitted, as it is only a matter of convenience and neatness, enabling the manipulator to more easily change the fluid where several determinations are to be made in succession. The tube should be about 12 millimètres (½in.) internal diameter. In height it need not exceed 400 millimètres (16in.), though for accurate work it should be two or three times as high. This applies to the long members. The central portion should be a little more than half as high.



The tube is mounted on a stand provided with a levelling screw. Back of it is a mirror, which should be of good quality, free from striæ or bubbles. The tube lies snugly against this. On the mirror a scale is marked for all four members of the tubing. The graduation must be executed with the greatest accuracy. The lines must lie all in one direction, parallel to each other, and those on one side should be continuations of those on the others. If this condition is departed from, at the very least the scales for the short and long tube on either side must be identical in level as far as the short one extends. The scale need not be etched or engraved on the mirror. It may be marked upon the front of the tube. To determine the specific gravity of a liquid, water is first poured into the right-hand tube, until the short tube is filled nearly to the bend. The apparatus is now levelled with the levelling screw seen passing through the base, the water being used as the gauge.

In reading the height of the columns, the eye is so placed that the division of the scale nearest to the water level bisects the reflection of the retina in the mirror. The level of the weter can then be read off within a small fraction of a millimètre. The fluid to be tested is poured into the left-hand tube in about equal quantity. By blowing into the rubber tube, the water and other fluid are forced down the centre tubes and up in the outer. When the inner columns have sunk nearly to the bottom of the tube, the rubber tube is closed by a pinch cock. The pinch cock is best applied close to the glass nozzle. Upper and lower readings for both liquids are taken, just as in a siphon barometer. The lower readings are subtracted from the upper ones, giving the true and relative heights of the supporting columns. The height of the water column' is divided by that of the other column, and the quotient is the specific gravity. The best method of levelling the apparatus is to first pour water into both sides, to force it upward as described, and take regular readings and adjust the levelling screw by these observations. The different capillarity of various liquids does not affect the observations, as the surfaces counteract each other's effects. There is no trouble in reading within one or two tenths of a millimètre, so that in an apparatus a mètre high the readings would be within two ten-thousandths, and the quotient expressive of specific gravity of course much closer. As the same water will answer for a series of observations, no cock need be supplied for drawing it off. For extremely accurate work, a rather large diameter of tube should be fixed upon (20mm., or ¾in.), and the tubes should be made long. As above suggested, a mètre (39·37in.) effectual height would be sufficient for any work, especially if the readings were taken with a cathetometer.

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* By T. O'CONOR SLOANE, Ph.D., in the *Scientific American*.

NEW METHOD OF FIXING SECTIONS TO THE SLIDE.*

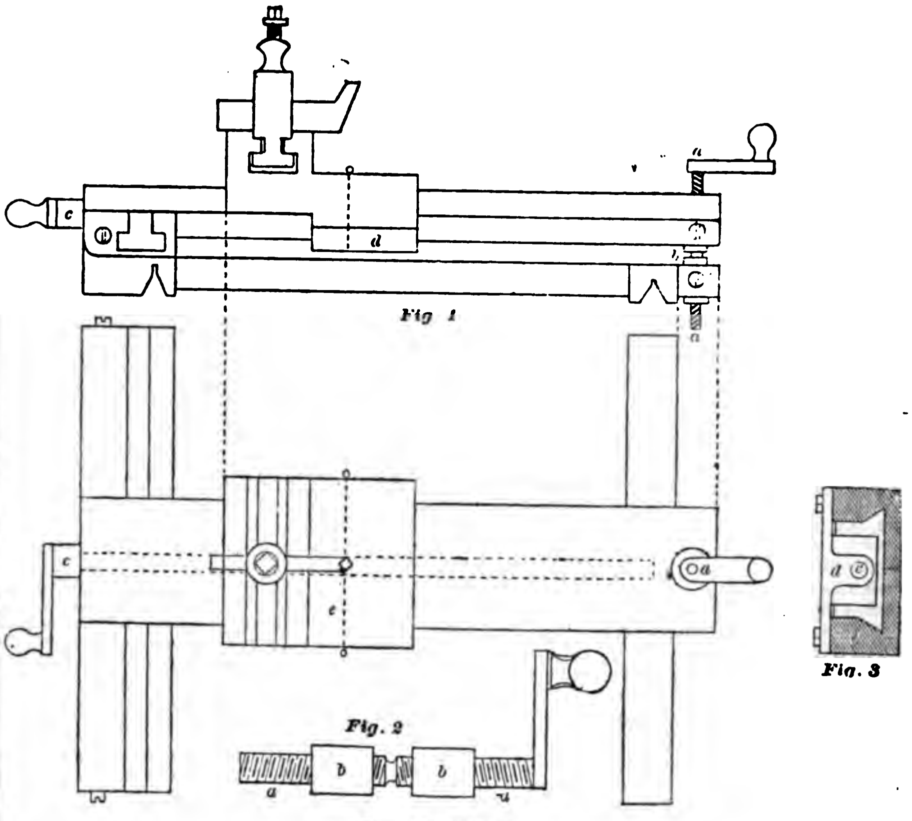
THE following method has been tested with paraffin and celloidin sections. For either kind of sections the slides are first coated with collodion, either by flowing from a bottle or by a brush, and allowed to dry. The celloidin used for imbedding, thinned with alcohol and ether, answers admirably. The coated slides may be kept indefinitely before using. Paraffin sections are arranged upon the slide, and a small amount of a mixture of equal parts of alcohol and ether is then dropped upon the slide. The liquid will be immediately drawn under the sections. Bubbles of air will rarely remain beneath the sections, but if they do, they may easily be displaced by gently touching the section with a soft brush. The liquid is allowed to evaporate spontaneously. When quite dry, which will take but a few minutes, the paraffin may be dissolved and the sections will be found firmly fixed.

Celloidin sections are placed for a few minutes in 95 per cent. alcohol, and then arranged on the coated slide. They are drained as free of alcohol as possible, and as soon as their surface is nearly dry, as is shown by its assuming a dull appearance, the mixture of alcohol and ether is dropped upon them rather freely. When this has evaporated until the surface of the sections again assumes a dull appearance, the slide is placed in 80 per cent. or weaker alcohol, and may then be treated by any of the reagents applicable to paraffin sections fixed with collodion.

The advantages claimed for this method are three: the use of heat is dispensed with, and thus one source of inconvenience and injury to the sections is avoided; the paraffin is not removed (or melted) until the sections are fixed, and thus in sections consisting of disconnected parts, the position of these parts is preserved; labour and work-table space are saved by having a single method which is applicable to both paraffin and celloidin sections. In a later note Prof. Summers adds:—"The following simpler method is found to work as well. Place the sections in 95 per cent. alcohol for a minute or two, arrange on the slide, drain off the superfluous alcohol by tipping the slide, then pour over the sections sulphuric ether vapour from bottle of liquid ether. The celloidin will immediately soften. Place the slide in 80, then 95 alcohol. The sections will be found firmly fixed, and may be stained, cleared," &c.—*The Microscope.*

TOOL CARRIAGES.

THE familiar device for adjusting a lathe tool vertically by tipping the upper portion of the carriage by means of a screw at the back end is not only the oldest but probably the best means of accomplishing the desired purpose, especially for the smaller classes of lathes. Mr. F. G. Woodward, writing in the *American Machinist*, considers the method shown in the annexed sketch to be the most satisfactory arrangement. The adjusting screw *a* is made right and left, its two nuts *b* being held on centre screws, as shown in Fig. 1. This device binds the two portions of the carriage firmly together, and gives quick adjustment to the tool. It will be noticed also by the sketch that the cross-feed screw *c* is inclosed in the carriage so that it is entirely out of the way of dust and droppings from the tool. This is accomplished by connecting the nut *d* to the tool block *e* at the sides (see partial cross-section, Fig. 3). The details of all machinery, especially of that designed for rapid execution, should be so arranged as not to crowd the handles and the parts which are to be frequently seized by the operator too closely together. These details should be so placed, if possible, that the hand of the attendant shall travel a little different route for each different adjustment or manipulation; this will facilitate the labour of the operator, inasmuch as the assistance of the eye will not be needed, and the whole work of the attendant will thus become more easily intuitive, so to speak.



TOOL CARRIAGE.

THE BULB MITE.*

THERE is a good deal of similarity between animals and plants; they each have their diseases and their parasites. Amongst the rest is the so-called Eucharis or bulb mite. Some time ago I was asked by a horticulturist in the North to examine some bulbs with the microscope. He said that the greater part of his bulbs were purchased about eleven years ago, and that they continued in vigorous health for some three or four years. It seems that he then purchased an additional small stock. After this importation the whole of the plants gradually began to show signs of deterioration. It is now almost certain that the decay in these plants was caused by the bulb mite, though the owner was not aware of its existence at that time, in fact he bestowed much anxious care and attention in trying the usual methods of remedying the unhealthy condition of his plants. About a year ago his stock of about 4,000 Eucharis bulbs were all planted out. Then began the worst possible state of affairs; the disease spread rapidly; about half the plants became denuded of leaves, and many even of bulbs and roots. In fact, this valuable lot of charming flowering plants was evidently being rapidly destroyed. It was at this juncture that he brought me some two or three specimens to examine. After considerable care I only found some organisms which appeared to me to be eggs. I requested that further samples should be brought me. In these the mites were easily found, both on the leaves and even on the flowers. They were pretty plentiful in the surface structure, and in some instances were detected in the centre of the bulb. I then ventured to suggest that he should subject the bulbs to various forms of treatment, such as would appear to him likely to destroy both mites and germs, and requested that duplicates should be kept of each of these doctored roots, so that they might be planted, and that the subsequent results might be verified. He duly forwarded to me specimens which had been treated by the following different processes:—No. 1 bulb was immersed in lime-water for 24 hours; No. 2 was put under a handglass filled with strong fumes of burning sulphur; No. 3 was immersed in a solution of carbolic acid and water for 24 hours; No. 4 was placed under a handglass, and exposed to fumes of sulphur: the latter was sprinkled on lime during the process of slacking; No. 5 was well soaked with burning tobacco many times during the day; No. 6 was steeped for twenty-four hours in an insecticide called "Fir-tree oil"; No. 7 was well washed in clear water, then worked in the above "Fir-tree oil" for a few minutes, then washed over again in the same manner. No. 8 was treated by a solution of sulphide of potassium, as recommended by your correspondent, Mr. E. Tonks. These investigations occupied much time and patience, and I received valuable assistance from the members of our microscopical society. It needs great care, and not a little skill to conduct these delicate investigations satisfactorily. Every part of the bulb must be exhaustively examined. In almost all the doctored bulbs dead mites were found that had doubtless succumbed to the treatment. It is not sufficient to examine the roots cursorily. Conclusions drawn from a perfunctory scrutiny would be alike misleading and fallacious. A small party of us spent hours and hours with first-class microscopes and appliances, examining the tissues all through. Sometimes, after long and persistent hunting, a single living mite or organism was detected. We deemed this as conclusive. In fact, the exhaustive searching of these specimens thus treated had to be spread over some two or three weeks, for my professional engagements would not allow of my working night after night consecutively. But notwithstanding, as we gained experience and found out how to proceed in the minute investigation, it proved full of interest and instruction. Briefly put, the sum of our inquiries under the microscope was as follows:—No. 1 bulb was found to contain, one dead and one live mite. No. 2 contained neither live nor dead mites. Query: Was this bulb diseased at all before being submitted to treatment? No. 3, contrary to what one might have expected, contained a plentiful stock of living specimens; No. 4 was also well stocked with samples lively enough. No. 5 contained one lying dead, and one alive, eating; No. 6, one or two dead and one busy feeding. No. 7 was a milder form of No. 6 way of treatment; as would be supposed, it had a good share of vigorous mites. No. 8 was rather anxiously scanned, hoping that the plan recommended by your sensible and attractively writing correspondent might prove more successful. The results recorded in this case were as remarkable as they were unexpected. The outer coats of the bulb, when examined with a pretty high power, under well-arranged "top-light," by the aid of a large condenser, showed a most puzzling but nevertheless most brilliant and charming sight. The outer tissue was filled entirely with myriads and myriads of exceedingly minute organisms, like microscopic vinegar eels in appearance, only more metallic-looking. They had all the look of sparkling threads of silver. They were all in the most active motion, and although I have witnessed many attractive sights under the microscope, I have never at any time beheld anything more charming than the spectacle these polished silver-like organisms presented; the tissues undulated with all the glistening effect which a fine threaded silver cloth exhibits under the blaze of the electric limelight. These strange organisms did not extend far into the meshes of the bulb; but a little further in we found any quantity of living mites! I am of opinion that the whole subject of these mites, and, indeed, of all plant parasites, should be very carefully studied. No slovenly or hurried observations are of any avail. If I can find time I hope to pursue the matter further. It is my opinion that the treatment hitherto adopted is unavailing. I have no wish to disparage my friend's intelligent efforts to cure his large and valuable stock of Eucharis bulbs; but it is evident that some other method more certain must be found out, and the sooner this is done the better it will be both for those who love flowers and for those who sell them.

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* By H. E. SUMMERS, Cornell University.

* By C. S. HALL, M.R.C.S., Pres. Carlisle Microscopical Society, in the *Gardeners' Chronicle.*

PAPYROTINT.

THE following description of a new photo-printing process devised by Sergt.-Major Husband, R.E., is given in the *Journal* of the Photographic Society of Great Britain. The process is especially adapted to the reproduction of subjects in half-tone, and is stated to be inexpensive—much cheaper than the old process of photo-lithography in line, while the working is exactly the same as ordinary lithography. Its advantages over other methods are that a transfer can be taken in greasy ink, for transfer to stone or zinc, direct from any negative, however large, without the aid of a medium, the grain of reticulation being obtained simply by a chemical change. The transfer paper being in direct contact with the negative, the resulting prints are sharper than by those processes where interposed media are used; whilst the same negative will answer either for a silver print, platinotype, or a transfer for zinc or stone. The advantage of being able to use a non-reversed negative is very great, now that gelatine plates have so largely superseded those made with collodion. The method of manipulation is as follows:—Any good surfaced paper is floated on a bath composed of—

Gelatine (Nelson's flake)	8	oz.
Glycerine	1½	,,
Chloride of sodium (common salt)......	2	,,
Water..	50	,,

Great care should be taken that the solution is not overheated, and that the paper is coated without bubbles. It is then dried in a temperature of 60° Fahr. The paper will take about ten hours to dry, and in this state will keep for years. When required for use, it should be sensitised by floating, or immersing, in a bath of—

Bichromate of potash...........	1 oz.
Chloride of sodium...............	½ ,,
Ferricyanide of potassium ...	100 grains.
Water................................	30 oz.

This need not be done in the dark room, as the solution is not sensitive to light.

The paper, after sensitising, is dried in a temperature of 70°, and in a dark room. When dry, it is exposed under any half-tone negative, in the ordinary printing frame. It is preferable to print in sunlight, and, for negatives of medium density, an exposure of three minutes is required; but the exposure will vary according to the density of the negative. The correct time of exposure can best be judged by looking at the print in the frame. When the image appears on the transfer paper of a dark fawn colour, on a yellow ground, the transfer is sufficiently printed. It is put into a bath of cold water for about ten minutes, until the soluble gelatine has taken up its full quantity of water; then taken out, placed on a flat piece of stone, glass, or zinc plate, and the surface dried with blotting-paper.

The action of the light has been to render the parts to which it has penetrated through the negative partly insoluble, and, at the same time, granulated. A hard transfer ink is now used, composed of—

¼ oz.	of white virgin wax.
¼ ,,	stearine.
¼ ,,	common resin.

These are melted together in a crucible over a small gas jet, and to them are added 4oz. of chalk printing ink, and the mixture reduced to the consistency of cream with spirits of turpentine. A soft sponge is saturated with this mixture, and rubbed gently over the exposed paper (in this stage the nature of the grain can be best seen). An ordinary letter-press roller, charged with a little ink from the inking slab, is then passed over the transfer, causing the ink to adhere firmly to the parts effected by the light, and removing it from the parts unacted upon. It will be found that with practice, rolling slowly and carefully as a letter-press printer would his forme, the ink will be removed by the roller according to the action that has taken place by light, leaving the shadows fully charged with ink, and the high lights almost clear, the result being a grained transfer in greasy ink. The transfer is next put into a weak bath of tannin and bichromate of potash for a few minutes, and when taken out the surplus solution should be carefully dried off between clean sheets of blotting-paper. The transfer is hung up to dry, and, when thoroughly dry, the whole of the still sensitive surface should be exposed to light for about two minutes. A weak solution of oxalic acid should be used for damping the transfer (about 1 in 100), and this should be applied to the back of the transfer with a soft sponge. After it has been damped about four times, it should be carefully put between clean sheets of blotting-paper, and the surplus moisture removed. A cold polished stone is then set in the press, and after everything is ready the transfer is placed on the stone and pulled through twice. The stone or scraper is then reversed, and the transfer is again twice pulled through. A moderate pressure and a hard backing sheet should be used, care being taken not to increase the pressure after the first pull through. The transfer is taken from the stone without damping, when it will be found that the ink has left the paper clean. Gum up the stone in the usual way, but, if possible, let the transfer remain a few hours before rolling up. Do not wash it out with turpentine, and use middle varnish to thin down the ink.

It should have been mentioned that varying degrees of fineness of grain can be given to the transfer by adding a little more ferricyanide of potassium in the sensitising solution, and drying the transfer paper at a higher temperature, or by heating the paper a little before exposure, or by adding a little hot water to the cold water bath, after the transfer has been fully exposed; the higher the temperature of the water the coarser the grain will be. The finer grain is best suited to negatives from nature, when a considerable amount of detail has to be shown. The coarse grain is best for subjects in monochrome, or large negatives from nature, of architecture, &c., where the detail is not so small. Even from the finer grain several hundred copies can be pulled, as many as 1,200 having been pulled from a single transfer, and this one would have produced a great many more if required.

POROUS POTS FOR BATTERIES.

IN a recent number of the New York *Electrical Review*, Mr. A. V. Garratt refers to a remark made by Mr. Swinburne on "this side," that "sufferers from the primary battery disease" have never thought of making porous pots for primary batteries from biscuit impregnated with carbon deposited from hydrocarbons by heat. This statement goes to show that our friends from over the water are not aware how very sick some of the sufferers above alluded to have been here in the States, and how many remedies we have tried—among which may be found some proprietary medicines, and perhaps a few which were not of domestic manufacture. The expedient of making porous pots of biscuit or unglazed earthenware, impregnated with carbon, was one that looked hopeful. The writer has experimented somewhat in that direction, but will not here describe the experiments, which were necessarily complicated, for the reason that they proved to be entire failures. Many different kinds of clay were used, and they were manipulated in the various ways familiar to potters. The plan was also tried of baking the various kinds of carbon to be obtained commercially, with clay of various kinds, manipulated in various ways. The result was the ruin of several kilns full of valuable pottery, because of carbonaceous gases, and a large and varied assortment of worthless porous pots. The object of this experimenting was not, as suggested by Mr. Swinburne, to afford a passage of low electrical resistance between electrodes separated by the porous pot, but to make the porous pot itself the negative electrode of the cell. And the object of so doing may be found in the following experiment.

If we fill a new porous pot with any of the chromic battery fluids now in use, and stand it in a clean glass jar filled with dilute sulphuric acid, the chromic solution will be seen to force its way through and hang in a film on the outer side of the porous pot. Now if we place in the glass jar a strip of bright zinc and in the porous pot a piece of carbon, and connect them with a wire, the red film will show, by turning green, that it is giving up oxygen, and will begin to slip down the surface of the porous pot to the bottom of the glass jar, and fresh chromic solution will come through to take its place. It is now obvious that if the outer surface of the porous pot was carbon, forming the negative electrode, and in good contact with the positive pole, we should have a cell of very low internal resistance. It is a popular but mistaken notion that the depolariser absorbs hydrogen at the surface of the negative electrode. This action takes place (supposing, of course, the cell is in good working condition) at the surface of the porous pot. If the cathions get much further than that the cell begins to show signs of polarisation. The question of getting the negative electrode as near as possible to the point where the cathions are oxidised, without interfering with a constant, fresh supply of the depolarising or oxidising substance, is one of the most hopeful and also one of the most discouraging problems in connection with the making of powerful primary batteries. It is often said, when reciting the properties which a theoretically perfect dynamo should have, that unfortunately they are not capable of being introduced into the same machine. For example, the armature should have the greatest length of wire upon its coils; the wire of the armature should be as thick as possible, so as to offer little resistance. Now these two properties are no more incompatible than some points in primary battery construction; as, for example, the attempt to place the negative electrode where it will work to the best advantage, without interfering with the proper supply of the depolarising agent. A perusal of some old patents will show that not an inconsiderable amount of ingenuity has been expended in this direction. So far, all attempts to make porous pots partly or wholly of carbon have failed to give results that would warrant their use.

THE ELECTRO-OSTEOTOME.

THE invention of a fundamentally new instrument of precision has often been found to result in opening up an entirely new field of knowledge, or of increasing greatly the range of knowledge within the branch of science to which it applies. We, therefore, watch with special interest the introduction of any new surgical instrument or appliance which will tend to reduce human suffering or lead to improved methods in operative surgery. We, therefore, acknowledge a debt of gratitude to Dr. Milton Josiah Roberts, of New York City, for having invented a new surgical instrument, which he calls the "electro-osteotome," with which he can make cross, oblique, and linear sections of bone with exceeding ease and astonishing rapidity, while a mathematical precision can be maintained as to the accuracy of the cut, both in regard to direction and extent. Take, for instance, such a deformity as knock-knees, due to a curvature of the bones; to remedy which, in the usual way, requires a long, tedious operation with a mallet and chisel, with which a wedge-shaped piece of bone is cut away. It is, perhaps, the most brutal and unscientific method which could be adopted, and sounds like the operative butchery which existed in the last century. Yet that is now the practice with surgeons of the present day who perform such operations. Dr. Roberts reforms all this at a stroke. His electric osteotome is an instrument holding a circular saw at its extremity, which revolves with lightning speed by an electric motor. This, when held against a bone, makes a clean cut through it in a few seconds; in fact, its action is almost instantaneous. By holding the electric osteotome in a slanting position, wedge-shaped pieces can be cut out with equal promptitude. There is no danger of the saw cutting the soft parts, as they are protected by a retractor, an instrument which is passed down and under the bone. When such a wedge-shaped piece of bone of proper angle is removed, the remaining bones of the leg can be straightened, and the deformity is remedied for ever.

There are a great many diseases of the bones requiring this kind of section cutting. In some instances they have to be cut through in several places. We understand that Dr. Roberts made over twenty-four sections on a single individual at one setting with his osteotome. Sometimes the bones become diseased, soft and rotten. This is called caries of the bone. In such cases the diseased parts have to be cut away. The ordinary surgeon would require about three-quarters of an hour's work with his mallet and chisel to perform this operation. Dr. Roberts with his electric osteotome would remove the bone in a few seconds, not only insuring despatch and precision, but with less shock to the patient, and consequently removing one of the chief risks of life. We have, perhaps, indicated sufficiently the value of Dr. Roberts's invention, and those who are unfortunately requiring relief from bone troubles requiring operative measures will be indeed foolish not to make use of it. Such operations at the best require the close attention of a specialist and the most perfect surgical appliances which science can place in his hands.—*Health.*

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE May meeting was held on the evening of Friday, the 13th inst., J. W. L. Glaisher, Esq., in the chair.

Dr. Gustavus William Nicholls, of Pernambuco, Brazil, and Mr. W. Austin Ashe, of the Observatory, Quebec, were balloted for and duly elected Fellows of the Society.

Col. Tupman announced that 75 presents had been received by the Society since their last meeting. Amongst them were some very beautiful photographs of stellar spectra, which had been taken by Prof. E. C. Pickering, of Harvard, with instruments provided for the observatory by Mrs. Draper as a memorial of her husband, Dr. Draper. The photographs show a great advance in this branch of astronomy, and they will probably enable the motion of stars in the line of sight to be determined with much greater accuracy than has been hitherto possible. On the scale of the enlarged photographs shown, the deviation found by Dr. Huggins in the case of Sirius would correspond to a change in the position of the lines of about half a millimetre. Mrs. Draper has not only given the instruments, but she has provided the means for keeping them actively employed during the whole of every clear night, and also of reducing the results by a considerable force of computers, and of publishing them in a suitable form.

Mr. Ranyard said these photographs will enable an enormous step in advance to be made in the study of stellar spectra, and the behaviour of the elements under various conditions. The range of temperature and difference of condition opened up to our study is probably much greater than that which can be studied in passing from the spectrum of a sun-spot to that of a prominence. These photographs are on such a scale that one would at first take them for photographs of the solar spectrum. Prof. Pickering has taken them by means of large prisms placed in front of an object-glass. A linear spectrum of the star is thus thrown at right angles to the diurnal motion of the star, and the spectrum is spread out into a band by controlling the motion of the driving clock. These photographs were taken with four prisms of only 15° each, and the definition is so perfect that the photographs bear considerable enlargement. As no slit is made use of, there is no possibility of obtaining an accurate reference spectrum for studying the motion of the star in the line of sight, except by employing some absorbing medium which gives narrow absorption lines for reference.

The President called upon Mr. Knobel to read a report of the Photographic Congress which assembled in Paris on the 16th of April, in response to an invitation issued by the Academie des Sciences. It was attended by 57 delegates, representatives of different countries. The eight representatives from England were Messrs. Christie, Common, Gill (from the Cape), Knobel, Perry, Roberts, Russell (from Australia), and Tennant. The Conference was opened by the Minister for Foreign Affairs, who expressed a cordial welcome to the members on behalf of the French Republic, and assured them of the co-operation of the Government in the work they might undertake. The following general resolutions which had been printed in the programme were first taken into consideration and adopted unanimously:—(1) That the progress made in astronomical photography demands that the astronomers of the present day should unite in undertaking a description of the heavens by photographic means. (2) That this work should be carried out at selected stations and with instruments which should be identical in their essential parts. 3. That the principal objects are (*a*) to prepare a general photographic chart of the heavens, and to put down data which shall enable us to determine with the greatest possible accuracy the position of the stars; (*b*) to be able to utilise in the best way, both at the present day and in the future, the data obtained by photographic means. A committee was formed to consider the magnitude of the stars which it was desirable to photograph. At a meeting on the 18th it was unanimously resolved that the refractor was the best form of instrument, the dimensions being those of the telescope at the Paris Observatory. The committee above referred to recommended that the instruments employed should be exclusively refractors. That stars should be photographed down to the 14th magnitude inclusive, and that the aperture of the object-glass shall be 35 centimètres. Directors of observatories will be free to have their object-glasses made by any optician they desire to employ, provided they comply with the general conditions determined by the congress. Other resolutions were also passed with reference to object glasses, and with reference to the conditions under which the photographs of the heavens are to be made. It is proposed that the results of the photographic observations shall be compiled and published in the form of a catalogue.

Mr. Common said: Mr. President, perhaps the Fellows may like some explanation from their delegates on one or two points that are not explained in this report. The most important decision was, to my mind, the choice the Congress made of the refractor. There is no explanation given, and no account of the discussion which took place as to the relative advantages of the refractor and the reflector in this case; but I should like to explain some reasons which were at work, I believe, in the minds of my co-delegates in this matter. Mr. Christie and Mr. Gill are here, and can tell you if the account I give differs from their own opinion. The reflector, I believe, is the best instrument for photography for many reasons, one being that it brings all the rays of light to one focal plane or point. Therefore, other things being equal, there is a smaller star disc, because the whole of the light that comes from that star is used to produce the photographic image. The extent of the field from experiments made by Prof. Pritchard, is comparable with the refractor, and it is rather doubtful if it does not exceed the extent of field given by the Bros. Henry's telescope; at any rate, the star discs are a little larger in the case of the reflector. Still, they retain their round shape, which is very essential to proper measurement. But apart from that, there is the question of light stars being shown with a newly-polished speculum, which cannot be seen when it is a little tarnished. One of the recommendations which influenced the Congress is that the light-grasping power of the reflector is not so permanent as that of the refractor, and as this is of immense importance in work of this kind, that is another reason why the refractor was chosen. There is also another difficulty with the reflector, and that is that it is very difficult to mount a reflector in such a way as to fix it permanently with respect to the mounting, though I have not the slightest hesitation in saying that if we make our reflector discs of glass not $\frac{1}{10}$th or $\frac{1}{12}$th of the diameter in thickness, but $\frac{1}{3}$th or $\frac{1}{6}$th, we should be able to confine the mirror rigidly by bands, as rigidly as the refractor object-glass, though, of course, a slight change in the position of the object-glass of the refractor does not affect the position of the image on the plate as the shift of a reflector does. I believe if we were to make our mirrors 3½in. or 4in. in thickness, and if it was tightly supported round the edge with two or three bands, they would have no injurious action. But the reflector is not the instrument of the professional astronomer; and that was another reason why in a case of this sort, where the difficulties were already sufficient, it would be necessary to give a man that instrument he was most used to. These were the chief reasons that were at work in inducing the Conference to come to the decision it did to use the refractor in this undertaking. I believe we shall eventually find the reflector the best telescope; but it will have to be improved, and there will be a great deal of work to be done before it can be sufficiently improved. I will just run through the week's work of the Conference. We got there on Friday, and on Saturday the Conference was opened by M. Flourens, the Minister for Foreign Affairs. The Conference got to work directly M. Flourens' speech was over, and they passed resolutions that day and elected a special committee to sit on Monday to formulate some of the questions as to the refractor and reflector, which were accepted on Tuesday by the Conference at large. On Tuesday it was felt that the different questions of taking photographs, the kind of instrument, and all those details would be better dealt with by the formation of two sections. Those sections sat until Friday, with the result Mr. Knobel has stated. I do not think there was a single hard-and-fast line drawn unnecessarily. Of course, the size of the telescope and the focal length had to be defined. It gave a convenient scale, which must be uniform.

Mr. Green read a memoir upon the planet Jupiter, which he stated was the result of twenty-six years' work and careful drawing of the planet. He had given a chart of the markings of Jupiter from 1860 to 1887, a few in each year, showing the remarkable changes through which the planet had passed. During the period from 1860 to 1868 the Equator was occupied by a band of white, edged with dark belts in the southern hemisphere. In the period from 1869 to 1872 the Equator was of a decided coppery hue, the northern and southern belts moved towards the south, and were greatly reduced in breadth. The third period from 1873 to 1878 was marked by the appearance of a multitude of most delicate markings in the southern hemisphere, and by a reduction of the coppery colour of the Equatorial region. In the fourth period, from 1879 to the present date, the planet had exhibited most perplexing changes of colour and of form.

The following papers were taken as read:—Lt.-Col. Tupman: Occultation of α Tauri, 1887, March 2. Maxwell Hall: The Sidereal System, revised in 1887. J. Tebbutt: Observations of Saturn and δ Geminorum, *Jan.*—Feb. 1887. W. H. Finlay: On the Probable Errors of Transit-Observing. Capt. E. J. Molony: Sextant Observations of Comet α, 1887. Dr. J. Morrison: The Orbits of Comets Fabry and Barnard-Hartwig. Dr. J. Morrison: Ephemerides of the Satellites of Mars during the Oppositions of 1888 and 1890. W. H. S. Monck: On the Inclination of Cometary Orbits. Rev. S. J. Johnson: Note on a MS. Eclipse Volume. J. L. E. Dreyer: Note on the Effect of Refraction in Stellar Photography. E. Neison: On Prof. G. W. Hill's Paper on Delaunay's Method. R. Bryant: On the Orbit of Comet II., 1883. A. Marth: On the Formulæ for Correcting Approximate Elements of the Orbits of Binary Stars. H. Lefavour: The Right Ascensions of Certain Stars within 10° of the Pole Reduced from Observations by F. G. W. Struve. J. L. E. Dreyer: On some Nebulæ Suspected of Variability or Proper Motion.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE eighth and last general meeting of the session was held on Monday, May 9th, Mr. Walter Sang in the chair. Thirty-eight members were elected, and Dr. L. da Rocha Miranda, of the Imperial Observatory, Rio de Janeiro, was elected an honorary associate of the society.

In a note on "The Solar Eclipse of August, 1886," the Rev. S. J. Johnson mentioned that, as the greater portion of the total phase could only have been observed on the ocean, he had been induced to make inquiries of the different lines of steam and sailing vessels for the purpose of ascertaining whether any observations of totality had been secured; but his applications had hitherto not met with success. Captain Owen, of the Union Line steamer, *Pretoria*, obtained seven negatives of the partial phase only, his ship being at the time about 520 miles S.E. of St. Helena. Mr. Johnson suggested the desirability of further inquiries being prosecuted in this direction, as it was quite possible that some Liverpool vessels may have been in the line of totality, and that matters of interest in connection with the total phases may have been entered in their log-books.

In a paper entitled "Stellar Influences on Physical Geography," Mr. W. H. S. Monck said that a paper which he had read before the society some time before, on the possible effects of terrestrial heat on the moon, had naturally suggested the question to his mind as to whether the earth itself might not in past ages have been subjected to similar influences, the effects of which we might be still experiencing. Such a source of heat could, of course, only have had its origin in one of the fixed stars. The rate of motion of our own planet round the sun was from eighteen to twenty miles a second—rather under than over the average velocity of those stars whose motions of approach or recession have as yet been determined by means of the spectroscope. In fifty millions of years a star travelling at the same rate as our earth would have moved over a space which light would take 5,000 years to traverse, and it is probable that the distance of very few (if any) of the seventy millions of stars within the range of our most powerful telescopes exceeded 5,000 years light-passage. Hence it was possible that any or every one of these seventy millions of suns, supposing their proper motions were suitable, may have visited our solar system within the fifty millions of years which the great majority of geologists consider have elapsed since the earliest dawn of life on our globe; or, as our solar system has undoubtedly a proper motion in space, which is not estimated by any astronomer at a value less than one-fifth of that of the earth's motion round the sun, our system might in the same way have come within the influence of some one of these stars. To the objection that such an approach would have deranged the stability of the planetary orbits, it may be urged that an intensely hot star might approach near enough to affect our climate without materially deranging our motions. The effect produced would, of course, be greater if our visitor was not a single star, but a star system. The writer considered that the evidences of geological action in past ages tended to bear out his hypothesis.

Mr. A. Stanley Williams contributed a paper on "The Motions of the Markings on Jupiter." He mentioned that during the last few weeks there had been many large and conspicuous markings visible, which exhibited in a striking manner the extent and nature of some of the movements peculiar to these objects. A group of light and dark spots which, on the 20th of March, was a long way following the red spot, had moved by the 10th of April so far to the westward, that these markings were then nearly as far *preceding* the red spot as they had been *following* it three weeks previously. All the markings just on the equatorial side of the south equatorial belt have the same rotation period, and afford evidence of a vast aërial current in the atmosphere of Jupiter. On the other hand, an oval white marking on the northern side of the double north equatorial belt had a rotation period approximately the same as that of the celebrated red spot, which differed considerably from that of the groups of light and dark spots mentioned above. There are also other markings situated in different latitudes, the periods of which have not yet been satisfactorily ascertained. Mr. Williams's paper was illustrated by two drawings made with the aid of his 6½in. Calver reflector.

In bringing his series of papers on "Telescopes and Telescopic Work" to a conclusion, Mr. W. F. Denning made a few remarks on the importance and attractions of the subject, the latter being abundantly evidenced by the growing popularity of observation in the diverse fields of astronomy. As regards the future prospects of telescopes and telescopic work, the outlook was intensely encouraging. Several very long telescopes had recently been mounted, among them being the 30in. refractors at Pulkova and Nice, and several more were under construction. The immediate future held out a prospect of successful activity far exceeding that of any past age. The work of the Meteoric Section, conducted by Mr. Denning, included about 150 observations of shooting stars at Stonyhurst, London, Sunderland, Bristol, and Kenley. A comparison of the results obtained at the various stations did not, however, reveal any duplicate observations of one and the same meteor.

The report of the Lunar Section, under the direction of Mr. Elger, included thirty drawings of various formations which have been made by members. The principal work was a careful delineation of Stadius, showing 41 craterlets, or craterpits, in the interior of that formation. The twin craters, Le Verrier and Helicon, and the ring plain Hercules had also been diligently observed and mapped.

The following is a list of the members who have been appointed by the council to serve on the executive. President, Mr. Denning; vice-presidents, Messrs. Elger, Espin, Gore, and Newall; special observer, Mr. Gill; editor, Mr. Sadler; librarian, Mr. Defieux; secretary and treasurer, Mr. Davies. Council: Miss E. Brown and Messrs. Backhouse, Calver, Deane, Gill, Higgs, Lynn, Monck, Oliphant, Tarrant, and Majors Markwick and Watson. The directors of the sections are: Solar, Miss Brown; lunar, Mr. Elger; coloured star, Mr. Franks; double star, Mr. Tarrant; variable star, Mr. Gore; and spectroscopic, Mr. Rand-Capron; Mr. Denning directs the comet seeking, meteoric, and Jupiter sections.

The Secretary announced that the meetings would in future be held at the Royal Institution, Colquit-street. The session was then formally closed.

USEFUL AND SCIENTIFIC NOTES.

Longevity in Germany.—The Berlin *Statistischen Korrespondenz*, by way of celebrating the Emperor of Germany's ninetieth birthday, has recently published a list of all the known persons in the Prussian kingdom who are older than the sovereign. At the taking of the census of Dec. 1st, 1885, there was one man of 120 years, another of 118 years; a woman of 117, another of 115; two women of 112; two men and one woman of 111; five women of 110; one man and four women of 109; three men and two women of 108; two men and ten women of 107; thirteen men and seven women of 106; and quite a large number who had attained to their 105th year. The total number of persons who gave their age at over 100 was 160. The Province of Silesia appears to be exceptionally favourable to longevity. Out of the 1,073 male persons between their ninetieth and ninety-fifth year in all the Prussian provinces one in five is a Silesian, and out of the 306 men between 95 and 100 years old fifty-one are natives of Silesia. Out of the 2,766 Prussian women between the ages of ninety and ninety-five, 371 are Silesians. There are ninety-nine women in Silesia between ninety-five and 100 years old, and thirty Silesian women who have exceeded their 100th year. The centenarians are thickest in the district of Oppeln. They are also numerous in the Provinces of Posen and East Prussia; but the western dominions of the King of Prussia, and particularly the Rhineland and the manufacturing districts of Eberfeld, Crefeld, and the Dutch frontier, are not so favourable to extraordinary length of life.

Artificial Whetstones.—The *Guide Scientifique* describes the following method of making artificial whetstones. Gelatine of good quality is dissolved in its own weight of water, the operation being conducted in a dark room. To the solution 1½ per cent. of bichromate of potash is added, which has previously been dissolved in a little water. A quantity of very fine emery, equal to nine times the weight of the gelatine, is intimately mixed with the gelatine solution. Pulverised flint may be substituted for emery. The mass is moulded into any desired shape, and is then consolidated by heavy Pressure. It is dried by exposure to strong sunlight for several hours.

SCIENTIFIC NEWS.

THE death is announced of the eminent French chemist, M. Joseph-Dieudonné Boussingault. Born in 1802, the deceased was educated at the St. Etienne School of Mines. On leaving there he was commissioned by an English company to go to South America in order to discover the ancient mines which are known to have existed there in past ages. He made a number of researches and discoveries which were warmly appreciated by Baron Humboldt and other learned men; but a revolution having broken out in the Spanish South-American colonies, M. Boussingault was compelled to leave his work. He thoroughly explored Bolivia and the province of Venezuela. When he returned to France he was named Professor of Chemistry to the Lyons Faculty of Sciences. In 1839 he went to Paris, where he was associated with the Academy of Sciences, and also obtained the chair of agriculture in the Conservatoire. In 1848 deceased was elected to the Constituent Assembly by the department of the Bas-Rhin, and he became by election a member of the Council of State, upon which he sat until the *Coup d'Etat* of the 2nd of December. From this time he renounced political life, and devoted himself to his favourite studies, greatly to the advantage of science and industry in France. He was named Commander of the Legion of Honour in 1857, and promoted to the rank of Grand Officer in 1876. Chemistry in its application to agriculture and the raising of cattle owed much to the labours of M. Boussingault. He also, in conjunction with another distinguished chemist, M. Dumas, made many important investigations into the aërial elements. The deceased was the author of a large number of papers on physics and chemistry, and of treatises on "Chemistry and Physiology in Agriculture," "Rural Economy," "Agronomy," and "Studies on the Transformations of Iron and Steel." M. Boussingault was a member of the Institute.

From Dun Echt Circular, No. 144, we learn that Mr. Barnard, Director of the Vanderbilt University Observatory, Nashville, Tennessee, has discovered another faint comet, making the third he has been the first to observe during the present year. On May 12th, the position at 16h. 57m. 22s. G.M.T. was: R.A. 15h. 10m. 49s.; S. Dec. 30° 35′ 30″. The daily motion is plus 88s., 30′ N.

Mr. Peek has published the meteorological observations made at Rousdon Observatory (Lyme Regis, Dorset, is the postal address) during 1886. Rousdon is a second-order station of the Royal Meteorological Society, and the observations are carefully made with the best instruments. Besides the usual records, the present volume contains notes on the geology of Rousdon, and some interesting deep-well observations. It appears that in the courtyard of the house there is an ancient well 207ft. deep. The depth and temperature of the water in this well were ascertained at intervals of 15 days throughout last year, with the result that the temperature varied less than two degrees (1·9°) during the whole year. The mean temperature was 51·7°, and the mean depth 5ft. 7in. Experiments were made on the evaporation from the surface of earth and from water, the apparatus consisting of two precisely similar iron tanks, 2ft. square and 15in. deep, freely exposed to the air, but protected from the rays of the sun. The tank containing the earth was placed on a weighing machine, the earth being ordinary soil, turfed over to represent meadow land. Surplus water could be drawn off and weighed. The water tank was so arranged as to maintain a uniform depth of 12in., and measurements were taken on the first day in each month. The earth tank was weighed daily. The total evaporation for the year was 24·79in. from the earth, and 22·81in. from the water tank, the mean daily evaporation being ·07 for earth, ·06 for water. Mr. Peek gives an illustration of these tanks as arranged.

The Visitation of Greenwich Observatory will take place on the 4th of June.

The Bakerian lecture before the Royal Society will be delivered on the 26th inst. by Mr. J. J. Thomson, F.R.S., Cavendish Professor of Experimental Physics at Cambridge.

The new buildings for the Royal Observatory of Brussels, at Uccle, about four miles from its present position, are nearly complete, and the transfer will be made next year. The site at Uccle is much higher than that at Brussels.

The first annual soirée of the County of Middlesex Natural History and Science Society will be held on Monday next, the 23rd inst., at 11, Chandos-street, Cavendish-square, W., at 8 p.m., the Right Hon. the Earl of Strafford, Lord-Lieutenant of the county and president of the society, in the chair.

A useful pamphlet to students of palæontology has been issued by Mr. E. T. Newton, of the Geological Survey, through Philip and Son. It is a synopsis of the animal kingdom, with especial reference to the fossil forms, and appears as Appendix II. in the new edition of Woodward's "Geology of England and Wales," also published by Philip and Son. The table is founded on the classification proposed by Prof. Huxley, and by variations in the types used in printing, the reader can distinguish at once recent from fossil genera, and amongst the fossils those which occur in the rocks of Britain.

The Government Inspector of the Royal Bavarian Court Theatre, Herr Stehle, thinks the use of luminous paint is a great safeguard against panic in theatres, and he has had inscriptions put up in the passages of that theatre which indicate the "way out." We understand that experiments are to be made at some of the principal London theatres with large-sized tablets, in order to test the effect of the rather poor light of the corridors in exciting the paint. That, it is known to those who have experimented, will be sufficient, but if necessary the notices can be excited in a few minutes by means of a powerful lamp.

An account of an interesting series of experiments in connection with the spectroscopic reaction in gases has been communicated to the Manchester Literary and Philosophical Society, by Mr. T. W. Best, who made them at the suggestion of Sir H. Roscoe. The author mixed the pure and perfectly dry gases in eudiometers provided with aluminium electrodes, which were connected with an induction coil and Leyden jar. The light of the discharge was focussed upon the slit of a one-prism spectroscope. The gases experimented upon were hydrogen, nitrogen, and oxygen; but others will no doubt be examined. When nitrogen is added to hydrogen at ordinary atmospheric pressure, the least quantity of the former element that can be detected is 1·1 per cent. At the same pressure as little as 0·25 per cent. of hydrogen can be detected in nitrogen. This curious difference is also observed with mixtures of nitrogen and oxygen. As little as 0·8 per cent. of nitrogen can be detected in oxygen, whereas not less than 4·5 per cent. of oxygen gives a visible spectrum in nitrogen. At lower pressures the results are somewhat different, the least quantity of nitrogen perceptible in hydrogen being at 10½in. 3·6, and at 3½in. 2·5.

Mr. H. Howorth, M.P., is going to bring out a work entitled "The Mammoth and the Flood," in which he will endeavour to show that a cataclysm brought the Mammoth period to a close, and that this catastrophe involved a widespread flood of water, which not only drowned the animals, but buried them, sometimes with their bodies intact, and in many cases along with a crowd of very incongruous beasts, and covered them with continuous mantles of loam and gravel!

Last year Herr Pichler and Major von Obermeyer gave to the Vienna Academy an account of their experiments in condensing the smoke of furnaces by the electric method developed to some extent in this country by Prof. Oliver J. Lodge and Mr. Walker for depositing lead fumes. The machine used was a Töpler, which proved to be of insufficient power; but Messrs. Siemens and Halske are building a very large induction machine, with which the experiments will be continued.

The Society of Arts has added to its plant an Immisch series-wound electro-motor [illegible] with the field connections so arranged that th [illegible] coils can be coupled in series or parallel. Th [illegible] maximum power is three-brake horse-power [illegible] 950 revolutions, the E.M.F. required being [illegible] volts.

The Baltimore and Ohio Railroad Company has ordered all its passenger rolling-stock to be fitted with the Westinghouse air-brake.

At a recent meeting of the New York Neurological Society two interesting examples of brain surgery were recorded. The first was the case of a man forty-two years of age, who suffered from left lateral hemianopsia, slight dilatation of the left pupil, awkward gait, and double optic neuritis. A large tumour in the right occipital lobe was diagnosed, and Dr. Weir proceeded to remove it. The mass removed weighed 5¼oz., and the operation was attended with very troublesome hæmorrhage, for which the wound was plugged. Unfortunately the bleeding recurred, and the man died from it. The other case was one of unilateral convulsions, followed by paralysis of the left side of the face, then of the left arm, and then of the left leg. A tumour was diagnosed in the right motor area, and the skull was opened and the brain explored with a hypodermic syringe without any result. The patient died, and at the necropsy three cysts were found lying close together in a line deep in the white matter of the right hemisphere.

A chart, showing the recorded positions of icebergs in the North Atlantic, has been issued by the Deutsche Seewarte at Hamburg. As early as the first half of March several icebergs were met with south of 42° N. lat, and one even south of 41°. In drifting southwards the icebergs, as always, are found between the meridians of 46° and 52° W.

USEFUL AND SCIENTIFIC NOTES.

Disinfection v. Deodorisation.—It has often been pointed out in our columns, as elsewhere, that deodorisation is one thing and disinfection another. The destruction of bad smells by no means involves the destruction of "infective agencies," but the destruction of bad smells is also an important work, and one which every disinfectant intended for general use ought to accomplish. Carbolic acid is defective in this respect, for, although a good disinfectant, it does not deodorise, and simply adds its own disagreeable smell to those which existed before. Chlorine, metallic chlorides—such as the chlorides of zinc, mercury, and lead—sulphurous acid, and the alkaline permanganates are far more effectual in this respect, and each possesses in a greater or less degree the power of disinfection. Whilst the "saucer" treatment of sick-rooms with a little Condy's fluid or chloride of lime may well be distrusted, the laudation of such means as the use of euchlorine (a mixture of chlorine and chlorine peroxide) and bromine as aërial disinfectants cannot be commended. Sulphurous acid is sometimes underrated. As gas it is just as unsuitable in the presence of patients as bromine or euchlorine, but in dilute solution it is very active. Complete disinfection of an infected atmosphere in the presence of patients is impossible, but partial disinfection is easy, and the complete disinfection of wearing apparel, bedding, &c., by the prolonged use of weak solutions of metallic chlorides, sulphurous acid, and the like, can be readily effected without the slightest injury to the fabrics.—*Lancet.*

A New Battery Solution.—The *Electrical World* states that Mr. William R. Kookogey has recently devised a method of removing the base of the chromic salt in the form of crystals, leaving the chromium in the solution. This is accomplished by adding boiling water to a certain proportion of bichromate of potash or bichromate of lime, and while the mixture is still at or near the boiling point adding sulphuric acid. The exact proportions are as follows:—To 8oz. of bichromate of potash or 9oz. of bichromate of lime, 2¼lb. of boiling water are added. To this is added 3½lb. (avoirdupois) of sulphuric acid of a specific gravity of 1·835. The solution so made is allowed to cool and to remain standing for about 24 hours at a temperature of from 60° to 68° Fahrenheit. The liquid is then siphoned off, and is ready for use. The base or sulphate of the base will be found deposited on the bottom of the vessel.

Freezing Mixture.—A liquid invented by Raoul Pictet, of Geneva, Switzerland, for use as a disinfectant, answers well as a freezing mixture for hardening microscope specimens. Sulphur dioxide and carbon dioxide, having been mixed and cooled, are compressed until they are liquid, and stored in siphons. When liberated, they rapidly evaporate with great reduction of temperature. By this means mercury may be frozen, and animal or vegetable tissues rendered solid in a few seconds. It is as easily managed and more effective than ether, the odour being the principal objection.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

ERRATUM — REGULUS AND SIGMA ORIONIS—EXPOSURE OF AN OBJECT-GLASS TO DAMP—RHUBARB—GEOLOGY OF THE SUFFOLK COAST—DIOPTRIC TELESCOPE—SUNSPOTS—PROJECTING THE SUN'S IMAGE TO DETERMINE PERSONAL EQUATION—PROFESSOR ABBE ON SUNSPOTS—PHOTOGRAPHIC MEASUREMENT OF STELLAR PARALLAX—A CORRESPONDENT WHO CANNOT LET WELL ALONE — LUNAR CLEFTS — HUYGHENIAN EYEPIECES FOR A 33in. OBJECT-GLASS—A BAD OBJECTIVE—TRIGONOMETRY—APLANATIC EYEPIECE.

[27268.]—IN letter 27196, p. 219, paragraph three, "In it Suidas" should be "It is Suidas."

I cannot help thinking that the "tiny companion" to Regulus, spoken of by "Arcturus," in query 62340 (p. 231) must be a subjective phenomenon, and have its origin either in his eye or in the eyepiece of his telescope, as I have not only never seen it myself, but can find no record whatever of its having been observed by anybody else. Surely, had it an objective existence, it must have been picked up in some of the numerous reflectors of considerable aperture now so common. I suspect that the faint and close pair in the same field as σ Orionis are Ward's pair, spoken of by Webb on p. 359 of the last (fourth) edition of "Celestial Objects for Common Telescopes." Finally, it is *not* wise to leave a telescope out in a yard in all weathers, and very notably if that yard happens to be in a town, as the sulphuretted hydrogen in the atmosphere and the damp combined will almost certainly attack the lead in the flint lens of his objective and spoil it.

If "Hamlet" (query 62349, p. 231) is afraid of getting renal calculus from eating rhubarb, it matters little or nothing upon what particular soil it grows, as *all* rhubarb contains crystals of oxalate of lime (technically called Raphides), and very beautiful these stellate crystals are under the microscope. Perhaps when I tell him that the same salt is found in onions he will eschew them, too.

In reply to query 62371 (p. 232), the cliffs of the Suffolk coast to the south of Lowestoft are mainly Pliocene (crag). Here is Dr. Taylor's description of the section at Kessingland, some four miles south of that town: "First at Kessingland," he says, "there is the fresh-water Unio-bed similar to that at Mundesley and Runton. Above this is the Fluvio-marine crag, resembling the Norwich lower crag. This is rare; but it has been exposed near Easton Bavent and at Kessingland. Next occurs the Marine crag: then the pebbly beds indicate the increasing depth of the sea; above this the lower Boulder clay with scratched boulders, chiefly granitic and trap rocks; next the middle Drift beds are found to yield several molluscs peculiar to them, which have been noticed by Mr. Searles Wood. The upper boulder clay is well displayed wherever the cliffs attain a certain height. This contains oolitic boulders principally, and abounds with the derivative vertebræ of saurians and fish," &c. Doubtless "Old Fossil's" ammonites and belemnites are derivative too, and were washed out of the subjacent chalk, when the beds he describes were in the course of deposition. There is a bed beneath the Norwich crag in which the tooth of the mastodon has been found.

I would refer "Dioptric" (query 62372, p. 232) to the antepenultimate paragraph of letter 27196, on p. 219 of the same number. It would be an utter waste of money to attempt to convert such a telescope as he describes into an astronomical one. I, myself, have a beautiful terrestrial telescope of 1⅝in. aperture, by Baker, of Holborn, giving a measured linear magnifying power of 24, with the usual 4-lens eyepiece, and this shows spots on the sun, some of the most conspicuous lunar detail, Jupiter's moons and (to anyone who knows precisely what to look for) Saturn's ring, and yet I would never dream of going to the cost of a Huyghenian eyepiece for it. A 2¼in. object-glass is the very smallest that can be employed in the slightest degree usefully in celestial observation, and a 3in. is none too small for the veriest beginner.

Writing about sunspots in the paragraph above suggests to me to remark on the recent almost sudden reappearance of somewhat conspicuous isolated spots at intervals on the sun's disc, after the very protracted period of quiescence which we have for some months witnessed. It is noteworthy that the last maximum occurred more than thirteen years and a half after the previous one. I have not heard yet how far the eleven-year magnetic period, auroræ, storms, cyclones, commercial panics, and the rest of the stock-in-trade of the sunspot-monger, have condescended to conform to this very flagrant departure from the regularity of the solar period with which they have been alleged to be coincident.

In the current number of the *Observatory*, there is a précis of a paper by Professor di Legge, read before the R.A. dei Lincei, in which he discusses the mean horizontal semi-diameter of the Sun as deduced from 5796 transits by four observers in 2,218 days during the years 1874-83 at Campidoglio. He finds it to be 961·188″ at the Earth's mean distance from the Sun, a quantity 0·632″ in defect of the value adopted in the *Nautical Almanac*, but only ·062″ less than that determined by Mr. Thackeray (R.A.S. *Monthly Notices*, Vol. XLV. page 392), from a discussion of all the observations made with the Transit Circle at the Royal Observatory. My reason, however, for noticing Prof. di Legge's paper here is that he states that since May, 1876, the Sun's transit has been observed by projection, thus enabling several persons, if necessary, to observe it simultaneously and under identical conditions, thereby affording exceptionally favourable opportunities for the determination of personal equation. I commend this excellent idea to all whom it may concern.

I was very glad to find Professor Abbe's effective onslaught on Sunspottery reproduced in your own interesting article on "Popular Meteorology," on p. 235, because it disposes of the whole question as tersely as it does convincingly. We know in this country how this matter was "worked" by certain members of the "Endowment of Research" clique as a scarcely-veiled means of providing a billet for one of their own personal friends; but it may, of course, be that a more disinterested belief in sunspottery may still linger among a few people in out-of-the-way parts of America. To such, Professor Abbe's lecture can scarcely fail to be of the greatest value.

I must confess that the discussion which took place at the January meeting of the Royal Astronomical Society (Vol. XLIV. page 449) considerably shook my faith in the rigid accuracy of the results obtained at Oxford in the investigation of the parallax of 61 Cygni, carried on there by photographing that star, and measuring its displacement, as indicated on plates taken at distant intervals. I, however, happen to have recently seen the original negatives, and to have had an opportunity of personally examining them *in situ* on the De la Rue micrometer; with the result that I am convinced that Professor Pritchard's method affords results superior in accuracy to any obtainable by mere eye observation. Expecting to find star discs ill-defined and granular, with a variety of axes, I was surprised to find how sensibly circular they are, and how much easier to bisect than the image of a real star in the heavens, dancing and bobbing about on each side of the wire. Of course, over-exposure will enlarge, and to a certain extent distort, star discs; but experience has taught the photographic operator to expose just so long as is necessary to impress the star image fairly on the plate. That this system of determining stellar parallax has not yet arrived at perfection may be freely granted, but I gravely question if, even in its existing stage, it does not notably surpass the older eye method in accuracy, and I certainly think that we have reason to be grateful to those who initiated it and have brought it so far towards the goal.

I really do not know what "Dubitans" (letter 27233, p. 241) considers "very vague authority." Sir John Herschel makes his statement on that of the "celebrated optician" (presumably either Dollond or Troughton) who had his attention originally drawn to astronomy by the sight of a bright star in sunlight visible through the shaft of a chimney. It is quite evident that Sir John did not regard this definite and explicit statement as "vague," or he would never have continued to repeat it in every edition of his famous book that was published up to the date of his death. Of course, as a personal statement to him is characterised in the language employed by your correspondent, the miner who told his story to

"Medicus" (letter 27282, same page) would be out of court altogether.

"Tau" (reply 62181, p. 251) might profitably employ ten minutes in the calculation of the size and mass of a meteorite which could plough a cleft a mile wide and 300 miles long on the lunar surface. Proctor's exact words in connection with lunar craters are these: "It may seem, indeed, at a first view too wild and fanciful an idea to suggest that the multitudinous craters on the moon, and especially the smaller craters . . . . have been caused by the plash of meteoric rains, *and I certainly should not care to maintain that as the theory of their origin*" (the italics are mine).

If "Rex" (query 62381, p. 256) will get two plano-convex lenses of ·55in. and ·18in. focus and mount them ·36in. apart with the ·55in. lens as a field glass and the ·18in. as an eyeglass (the convex sides being, of course, towards the object end of his telescope), he will have an eyepiece giving very approximately a power of 120 with a 33in. object-glass; and, similarly, two lenses of the respective foci of ·44in. and ·15in. mounted ·3in. apart will give him a power very near to 150. The 1½in. and ½in. lenses should be mounted 1in. apart and will magnify a little over 42 with his objective. It is almost needless to add that in each case a stop must be placed in the focus of the eye-lens.

"Forest Gate" (query 62383, p. 256) has got hold of a hopelessly bad bargain. A hazy fringe of light round the moon or a planet, is a sign of a radically defective object-glass, upon which any money would be wasted.

I answer query 62390 (p. 256) with a certain amount of hesitation, as it looks suspiciously like a question set in a cram examination; but supposing that "Logs." really has made the measures he refers to for his own information, their reduction is as simple as possible. He has, to begin with, B A C = 76° 30′ and A B C = 46° 5′; hence, A C B = 57° 25′. Then we say as sin. 57° 25′ : sin. 46° 5′ : : 1,000 : length of A C. In like manner we get B C, A D, and B D. Then, in either of the triangles C A D or C B D, we have two sides and the included angle, whence C D is derivable at once.

I am sorry to be obliged to tell "Another Corona" (query 62400, p. 257) that I have no work in my library treating on the theory of the aplanatic eyepiece, and that, hence, I should have to investigate it *de novo*, and deduce my own formulæ from which to calculate numerical results—a very charming little job indeed, which I must beg to be excused. Quite possibly "Prismatique" or some other one of our practical opticians may have tables ready computed from which he can supply the required practical detail.

A Fellow of the Royal Astronomical Society.

♅ 37^{4} DRACONIS.

[27269.]—Mr. Tarrant has been kind enough to send me a note privately upon this object; but as he promises to send one to you, Mr. Editor, himself, I will not further refer to his observations than to say he agrees with me the star is not now in the centre of the nebula, and he sees detail in the nebula itself which so far I have been unable to pick up. I have also some notes from a friend who observes with a 12½in., who also finds the star away from centre, but with a little difference as to exact place. He has referred me to several previous notes upon ♅ 37^{4} in former numbers of "E.M." (Sept. 3, 1886). Prof. Swift often observed nebula with 16in.—*central* star *always well seen*; and Mitchell, in 1847, saw it: "Eye fixed on *central* point, nebula *fades from view*; looking aslant, the star fades and nebula brightens in a beautiful manner; unlike a star, as it is round and clear—a minute disc; no radiancy." And Mr. Knott (Oct. 8, 1886) saw it, "bluish and elliptic in outline, 4—5 major axes at 45° × 225°, and star a minute disc, nearly in centre, perhaps a little *n.f.*" I have not been able to reproduce the fading and brightening phenomena, and should think it attributable to some peculiarity of eye. The nebula always remains plainly visible to me. The star is always a minute point. Its magnitude is so small that I doubt if diffraction rings would be perceptible on a *dark* sky with 9in., and therefore are still less likely upon a luminous background.

I got a pretty good observation of it upon May 8, when, with 600, the stellar point was sharp, and, to the best of my judgment, directly preceding the centre of nebulosity, and about halfway from centre to margin. The moon was bright at the time, and may have influenced perception of margin of the nebula to some extent.

Formerly, when using a lower power, I could only occasionally pick up this star, and find the same now; but I have latterly always used a power of 600, and can nearly always see the star point with this.

Mr. Sadler has a very valuable summary of all the observations he could find, in "E. M.," Aug. 6, 1886. Any reader interested can refer to that. The evidence is conclusive of the star point or nucleus being central; the language not admitting of misconception. "O Σ" says: "Nucleus occupies *exactly* the centre"; Budd, "very near centre"; Knott, "star not quite, but nearly, in centre"; D'Arrest, "star in centre"; Schweizer, "small star in centre, consequently the pointages of the micrometer wire are precise"; D'Arrest again, in 1886, "a white star in the centre"; Brunnow, "has in the centre a well-defined point"; Bredichin, "has a small star in the centre"; Sadler, "star in centre." It is certain that the star is *not now in centre and not n.f.*, as Mr. Knott saw it. The question arises, whether the nebula or the star has moved.

I had some suspicion of a small star following at about 80″ or 90″, and I also suspect other stellar points in the nebula. This, Schultz also did (see Mr. Sadler's summary).

I found a small *comes* to Σ 2368 a week or two ago, which Mr. Tarrant measures 131·7°, 48·21″, mag. 11; but Mr. T. adds a still fainter star a little nearer at 320.°

Edwin Holmes.

NOVA ORIONIS.

[27270.]—With reference to Mr. Gemmill's suggestion (letter 27231, p. 241), I may mention that I have already entered the "Nova" as U Orionis in my forthcoming "Revised Catalogue of known Variable Stars."

May 14th. **J. E. Gore.**

ASTRONOMICAL.

[27271.]—Permettez moi d'informer au plus vite les lecteurs de l' "E. M.," qui s'occupent tant de Saturne, d'un changement remarquable que je crois avoir observé dans l'anneau B le 8 mai dernier, à 8h. 30m. du soir, avec le grossissement de 280 fois de mon équatorial de 8 pouces de Grubb. En décembre 1886, janvier et février 1887, l'anneau B était très sombre à l'interieur, dans les régions voisines de C, et c'était seulement à son extérieur, près de la division Cassinienne, qu'il prèsentait un grand éclat. *Le 8 mai j'ai vu, avec surprise, que ce grand éclat occupait presque toute la largeur de B; c'est à peine si, contre C, on voyait encore une région un peu plus sombre!* Ce même jour la division de Struve apparaissait encore d'une manière fort remarquable, surtout à l'occident, et je voyais cette fois distinctement qu' à son extérieur régne une fine portion de l'anneau C, la division apparaissant donc dans C et non aux confins de B et C.

La division d'Encke se voyait encore très bien sur l'anse orientale, et je n'avais pas encore aussi bien vu que ce jour là le globe à travers l'anneau obscur. Malgré l'éloignement de la planète je voyais encore toutes les bandes du globe figurées dans mon dessin de l' "E. M." et aussi la dentelure de l'ombre sur la division Cassinienne, mais plus petite qu'auparavant; l'ombre semblait cette fois légèrement convexe et concentrique au bord du globe. Je suis bien heureux de vois que je suis si bien d'accord avec M. Elger pour nos observations de Saturne.

P.S.—Hier, 10 mai, à 9h., avec le grossissement de 280 fois de mon équatorial de Grubb, par un ciel légèrement nébuleux, j'ai vu la tache rouge de Jupiter sous forme d'un nuage blanc, ovale, entouré d'une bordure grise elliptique moins marquée à l'ouest; l'extrémité orientale est passée au méridien central vers 9h., t.m. de Bruxelles. A 8h. 30m., j'ai confirmé le changement que je vous ai signalé dans l'anneau B de Saturne.

Dr. F. Terby, F.R.A.S., A.L.A.S.

Louvain, 11 mai.

STARS VISIBLE IN DAYLIGHT.

[27272.]—With a clear sky above, I looked up this morning through a shaft over 100ft. high, and failed to discern a single star. On the other hand, Mr. Mist, chairman of the Queenborough School Board, tells me that he has repeatedly seen stars in the daytime from the bottom of Sandwell Park coal pit, West Bromwich, the depth of which is either 450 or 550 yards. The greater depth will probably account for the different result.

Sheerness-on-Sea. **W. H. Shrubsole.**

A CURE FOR RHEUMATISM.

[27273.]—Let all of "ours" know the following. My wife has suffered occasionally with acute rheumatism in her feet, with painful swelling, completely taking her off her feet for many days at a time.

The following remedy was recommended last Saturday and tried, and took away the agonising pain in less than 15 minutes, and she can now walk very fairly; and in a couple of days she will be able to button her boots, and walk without a stick or crutch.

One quart of milk, quite hot, into which stir 1oz. of alum; this makes curds and whey. Bathe the part affected with the whey until too cold. In the mean time keep the curds hot, and after bathing put them on as a poultice, wrap in flannel, and—go to sleep (you can). Three applications should be a perfect cure, even in aggravated cases.

I wish all sufferers who find ease and
from any remedy recommended would impa
experience to other sufferers.

Vauxhall. **J. G. B**

SCIENCE AND THE SUPERNATU

[27274.]—"Sigma's" letter (27260) on
and the supernatural contains much I
agree with; but omits just one "concep
nature" which appears, at least to me, su
the one so well expressed by Pope, that
ever is, is good." Necessity compels me
ceive in Nature three qualities—the good,
or evil, and the indifferent. The observe
of phenomena, or the law of cause and effe
to explain to me their common source from
supreme and universal cause. This othe
ception of Nature" I find most ably explai
Haeckel in his "Pedigree of Man," page
follows:

"For if our uniform or monistic concep
Nature is rightly founded, all living matt
soul, and that most wondrous of all natur
nomena that we usually designate by th
spirit or soul is a general property of all
things. Far other than believing in a crud
less material, after the manner of our adve
we must rather suppose that the primal e
of soul-life, the simplest forms of sens
pleasure, pain, the simple forms of mot
traction and repulsion, are in all living ma
all protoplasm. But the grades of the upb
and composition of this soul vary in d
living beings, and lead us gradually upwar
the quiescent cell-soul through a long s
ascending steps to the conscious and ratio
of man."

Further on Haeckel says: "And if a
is poetic and accurate alike in the highest
assuredly it is the beautiful thought that
smallest worms and in the most minute
thousands of indivividual delicate souls are
that in every microscopic unicellular inf
a special soul is busy, even as in the bl
puscles ceaselessly travelling in our veins, o
brain-cells, that rise to the highest of a
functions—clear consciousness. From thi
of view we see, in the study of soul-ce
greatest step yet made towards the recon
of the ideal and the real contemplation of
the old and the new conception of the univ

By this theory, "spirit or soul" is repr
as an immortal, ever-present force in the a
all living matter, manifesting its existence
phenomena of life in its infinite variety, ac
to their simple or more complex combinati

F. V

THEORY OF PERIODIC INUNDAT

[27275.]—Most scientific people assert t
place of the perihelion of a planet's or
little or no connection with its well-being.
is true, this theory can have no claim to co
tion; but, if in reference to our own plane
be shown the passage of the perihelion o
Equator does produce, or is the primary c
vast changes on its surface, it must then b
as an event of most vital consequence.

If we can admit that the sun has a
orbit in space, and completes his circuit
period that is allotted to a revolution
apsides, we have not only the same agree
the mean motion of our planet's nodes, bu
"very different idea" respecting the cause
recession of the equinoxes;—we can admit
more readily from the fact that the vernal e
having a fixed relation to the sun, and mo
earth with it, seems a proof of the solar or
may, on account of our globe *not* keeping
relation to the sun, cause the earth's n
recede in proportion as the Ecliptic is
round the central point of the solar orbi
this orbital motion of the sun would acc
perturbations in the other members of the

Were this true that the apsides perfo
circuit of the Ecliptic during the period of
orbital revolution, we should be prepared t
that the angle of obliquity of the Eclipt
uniform decrease (or motion) extending
all ages, and that there was a time in the
past when the axis of the earth coincid
the Ecliptic, while the Equator was perpe
to it, which would be at a period of 482,6
ago, or 18½ revolutions of the apsides.

If we accept the geological teaching, that
ing the primary formation of the earth's cru
succeeding formation, where undisturbed
canic action, is the result of ages of depo
oceans—necessarily of great depth—and e
cessive deposit, by its totally different n
regard to its materials and fossils, showi
stage to be the result of submersion by a d
ocean, the idea can hardly be conside
travagant that points to these subm
occurring at fixed times, and regulate
natural law. Since thirteen submerge
least are distinctly marked by the vario

earth's crust, we may for the sake of assum- date suppose the process of cooling to have sufficiently advanced, and an ocean formed, period equivalent to 13½ revolutions of the es and perihelion, or 348,178 years ago. The ern hemisphere would then be submerged, s then probably the then obliquity of the tic would be 77°, the force of the perihelion's a would be very great; and as, at the same , the minor axis of the earth's orbit would be st at its shortest dimensions, the heat would be excessive.

e first passage of the perihelion over the ator, with the attendant inundation of the hern hemisphere, would occur when the helion entered Libra 6,448 years after this med date, and recur at intervals of 12,895 s to each hemisphere in alternation, as the helion entered the Equatorial signs. As the h's orbit became more circular, and the quity of the Ecliptic decreased, the effects of perihelion force would diminish in proportion, ould also the intensity of the earth's heat, so there may be a time in the distant future n this inundating force will have lost its er.

, then, for a starting point, we commence from primary rocks, we have this succession for each lution.

The Metamorphic series: Mica, slate, schist, s.

The Cambrian group: First fossiliferous ation.

The Silurian groups: Marine fossils and

nd 5. The Carboniferous group: Limestones, millstone grit, plants, trees, fresh and salt r fossils, and the Devonian groups.

The Oolites, Lias, and Triassic groups: Period ptiles.

The Wealden and Purbeck: Fresh and salt r formations.

The Chalk, Marls, Greensands, and Gault: ne fossils.

The Upper Chalk with, and Lower Chalk out, Flints: Marine fossils.

The Eocene formation: Plastic and London tropical fossils, pachydermata, mammalia, and s.

The Miocene and Older Pliocene: Red and line crag, Norfolk crag, tapirs, mastodon, oceros, and megatherium.

Newer Pliocene: Recent and post-pliocene, ge and increase of shells, ruminata of the nt time, mammalia, and possibly man.

. Alluvium, and the Till and Boulder forma- s: This last passage of the perihelion through a would occur 7,220 years ago, and 5,670 s hence it will pass through Aries, carrying it a submerging ocean into the northern isphere.

s the disturbing influences must continue until perihelion has attained, or exceeded, the middle nation in either hemisphere, it would have red the sign Scorpio, after the last inunda- , before the Antediluvians, who had survived aking refuge on hills and mountains, where bers must have perished for lack of sustenance, d descend and seek a resting-place elsewhere wer lands that had become dry, or where they d find rivers and plains which their long suffer- on the mountains would make them eager to .

would appear more than an ordinary coinci- e that the place of the perihelion 4,930 years was in 2° Scorpio.

his theory would account for the presence of bitants in Polynesia, Australia, and other s of the world; for the different races of man; probably point to the origin of cannibalism.

R. T. Metcalfe.

E THERE PERIODIC INUNDATIONS?

7276.]—MR. R. T. METCALFE, p. 248, has got of the book of M. Adhémar, a few years ago, ving an astrological fancy of the ancients, ent before anything was known of gravitation the orbits of comets. It is true that geology s almost all our lands to have been sea, "not or twice, but many times, and for long ds." But it gives not the least ground for osing more of the Northern Hemisphere, or of the Southern, submerged at any one time at present. Some countries, as Auvergne and h of Scotland, seem never to have been sea, but ys land since the inconceivably remote age of first emergence, before the oldest fossiliferous became rock. But, though never "sub- ged," they were certainly deluged as lately as 50 uries ago, as were all lands yet examined that not younger than that period. To be deluged water from heaven is one thing, but to be sub- ged is quite another. Neither is there the least gical trace of regular or "periodic" changes, gh abundant evidence of many quick and strophic ones, even as world-wide as this latest, more violent. As far as can be gathered from thickness of strata, the intervals of such catastrophes were utterly irregular, and never so short as the 12 or 13 thousand years that the perihelion remains in Northern or in Southern Signs. But, in fact, not a shadow of reason has ever been suggested why the moving of perihelion from one season to another, or from the southern hemisphere's winter to ours, should alter the distribution of land at all; far less, why, if changing it all, it should do so suddenly, or with any cataclysm. The quantities of ice permanent in each hemisphere it does and must alter. Far more now remains unthawed about the South Pole than about the North; and of the two polar circles, the north alone can contain an acre of land habitable, whereas 6,000 years ago, or 5,000 hence, the reverse would be true. But there was just as much ground for Zadkiel's or any astrologer's rules as for these "periodic inundations."

E. L. G.

[27277.]—IN regard to the assumption of a submergence of the Northern Hemisphere by the waters of a flood about 5,000 years ago, as mentioned by Mr. R. T. Metcalfe in his letter on p. 248, I hardly expect he will get much attention paid to his theory by the modern British geologists, as they seem to be fully taken up with the "Fluviate and tranquil alluvial deposit theory," and have no room for such a thing as a deluge. On the other hand, Mr. Metcalfe will find some substantial support in the writings of such able American geologists as Sir J. W. Dawson, Dr. Andrews, and Dr. Southall; and that there is room for a quiet and steady study of the subject is evidenced by the statement of Sir C. Lyell, in the tenth edition of his "Principles," that the Glacial Period came to an end in Europe 800,000 years ago; and in the last edition of that same great work the time is reduced to 200,000 years. On the other hand, Dr. Southall considers it came to an end between 5,000 and 6,000 years ago (a mighty difference) by the waters of a deluge, and Sir J. W. Dawson writes of that flood as the "great Flood of the Quatenary"; while Dr. Andrews, in the conclusions he came to from his study of the raised beaches of Lake Michigan, gives the date of between 5,000 to 7,000 years as the lapse of time since North America rose out of the waters of the Glacial Period, and to a certain extent also fixes the human period, for none of these Americans seem to think much of that other theory—"Palæolithic Man"; in fact, Dr. Southall says plainly enough that he does not believe such a being ever existed, so that with such a very great difference of opinion amongst the authorities, we humble students must be content to use the light of common-sense observation as far as possible; and I must say, from my own experience in putting the fluviate theory to the test in South Devon, it has been a miserable failure.

Dens.

DIVISIONS OF HUMAN NATURE.

[27278.]—DR. WILLIAM HITCHMAN, founder and president of the Liverpool Anthropological Society, recently gave a popular lecture on the "Divisions of Human Nature" at the New Brighton Palace, during a public visit to that cabinet of curiosities, of a remarkable specimen of monkey life, savagedom, and human development, known as Krao, or the genuine missing link, at whose *séances* hundreds of medical and scientific men attended. In the course of his address the lecturer observed:—"As regards the probable origin of the human race, it seems to me that a different series of laws, or forces, has operated in various unhistoric times and places, by virtue of which spiritual attributes have been infused. How else are we to account for the existence of several highly-educated and religious peoples in the veriest twilight of historic dawn? Men who had a very elaborate language and grammar were scientific astronomers, understood ship-building, the use of printing, knowledge of stereotyping, drawing, engraving upon hard stones, the skilful employment of magnifying glasses, and the refined arts of civilisation, together with the many benefits of trade and commerce? Moreover, who were the clever mariners that, *inter alia*, taught the Babylonians so much about the planets and the constellations, in reference to the science or art of sailing ships throughout the world, not to mention hints significant of aërial and inland navigation? Yes; the art, if not the act, of passing through the air, as well as inland lakes and rivers. It is not irrational to suppose there is an ancestral tree to the top of which no apes have climbed, or that the enlightened dwellers on the Tigris and Euphrates were emigrants from some more distant Eastern country, now, perhaps, submerged, if not lost for ever? Aryans, Indo-Germanic tribes, Shemitic people, Assyrians, Chaldeans, Jews, Phœnicians, and other kinds or varieties of our race may have resembled the highly-educated and spiritualised men in feature and figure generally, without speaking or writing a language related in origin or allied by blood. Again, there are several objections to the Darwinian theory of man's origin, which do not exist or apply to the hypothesis known as the Derivative, or one obtained from another."

Having introduced illustrations from the analogy of bones and other structures as showing conclusively how certain necessary changes of form would produce uselessness of limb, and consequent starvation in the battle and struggle for life on this planet, the doctor proceeded to state as follows:—"Through climate and circumstances or natural conditions, some divisions or varieties of human nature, no doubt, have been gradually evolved by way of lower animals, rolling through fish, rodent, and monkey, or the anthropoid apes called gibbon, orang, chimpanzee, and gorilla respectively. I do not affirm that man has actually descended from any one of them; but having carefully studied their divers bodily structure as found with mammoth and bear, or in Danish middens, Swiss lake dwellings, and English barrows, their comparative anatomy, in my opinion, teaches fairly enough the doctrine of derivation, and that, in point of fact, some of the anthropoid apes mentioned may be existing offshoots from the same primitive stock whence the modified Krao, as if to link the present with past, has come to us to keep up, so to speak, an old model of a new man! Indeed, the higher man-like apes are well adapted by their peculiar structure for a climbing life among those trees whose branches they grasp, to-day as in former ages, with kindred feet and hands. Apes, therefore, you will perceive, present us with intermediate stages between quadruped and biped. The gibbon, for example, will go along on its feet, touching the ground with its knuckles, first on one side and then on the other, and will run for a considerable distance with its arms thrown back to keep a perfect balance; whilst the gorilla will rise on its legs erect, and rush forward like a man if about to fight or make an attack. The orang, on the contrary, will rest on his bent fists, and draw his body forward between his long arms, as though mocking a human cripple between his crutches. I have already exhibited to you (as far as the present opportunity admits) some of the chief differences of race: stature, proportions, features, colour, hair, constitution, temperament, types of men and apes, as regards permanence, variation, and mixture, especially noting the skeleton of a man and that of an ape from the Menam-Kong river, or that extensive country of S.E. Asia, which includes Laos, as well as the lord of white elephants, and even Krao herself, in which the bony structure of each body corresponds almost exactly; but, as a rule, the Australian skull is prognathous, or muzzle-like, similar to the African, whilst the European is orthognathous, or upright-jawed, rather than forward-jawed in the divisions of human nature. Briefly, the narrow cranium of the negro can hardly be mistaken for the broad cranium of the Samoyed (in the extreme north of Europe and Asia), forming one of the four families of the Altaian stock. At the docks in Liverpool you may see to-day large groups of the divisions of human nature, men of races altogether different from any development in this room—skins so dark brown as to be popularly called black, and hair so naturally frizzled as to be fairly termed woolly. There, too, is visible enough the flat nose of the gorilla, or anthropoid ape, wide nostrils, thick protruding lips, and very projecting jaws, the satiny skin (more pleasant far to feel than to smell), as well as yellow jaundice integument, slanting set of the eyes, high cheek-bones, coarse ape-like features, prodigious width of mouth, huge specimens of decayed teeth, long and lopped ears, with and without favourite shells hanging from their noses, or under lips, with a macaw's feather and other ornaments.

"After all, of what use is beauty or knowledge without religion or morality? As an anthropologist of wide scientific correspondence, I may also state that occasionally females as well as males — the Dayaks, of Borneo for instance — have undoubted prolongations of the caudal vertebræ or backbones, and are sometimes exhibited to the public as "women with tails"! But, really, all such wonders—whether ycleped men or monkeys, absolutely pale in the living shining light of Krao, though she is not the "genuine missing link." I have already shown you very admirable female portraits from West Africa, South Africa, North Asia, Japanese, Colorado Indian, North American, and various specimens which are native to the British Isles; yet if you want an introduction to the general study of man and apes, I say, frankly, apply your minds closely to the science of the subject, with Krao as a fine sample of the quality of the whole. There is in such a specimen of anthropology a singular combination (as I will point out) of lower and higher forms, illustrative of well-marked natural chara teristics of monkeys lemurs, chimpanzee, orangutan, and man himself. Here we have an ape's organisation, movements and folds of features, symbolising the pleasures and pains, or loves and hates of every phase of animal and brute life;

whilst, in an instant, the baboon's eyebrows and forehead, or the wrinkling of the monkey, are spiritually transformed, as it were, not only into the brightness of human intelligence, but the beauty and sweetness of a smiling angel! For myself, I conclude by observing, conflicting theories of evolutionists, and those of creationism notwithstanding, that no more can the dawn of humanity be justly predicated, or assumed to have taken place in a Stone Age of barbarism, apedom, and savagery than in a golden epoch of angelic life, spotless virtue, and exalted wisdom, or men born with intelligence; each individual soul being due—in the latter case, probably—to a separate act of spiritual creation or evolution, and therefore endowed with a clear and certain perception of that which exists in the element of pure thought, or the logic of pure being, and the first principles of righteous practice." I think many readers may be interested in the above extracts from Dr. Hitchman's lecture.

A Constant Admirer and Subscriber.

NEW FORM OF WHEATSTONE BRIDGE.

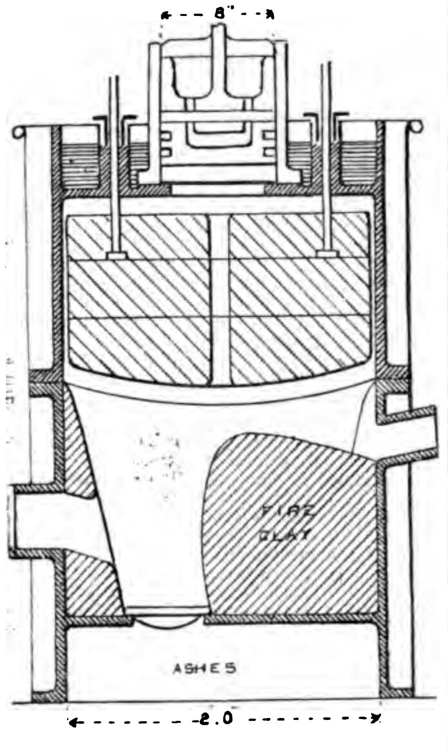
[27279.]—THERE seem to be some good features about this suggestion (letter 27201), more especially on the point of convenience and portability. I do not quite follow the connections, however. How does "A. N. S." vary his resistance on the zigzag wire, and where does he join up his battery wire? These questions may be considered superfluous, but perhaps I am a little dense in these matters.

Teko.

HOT-AIR ENGINE—"SILKE'S" SCREWING DEVICE.

[27280.]—I WAS much pleased to see Mr. Seal's design. The arrangement for moving the displacer without the usual complication I much admired, though I should prefer two ordinary eccentrics to his cams, as I fear the arrangement he shows would soon wear, and then it would rattle. I should like to know whether Mr. Seal has tried a 4½in. cylinder, and found it give as much as half a man; also, whether the cylinders could be lubricated with blacklead or anything not greasy, as the grease in this arrangement would find its way down into the heater.

I think the thin plate over the fire is good, because, if of good iron, it would last some time, and be easily renewed. What is the use of the P with its side holes, and why put a non-conductor at the bottom of cylinder? If you cool the cylinder you may weaken the up-stroke; but you strengthen the down to the same extent.



I think one might expect this engine, with its thin hot plate, to run in two minutes or less from lighting, whilst with a thick cast-iron heater you have to wait 10 to 15 minutes.

I send a sketch to show how I would arrange a 1 or 2 man-power engine. There are two main castings under the cylinder, and a hot plate of about ¼in. Lowmoor plate. There would be a casing round the outside made with hinges, so as to come off in cold weather, and a cover over the water, also made in half. I think such an engine as this ought to be obtainable for £12 to £15.

I read the description of "Silke's" screwing device with much pleasure. I think it would be a little difficult to size the pulleys correctly, owing to the variation caused by the thickness of the cord.

F. A. M.

LOSS OF LIFE AT SEA.

[27281.]—REFERRING to the sad accident to the *Victoria* and other vessels lately, I beg to inclose you a rough sketch of my idea for assuring the safety of travellers by sea. My invention can be made practicable to present vessels, although impeding their speed to a trifling degree; but to vessels built on my plan it would make no difference. The utility of the idea is as follows: Firstly, steamers running on rocks or sand-ban &c., will immediately refloat; secondly, ga caused by collision will be filled up by inflatin one or more air-bags, as circumstances may r quire; thirdly, if a steamer springs a leak, t whole set of air-bags could be brought into ope tion. My invention is simple and inexpensiv and may be summed up in a few words, and i simplicity, I trust, may be a plea for its adoptio To vessels now in use I propose there should affixed small chambers below water-mark to co tain air-bags, the inflation of which will give t vessel such extra buoyancy that it would be i possible for her to sink; but to vessels to be co structed the method is more simple, as the chambers containing the air-bags would be co structed inside them in such a way as not to aff their speed. These bags are inflated by the mea of steam donkey-engines, which are put in operation by an electric current from the captain bridge in time of emergency or danger.

Fredk. G. Helmore.

53, Gloucester-road, Regent's-park, May 6.

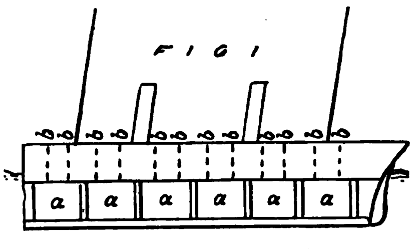


Fig. 1.—*a*, compartments holding air-bags; *b*, chains to deck, attached to top of air-bags.

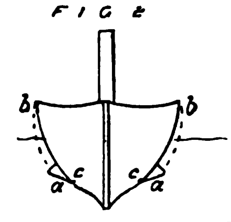


Fig. 2 shows adaptation to existing ships. *a*, compartments holding air-bags; *b*, chains to deck, &c.; *c*, mouth of pipes to let in air into air-bags from main pipe.

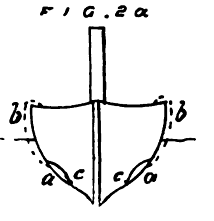


Fig. 2*a* shows adaptation for ships to be built. *a*, compartments holding air-bags; *b*, chains to deck, &c.; *c*, mouth of pipe to let in air into air-bags from main pipe.

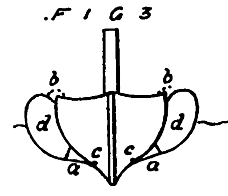


Fig. 3.—For existing ships. *a*, compartments holding air-bags; *b*, chain to deck, &c.; *c*, mouth of pipe to let in air to bags from main pipe; *d*, bag full of air.

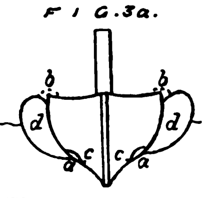


Fig. 3*a*.—For ships to be built. *a*, compartments holding air-bags; *b*, chain to deck, &c.; *c*, mouth of pipe to let in air to bags from main pipe; *d*, air-bags full of air.

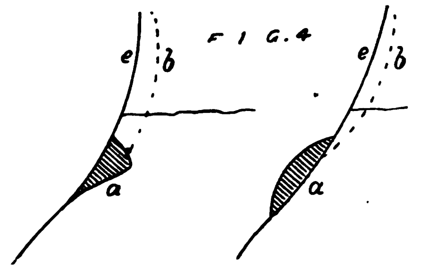


Fig. 4.—*a*, Compartments holding air-bags, outside or inside of vessel; *b*, chain to deck, &c.; *c*, mouth of pipe to let in air into air-bags from main pipes; *e*, side of vessel.

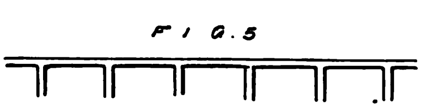
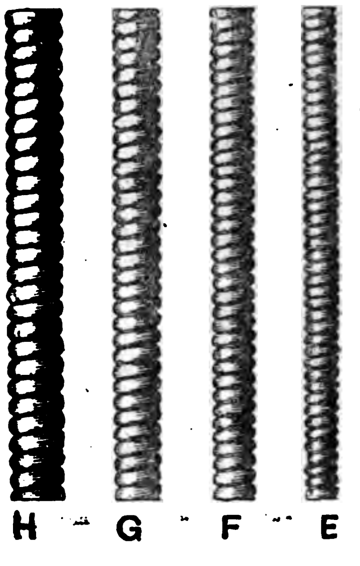


Fig. 5.—*f*, Main pipe for air (steam pump engine) to supply the several air-bag compartments. Main pipes to run down each side of the vessel.

THE "PUNKAH" OR WIND-FAN O INDIA.

[27282.]—FROM Cape Comorin to Peshaw cooling appliances of all kinds hold as high a pl in domestic importance as warming apparatus Europe. The chief and cheapest of the wind-p ducing constructions being a long frame of co bined canvas and wood suspended by ropes fr the ceiling, called a punkah; on the lower edge this is nailed a deep thick flounce of cotton cl to which at night the "old hand" pins a he washing towel, so that during his slumber whisks to and fro in the air within a few inch of his recumbent body, making a breeze and dri ing away the blood-hunting mosquito.



This abominable insect must be interview personally to be properly and feelingly describ Our English midges and summer gnats are few feeble in ferocity and voracity, compared to th flying plagues of the East. Curtains in the co months, punkahs in the hot, are the Anglo-Indi modes of defence, which cannot be combined. course, these ugly, though necessary appendages inhabited rooms, are pulled by manual labour— ever ready coolie; a day set of two or three m and a night set besides, being the requirements a private house; while in the British barracks a hospitals (especially in sickly times), in law cou churches, theatres, and places of assembly, th "punkah-pullers" are hired on monthly wages scores.

Perpetual motion is sadly required in this partment. For the sake of posterity I trust t British India may ere long be blessed with ch reservoirs of compressed air, or simple electr power, or readily-applied mechanical invention do this work, and supersede the oft fat and sle Asiatic manipulator. As might be expected w such crude materials as badly-twisted hemp, cotton cord, or even rattan, break-downs, noctu and diurnal, are frequent catastrophes; the bam tube, or bit of rough iron piping in the wall, rap abrades the above flimsy attachments, perpetu in a state of tension. The startled sleeper fi himself suddenly awakened to a pandemonium darkness, 90 degrees heat, and the sanguinary le of aërial foes! No escape—he must strike a li smoke if he likes, and, dressing himself, proce superintend repairs of fractures—perhaps onl find that knotting will prevent the run of rope—that he has no new spare one in his house; that daylight is some hours' distant, and only after that can he procure the now much-prized article? I know that the readers of our "E. M." muster strong in the Indian Empire, and I am happy to tell them that I have opened a correspondence with the patentees of a newly-introduced metal-covered cord, of various sizes, on the subject of sending a supply to the East. The sample seems to me perfect for the purpose. A twisted hemp line of the best quality is used. It is first soaked in beeswax and stearine, then wound round with a protective covering of smooth, flat copper wire. The price I call very moderate: No. H, the thickest, 12 yards for 12s. 6d.; No. E, the smallest, 12 yards for 5s. For any punkah three yards of the cord will suffice—i.e., only the portion entering the wall and working to and fro in the tube will require this hard material, a hook or ring being attached to each end, after insertion in the tube. Any kind of pulling rope will suffice. My annual outlay, of late years, in a rather large house, for constant breakages of rope and rattan, must have amounted to £1 sterling, or more. **Eos.**

CARDBOARD PLATES FOR THE WIMSHURST MACHINE.

[27283.]—GLASS plates, when properly fixed, will last for an indefinite period with careful usage; but the very fragile nature of the material is a drawback, especially in large machines. Ebonite would be better, if it were not so soon oxidised on the surface; but that and its cost make it practically of less value than glass.

I have been making some experiments lately on a very cheap and common material, to which I wish to draw the attention of those interested in the Wimshurst machine. An 18in. machine, fitted with cardboard discs and 16 sectors, gave exactly the same length of spark as when fitted with glass plates and 12 sectors, all other things being exactly the same. The action appeared to be fully as good in every way.

I use a very firm and stiff board rather more than $\frac{1}{16}$in. thick. This is thoroughly soaked in paraffin and then varnished with shellac, forming a stiff and flat plate, which is a first-rate insulator, and becomes more readily excited by friction than any other material I have tried. Its advantages are evident: it is inexpensive, there is absolutely no danger of breakage, it can be easily fixed to the boss, and as readily removed without injury, while it gives the experimentalist an opportunity of trying variations in the shape, &c., of the discs, which are difficult to carry out in the case of glass. It might also be useful for frictional machines, as the discs may be thickened and strengthened to any required amount by affixing two or more together.

It is not easy to prevent the discs touching in places when working, as the attraction between them draws the edges together. This does the disc very little harm, and does not affect the working, but it increases the friction, and makes more noise than is desirable.

Still, I don't think there is much difficulty in preventing this, and do not look upon it as of any great consequence.

Perhaps others may have tried the same materials, and, if so, I should like to know what their experience has been. **E. E. B.**

SHORT-SIGHT.

[27284.]—TO "Brightonian" (letter 27266). Your far point of distinct vision is probably 19in. In looking at near objects, such as reading a book, it is necessary to converge; convergence is always accompanied by accommodation. You, therefore, did not see the type clearly at 19in.; but, as a result of the accommodation, at 13in. By practice you have accustomed yourself to converge to 19in. without accommodating; you will never, by practising any method, become less short-sighted. Short-sight is not curable, as it is due to physical deformity, the eyeball being too long in its antero-posterior diameter. **E. W. S.**

A DEVICE FOR CUTTING GRAPES.

[27285.]—I SEND a device for cutting grapes which may be of use to some of your readers. I have used it two seasons, and intend doing so again, so I can answer for its being practically useful. Grapes may be cut in the tallest house without a ladder. It is easily made. Drawing shows plan and elevation of the cutting arrangement as fixed on a light pole, *i*. This pole should be about as long as the shortest height of the house; *c* is the stock of wood grooved out to take a spring, *l*; *a* and *b* are pulleys of boxwood, *f* is the cutter forged from a flat file. This covers the groove at one end, and slides between round-head screws; *d* is a block of wood with extension to hold a sort of cam *e*. On top of *d* is screwed a piece of saw blade *g*, sharpened. There is also a fixed screw or stud, *h*, attached to *d*, which slides tightly in the slot of the cutter *f*. A cord is taken from *a*, as [illegible] through a groove in *d* (underneath

FIG 1

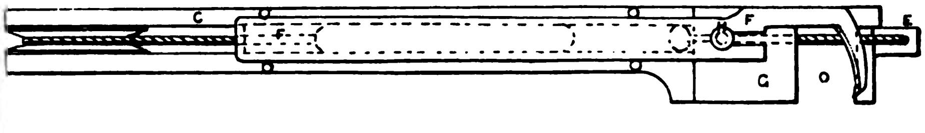
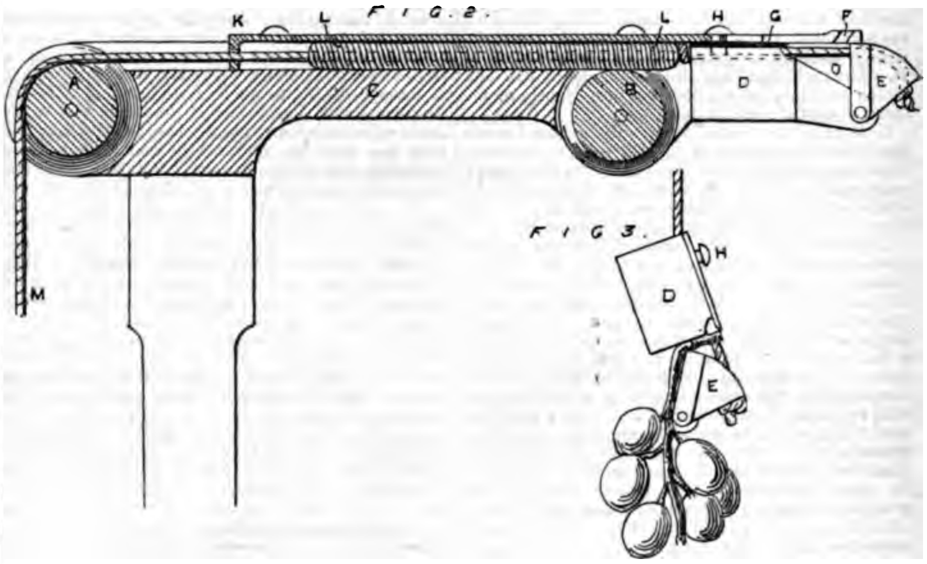


FIG. 2.

FIG 3.



knotted outside *d*, leaving enough cord free for *e* to open as shown; cord then passes through the spring. A knot is then made about 1½in. beyond the spring, and this knot is pushed into the spring, and the spring coiled together to secure the knot. Cord then passes through a hole in *f*, turned down at *k*, thence over pulley *a*, and down to a screw or hole about 2ft. from the bottom end of pole. To set for cutting, *e* is opened as in sketch, and *h* pushed into the slot, the thumb placed at *k* keeping the cutter in place. The opening *o* is brought about a stem and the cord pulled. On releasing cord the bunch descends as shown in Fig. 3. The action is as follows: The first part of the pull closes *e* on the stem; then the spring extends to *k*; then *f* advances on the stem cutting it, at the same time releasing the stud *h*, and with it block *d*. On releasing the cord, block *d* drops, holding the bunch firmly. After taking out the bunch *d* is hoisted, and *h* pushed into the slot, *k* being pressed forward with the thumb the while. It is then ready to cut again. It is handy for a lady, and will reach places where a ladder would be awkward to place. It is advisable to see that all stems are free when thinning out if this cutter is to be used. **Silke.**

HOOK TOOLS.

[27286.]—IN Volume XLII. we had an interesting correspondence on soft-wood turning. From this correspondence it was clear that for hollow turning "hooks" were the proper tools, and King's Cliffe the place to see them work. Several correspondents asked for drawings of these tools, but none were forthcoming. Since then I have had an opportunity of visiting Cliffe and seeing the turners at work. A most picturesque little village it is, and well worth a visit even without the attraction of its turners. One cannot, however, be in King's Cliffe without at least hearing the turners, for the sound of the lathe is in every street.

FIG 1.

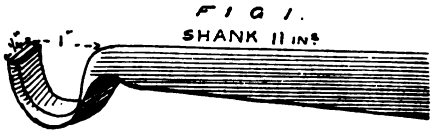
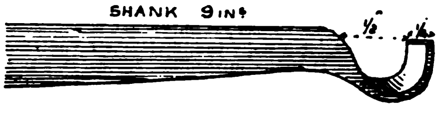


FIG. 2



No difficulty is experienced in seeing the shops—at least, I found the workmen most courteous and willing to show all the details of their work. Having secured a set of hook tools as used there, I have now satisfied myself that to make good work, thin, clean out, and requiring little [illegible]-paper, is not beyond the powers of any amateur possessed of a little patience and an ordinary lathe. Nor is the cutting of a screw on the rebate of a box with cover to fit by any means a difficulty the same amateur cannot overcome after a few trials.

The accompanying sketches are from these tools, and will help anyone who cares to try his hand at tool-making.

A set, as understood at Cliffe, includes another hook, in size between 1 and 2, another like 4, but rather larger and with a slight curve on the blade and a V-tool, the latter stronger than those sold as carver's V-tools. The V-tool is used to cut outside screws, while inside ones are cut with No. 3. The V-tool to be had in the shops, however, answers very well, and No. 3 can be made to suit it. These tools are made from worn files by the turners themselves, and have handles about a foot in length, that of the V-tool having an end like a carpenter's brace. This brace-like end is held against the shoulder to steady the tool when cutting a screw.

FIG. 3

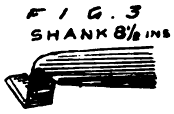
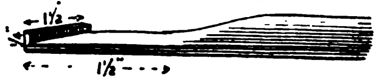
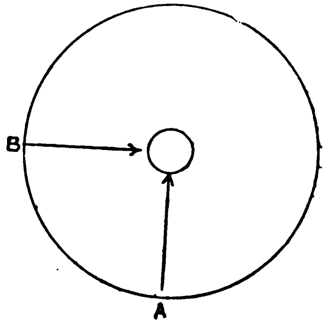


FIG 4.



Hooks are principally used to cut soft wood across the fibre. They cut hard wood, however, equally well—at least, with box they make a beautiful job. With very great care a little may be done in wood used plankwise; but from my own experience I should be inclined to say they were out of their element used so. I shall try to explain how thes

FIG 5



tools are used. Let a piece of plane, birch, or other soft wood be mounted in a cup or on a screw chuck, and the outside finished to the required form; then fix the rest across the face of the work, and with a nose-bit mounted in a handle, drill a hole the depth of the intended hollow. Having made this hole, either with the bit or gouge, fix the rest at least 1in. from the face of the work and slightly below the centre. Having thus arranged matters, grasp the T of the rest and the shank of the tool with the left hand, while with the right hold the handle firmly, pressing it against the right side to steady it. The right hand has thus command of the tool, which you may now allow to bite lightly *at the lower edge of the drilled hole.*

Cutting at this point A, it will be found much less liable to dig in than if held so as to cut at B. This was pointed out in the "E. M." a good many years ago by Mr. F. H. Wenham. I observed the Cliffe workmen took it between A and B, although they could, and did, at my request, cut at B.

Beginners, however, should follow the advice given me by a thorough master of the art—"Keep below the centre, and wet the tool on the back if it feels like digging in." Having taken out with the smaller tools as much as you wish, use the larger one to finish. No. 4 is used on the inside of a box when the bottom is at right angles to the sides. It is somewhat difficult to work, but by lowering the rest and cutting at A, a little practice will overcome the difficulty. Don't have the lathe cord tight, and have the tools as sharp as you can make them. Above all, don't get disgusted with hook tools should the first attempt with them not be quite successful. Try again, changing the position of the tool till you find how it cuts best. A little patience will be amply rewarded, for once mastered, the cutting of a sharp hook tool is simply delightful.

If allowed, I shall have a little to say at some future time on screw-cutting by single point as practised at King's Cliffe. **Copeaux.**

TWO ECLIPSES IN ONE DAY (SUPERNATURAL).

[27287.]—IT seems very largely overlooked that, though but three Gospels tell of the supernatural sun-darkening, their writers have preserved a fourth and most signal testimony to that miracle, in St. Peter's first Christian sermon, on that day seven weeks, to the crowd who had witnessed it. In Acts ii. 20, we have him applying to recent events a prophecy of Joel, and it is plain that turning "the sun into darkness and the moon into blood" were the popular phrases then for natural eclipses of the sun (when total) and of the moon (whether total or not). Now, if the true date of the Crucifixion was, as Sir Isaac Newton, with great diligence, made out, Friday, the 3rd of April, 33 (corresponding to Phlegon's "year 4 of Olympiad 202") the moon was that very evening eclipsed, visibly to Judæa and all surrounding lands. The extraordinary and unparalleled fact that Joel had predicted, and St. Peter told his hearers they had seen, was the eclipsing of both luminaries the *same afternoon* within the same 12 hours! This fact seems really necessary to explain Peter's speech, and though now so strangely forgotten, we find a tradition of it surviving far into the Middle Ages, in the constant practice of painting the Crucifixion between a totally eclipsed sun and partially eclipsed moon. Of course, the veriest rustics knew that the two luminaries, on the day of their opposition, could not be seen at once over the arms of the cross; but the liberty of so bringing them together in one scene (as the prophecies and inspired comment had done in one verse) was most warrantable.

If the event had been 20, or even 10 years later, the silence of Pliny and Seneca would have been strange; but was actually, as I have shown, more probable than their mentioning it. "Memnon" tells us (p. 224), that MSS. quote Phlegon's date two ways: "Some say the 102 Olympiad, others the 202." Now, if so, they can leave no doubt whatever which of *these* he wrote. He could not tell of an earthquake injuring a chief neighbouring city at a date before the said city was so called, or before it professed to have been founded. Turning to Smith's "Dictionary of Greek and Roman Geography," we find two origins ascribed to this Nikæa of Bithynia. One makes the place anciently bear various names; but, "a few years after the death of Alexander the Great (Olymp. 110), Antigonus . . . rebuilt the town, and called it after himself, Antigonia. Not long after, Lysimachus . . . changed the name of Antigonia into Nikæa, in honour of his wife . . . According to another account, Nikæa was founded by men from Nikæa, near Thermopylæ, who had served in the army of Alexander the Great." In any case, you see, there was no place so called in Bithynia to be shaken in Olymp. 102.

But the letters of Mr. Hampden (27192) and Mr. W. J. Grey (27217), infinitely beyond the Darlington doctor's who began this question, are deplorable in their evidence of the two rival quackeries, State-church and Anti-Christian, between which, as two mill-stones, you are ground. Not at all more portentous, indeed, were darkened sun and moon to the last age of Jerusalem, than two such evidences to these last days of quack-ridden (or, rather, devil-ridden) Britain! Mr. Grey has been told that Josephus's paragraph about Christ was "universally" held to be a forgery. (If it were so, by the way, this would be no ground for saying "Josephus never mentioned Christ," since further on he mentions "James, a brother of the Jesus that was called Christ," a clause never disputed). But Mr. Grey's informant is exactly parallel to the source whence Mr. Hampden learnt that Josephus had described the darkness: which was four years before his birth, and the very day that his father had been among those hounding the rabble to cry "Not this man, but Barabbas," and "Away with Him, crucify Him!"

Mr. Grey has further been told that Photius, reading Josephus, remarked that this writer had not a word about Christ, or the miracles, or the apostles of Christ; the simple fact being that this is the remark Photius made on the book of Justus of Tiberias, the rival historian most severely censured by Josephus in his own autobiography! Of course, this accounts for the perishing of the said Justus's book (which nobody since Photius has seen); but it further proves (if any proof were needed) that he found no such omission in the copies of Josephus, or he would have said so. He gave a short abstract of each of Josephus's great works, the "War," and the "Antiquities," and afterwards a longer one of the latter; but as he wrote for Christians in an empire already Christian for five centuries, he only took out those parts of Jewish history that are not Biblical. No European of his time needed from Josephus what they had in their Bibles; and the facts of the mention of Christ and his forerunner and St. James being as notorious then as now, why should he quote them? But as he does not, this "silence" might perhaps be twisted into some such argument, as Mr. Grey has seen, were it not for the above remark on Justus of Tiberias, which would have been repeated on Josephus if that author had been like him.

The ignorance of the two third-century Alexandrians, Clement and Origen, that Josephus had distinctly called Jesus "the Christ" (though they knew, unlike Mr. Grey, that he had written about Him), merely shows that they had read, in the great Alexandrian library, a copy (doubtless by, and for some Jew) that had omitted part or all of the paragraph in Book 18. In fact, the first quoter of that paragraph, and probably the first Christian to know of its existence, was Eusebius, the first Christian who could have access to the imperial library in Rome, and doubtless to the very volumes Josephus had deposited there for his patron two centuries before. To talk of forgeries interpolated in a book that had been two centuries circulated and multiplied by a Roman emperor's command, is about as rational as that a last year's Parliamentery paper is reprinted with forgeries. But small *omissions* are a very different thing from *interpolations*; and Josephus's "Antiquities," consisting, he says, "of 60,000 sentences," was a book far beyond the ability of poor men like the Christian Fathers to hold as property. They could only read it in public libraries. It treats, too, so exclusively of the author's nation, that hardly the richest gentiles can have cared to have copies, and those would be generally by Jewish scribes. The two earliest Christians Mr. Grey mentions (Justin Martyr and Tertullian), quoted only minor pamphlets of Josephus, and Whiston showed that they are not likely to have ever seen his great work. The remaining one, Chrysostom, wrote in a Christian world, when the testimony must have been almost as notorious as when Photius wrote five centuries later.

In his first work, the seven books of the "War," Josephus studiously avoided, evidently with difficulty, all mention of the new religion. In his next and chief, he found it necessary, as soon as introducing Pilate, to describe Jesus (as if Pilate's most important contemporary); and his familiarity with, and belief in, prophecies compelled him to add plainly that "This was the Christ." But though he was to turn ultimately an Ebionite churchman, and die their bishop, he was as yet only what is now called a Unitarian. He held the Messiahship of Jesus, but not His Deity or miraculous birth. He knew of this doctrine (probably had read St. Luke); and resolved, without mentioning it, to aim a blow at it. So, immediately on telling that the Christians "are not yet extinct," he awkwardly drags in, for the only time in all his writings, an indecent story, and one utterly foreign to his nation's religion or polity. About this time, he says, other calamities befell the Jews, and a scandalous enormity was committed in the worship of Isis at Rome. "I will first describe this disgrace to the Temple of Isis, and then return to Jewish affairs." The story of Paulina, that follows, has not the remotest reference to anything Jewish; but he thought it so closely bearing on Christ and Christians, that it must be pitchforked in here anyhow! It was to show how easily some supposed virgin's son might come to be accounted divine, not only if born in such a land as Judæa, in Augustus's reign, but even if a whole generation later, and in the very centre of civilisation! This was the sole conceivable object of that foul story of Paulina; and if there were copies wherein Jewish scribes had suppressed the preceding paragraph, this longer one, the principal one of the chapter, must have seemed nonsensical in its irrelevance to anything in the whole work, or in any of Josephus's works.

Nobody has suggested this story of Paulina is not by Josephus. Of all places, then, that the "pious forgers" could find for inserting their Christian bit, why should they choose *this* forsooth, just before the only foul passage, and one so strangely related to it? This is the very worst place they could have put it. And were there, in the fourth or third century, Christian forgers so ignorant of the relation between John the Baptist and Christ, as to put the latter before the former? The writer (Josephus or not) does so, and betrays not the least idea that these two prophets were anyhow connected, or their doctrines related.

We might challenge the production, in all literature, of a passage more impossible to have been inserted spuriously than this paragraph on Christ. Instead of "universally" held a forgery, it can be so held by none not combining these two qualities, to be both anti-Christians and fools. Hardly can Ananias and Sapphira have known better the price of their land, than the quack from whom Mr. Grey heard this was *universally* held must have known that neither Voltaire nor Rénan—anti-Christian enough, doubtless—were ever fools enough to maintain it. **E. L. G.**

THE SUPERNATURAL DARKNESS ON THE FIRST GOOD FRIDAY.

[27288.]—IF you would kindly give me another small space in your columns, I should like to correct the impression which has gained ground both here and in your paper, that a Darlington clergyman is responsible for the statement on Good Friday concerning the supernatural darkness.

It was the lot of a special preacher from Durham to electrify us; and we can only hope that he is a reader of the "E. M.," and has digested the thoroughly exhaustive replies which have appeared in answer to my query No. 27112.

I am especially obliged to "F.R.A.S."

Arthur J. Gardner.

RAILWAY BRAKES.

[27289.]—I HAVE read with interest the discussion in your recent issues on Mr. Marshall's paper with reference to railway brakes; but we need not go out of England to prove that the applying and releasing of the Westinghouse brake cannot be graduated. The Board of Trade blue-books on railway accidents contain more than one case bearing directly on this point; but the following will be sufficient for any fair-minded person:—

On 24th June, 1884, the North-Eastern 2 p.m. passenger train, Consett to Darlington, consisting of two engines and six vehicles, came into collision at Crook station through the air-pressure being worked entirely away by the application of brake from top of incline at Tow Law, although there were two air-pumps at work supplying air pressure. The driver of the first engine had charge of the brake, and, in his evidence before the Government Inspector, said:—

"The brake was all in good order, and acted properly at each place between Consett and Crook. I applied the Westinghouse brake five times coming down the bank from Tow Law to keep the speed regular. The gauge was indicating 60lb. the first time I applied it after leaving Tow Law. When I applied it the sixth time about 300 or 400 yards outside Crook West up distant signal, the brake did not go on, and I looked at the gauge and saw there was no pressure. *I applied it each time and released it myself. I took it off each time* and did not let it run off. I work this line regularly, and come down this bank once a week. I generally have to keep on applying the brake in a similar manner as on this occasion."

The Government Inspector said in his report:—"I tried the experiments with the same engine and some carriages with much the same result."

True, he found the driver of second engine had his brake handle in the proper position, as shown in the Westinghouse Brake Co.'s "Drivers' Book"—viz., the "feeding" or "running" position, and, in his own words, this was "with the tendency, if not actually to release the brakes, at least to reduce the power with which they were being applied, and so the whole of the air in the reservoirs would be lost quicker than the air-pumps could supply it." He tried the experiment with the brake handle of second engine in the neutral position, and said "the brake acted well and the train was under perfect control"—i.e., the two pumps could supply the air-pressure for the engines and six vehicles as quick as it was required; but the fact hat each time the driver wished to alter of the brake he had to release it, and .is hold of the train.

Samuel Davies.

BRAKES.

]—JUST now, when we hear so much out brakes, a little practice is refreshing. *ourne Argus* contains the account of a scape last month at the Flinders-street when an express train, crowded with s, amongst whom were two of the Rail- missioners of Victoria, was only saved by iptness of the Westinghouse brake from into an approaching train, which had gainst the signals. From the Continent come accounts of accidents, which show Rhineau, near Mannheim, on the Baden ilways, owing to the blunder of a signal- express train was recently turned into a nd again at Zuffenhausen, on the Wurtem- te Railways, an express was broken in two ignalman turning the points while the s passing. In both cases loss of life was y averted by the effective application of tinghouse brake.

s Mr. Geo. Kiernan, who so ably defends brakes, will oblige by giving an answer to wing seven questions:—(1) Vacuum does conditions of Board of Trade; if engine er part, it fails. (2) You cannot uncouple gine without brake going on. (3) When , you have no store of power to put on om van. (4) Piston rods get dirty and 5) Maintaining vacuum uses a great deal (6) Getting brake off is a big job. (7) cuum brake is longer going on than the house.

Loco.

OSE JOINTS OF RAILS ON RAILWAYS.

.]—YOUR correspondent, Mr. Ed. Gobert 7169), in his reply to my letter of the 29th ears to fully admit the defect in the joint- ne rails, although he gives his opinion that ended fish-plate joint is the best extant. rs to Mr. C. E. Stretton's book on this Mr. C. E. Stretton writes "that *several* appear to have returned to the old idea epers should be placed under the fish- nd that he is unable to agree with these en, as he is of opinion that the suspended e joint gives greater elasticity, and renders ction of every part of the rail as uniform le."

face of "the bumping" and "the jolts" se joints referred to in my first letter, I t the fact that the elasticity at the joint is t, and the deflection of the rail anything form; therefore I am inclined to agree *several engineers* that sleepers should be nder the fish-plates, or that something else e done to stiffen these joints, so that the n should be much the same as it is upon art of the rail. I quite agree that the ed fish-plates are very cleverly designed, great improvement upon what was done but it is evident they are not rigid enough heavy strains they are subjected to, and y work loose after a short time.

ms to me that (besides the comfort to the ers) it would be an economy and save a al of wear and tear if these joints were upported, and that a series of experiments be tried so as to prove whether this defect ot be remedied. This ought not to be a matter. Mr. Gobert suggests that "the 'bogies' for carriages greatly diminishes k caused by the wheels passing over the ; but in this case it would be more con- and economical to improve the permanent her than the carriages.

Hy. J. Lanchester.

ACCIDENT NEAR HARRINGAY PARK.

2.]—"NUN. DOR.," page 243, appears to ven correctly the details of the remarkable t which occurred upon the Tottenham and tead Joint line. As he asks for the opinions readers, I may say that I entirely agree e report of Major Marindin, that the cir- nces of the case are "so peculiar as to be incredible." I am of opinion that it is te for those who caused the collision that on was killed, or without doubt there would en a committal for manslaughter.

accident at King's Cross was due to the of "junction block working."

many years past the various railway acci- ave been fully and fairly discussed in your s; I therefore do not see why "Nun. Dor." "suppose the above accident will not be." the circumstances are complicated, or the ns involved as to the causes are important, teresting to consider them in your columns; but it becomes but a waste of your space to discuss cases which are perfectly clear.

Clement E. Stretton, C.E.

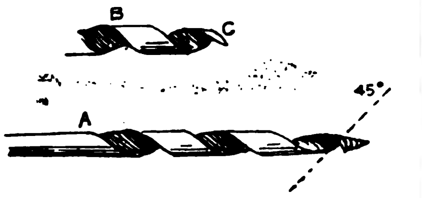
Leicester, May 14.

NORWEGIAN GIMLETS.

[27293.]—A FRIEND has kindly sent me three of these useful tools in sizes: their penetrative qualities come fully up to the description given of them by Mr. F. Carre last year, accompanied by a sketch. At first glance I saw the "reason why" of their clean-cutting powers, and sent each one through a half-inch plank of hard wood, making such a smooth circular hole as a centre-bit will produce. I took an old broken spiral gimlet, filed and ground at end a smooth edge of 45° angle, thus making a hooked lip, filing all round to give the spiral curves a sharp margin. I had then the satisfaction of sending it through the aforesaid plank, the clean hole matching the three first made by the Norse invention.

I then tried my altered gimlet as a boring-tool in the lathe; it worked most satisfactorily. Being easily made, I shall construct two or three of the larger gauges. I shall break off all the screw points of my English stock, and transform them as above described. What treasures such tools would have been to me in the old time of my hut-building and canoe-mending, and other hundred uses, of semi-savage life! Methinks it is the best of rifle rests in a forest country. The Canadian trappers long ago used it against "Injuns" and "Bars." The queer, flat, curved handles look as if made for a stalker. A bit of leather should be sewn over the shank, to save the rifle-barrel from abrasion.

Description of Sketch.—A, common twisted gimlet.



A diagonal line just below the screw point gives a flat facet of 45°, resulting in a claw-lip. A subsequent touch on the hone gives sharp edge to claw and spirals. Having no terminal screw to preserve centrality, a depression made with a pointed punch will be required for the first start; in the lathe a recess for insertion. B shows the alteration at C, after breaking off screw and grinding away to slope of metal.

Eos.

SIEMENS' BATHOMETER.

[27294.]—I SEE that "A Fellow of the Royal Astronomical Society" has replied to "T. S. S.," giving a list of books relating to gravitational astronomy, a subject in which I am interested, although I cannot get quite the right sort of books—for instance, Cheyne's "Elementary Treatise on the Planetary Theory" is rather stiff reading, even to one who has gone through all Todhunter's books, including "Differential Equations," "Finite Differences," &c.; and I notice that Cheyne's book is recommended by our "F.R.A.S.," immediately after an elementary work on the differential calculus.

The following is a gravitational problem of real practical use, and I should be much obliged to the correspondent above referred to, or to another, if he will read at least the first part, and let me know through the "E.M." whether Sir Wm. Siemens is correct, and if so where I am wrong.

An account of this wonderful instrument, the bathometer, will be found in Vol. II. of "Science Lectures at South Kensington," page 122 (Macmillan and Co.), but, as in most lectures, the theoretical part is rather sketchy, and the calulus work is put in an unfamiliar form, to me at least; I will therefore give what I think is a simpler form, using polar co-ordinates.

The bathometer is an instrument to enable us to ascertain the depth of the sea from the deck of a ship *without any sounding.*

Fig. 1 represents a section of the earth; P is a point on the deck of a ship floating on the sea, whose depth is h (of course, much exaggerated for the sake of clearness); a line is drawn at the bottom of h horizontally, which represents a plane (seen edgeways) cutting off a segment of the sphere (the earth being supposed a sphere for present purposes). Now, Sir Wm. Siemens shows that supposing the whole earth to be of the same density throughout, then the attractive force that the segment exerts on any object at P bears the same proportion to the force exerted by the whole earth on that object, as h is to $\frac{2}{3}$R (R being radius of the earth), or $A' : A :: h : \frac{2}{3}R$. This I propose to prove by the calculus presently.

Now, here comes the difficulty. Sir W. Siemens says: "If sea water were without weight, the attraction at P would be diminished in the above ratio of depth of water to $\frac{2}{3}$R; but the real influence of the depth, taking the specific gravity of water into account, is very nearly as the depth to the earth's radius."

As ratios are difficult things to carry in the mind, we will suppose the various attractions to be made manifest on some such instrument as a spring balance.

Suppose the vertical line in Fig. 2 to represent any weight, as shown by the movement of the pointer on a Salter's spring balance, the top of the line being zero, and the weight supposed to be suspended being W. Now, suppose a segment of the earth under the weight were to be made to disappear; the pointer would move upwards on the scale, owing to the loss of attraction belonging to that segment, and we have just seen that the attraction due to the segment is to that of the whole earth as $h : \frac{2}{3}R$. If, therefore, we call W divisions of the scale $\frac{2}{3}$R, the pointer will rise through the height h, drawn to the same scale; of course, in practice h would be very small in comparison with R, so we have to exaggerate in drawing a figure.

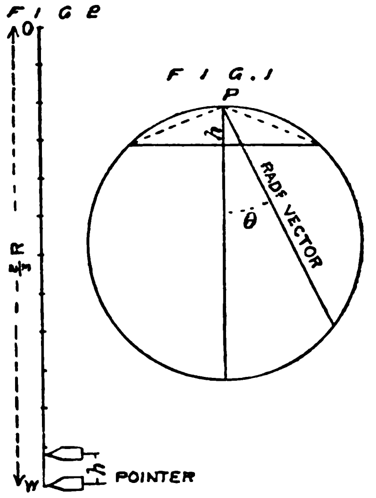


FIG 2
FIG. 1

Now suppose the segment of the earth to be replaced, but this time by *water:* the pointer would be pulled down again; but as salt water is only about one-fifth the mean density of the earth, it will be pulled down one-fifth the distance it had formerly risen, leaving it standing at $\frac{4}{5}h$ above its original position. Hence the weight of an object W at P over the solid earth is diminished when passing over water by an amount represented by $\frac{\frac{4}{5}h}{\frac{2}{3}R}$ W, or $\frac{h}{\cdot 83\,R}$ W; this, I suppose, is how Sir Wm. Siemens has calculated the loss of weight, and the fraction may be said to be nearly $= \frac{h}{R}$ W; but it appears to me there is a fallacy in this method, and that the fraction should be $\frac{h}{2R}$ W; for we must remember that although the mean density of the earth as compared with water is stated at from 5·45 to 6½ (Airy's experiments, Harton coal-pit), yet the density of the rocks, &c., near the surface is not more than 2½ or 3 at most; we may, therefore, take the density of the earth *as a whole* at about double of what it is within a few miles of the surface; hence, to revert to our diagram, when the segment of the earth is supposed to disappear, the pointer would rise to a height from its lowest point of $\frac{h}{2}$ instead of h; then when water occupies the space, the pointer will sink again one-third of this distance, or $\frac{h}{6}$, leaving the pointer standing at $\frac{h}{3}$ above its lowest point; hence we have the fraction—

$$\frac{\frac{h}{3}}{\frac{2}{3}R} W = \frac{h}{2R} W.$$

Now, which is right? It is true that Sir Wm. Siemens gives us a table showing the accuracy of the instrument as compared with actual soundings; but may not his scale have been graduated by some such method as is used in thermometers, that is by finding two or three actual soundings, and making his scale according to these, and not by actual calculation? In this latter case it would have been sufficient to have shown that the diminution of weight varied directly in proportion to depth of water, which it will do whatever may be the coefficient of R.

Now for the calculus. The "element" of a solid of revolution is represented by $r^2 \sin.\theta\triangle\phi\triangle\theta\triangle r$. (see Todhunter's Int. Cal. Art. 207) r being radius vector. Now, by the law of inverse squares, the attractive force of each element will be represented by the above multiplied by some constant to represent specific gravity, and by $\frac{1}{r^2}$ (the inverse square of the distance). Also, as we only require the downward pull of the element, we must apply by $\cos.\theta$, the above therefore reduces to $S.\sin.\theta.\cos.\theta\triangle\phi.\triangle\theta.\triangle r$. The S, however, may be omitted, as we are only *comparing* the attractive forces of parts of the same solid, supposed to be all of the same density. The attractive force of the whole earth or A will therefore be—

$$\iiint \sin.\theta\cos.\theta\,d\phi\,d\theta\,d\,r.$$

the limits of r are to be taken between 0 and $2R\cos.\theta$, the limits of θ between 0 and $\frac{\pi}{2}$, and the limit of ϕ between 0 and 2π; the above will, therefore, reduce to

$$4\pi R\int_0^{\frac{\pi}{2}}\sin.\theta\cos.^2\theta\,d\theta = \frac{4\pi R}{3} = A$$

Then, as regards the segment, here it is only necessary to deal with the cone (see dotted lines), as when h is small the segment becomes, for practical purposes, a cone. In this case the limits of r will be 0 and $\frac{h}{\cos.\theta}$ = the limits of θ, 0 and $\cos.^{-1}\sqrt{\frac{h}{2R}}$. The expression, therefore, reduces to $2\pi h\int\sin.\theta\,d\theta$. If this be taken between the above limits for θ, we get $A' = 2\pi h\left(1 - \sqrt{\frac{h}{2R}}\right)$. The second term may be omitted as being too small to affect the result, so we get $A' = 2\pi h$, hence—

$$A' : A :: 2\pi h : \frac{4\pi R}{3}$$
$$:: h : \frac{2R}{3}$$

Bath, May. A.Mem.Inst.C.E.

THE EDMUNDS LATHE MANDREL.

[27295.]—THANKS to the contributions of various friends, we now are in a position to report progress upon my proposition for a lathe-mandrel of model form and standard dimensions.

1. As to the bearing surfaces by means of which interchangeability of mandrel-heads—i.e., perfect alignment of the chuck-axis with multiple mandrel-axes—is to be secured, our choice lies between the following proposals:—

(*a*) My own combination of a peripheral bearing upon a wide flat mandrel-face, with a cylinder-base to the mandrel-nose, and a screw-thread which is a mere holdfast.

(*b*) The flat mandrel-face with a screw-nose reproduced so accurately that the chuck will run true upon any number of copy-mandrels.

(*c*) The cone-face fitting—i.e., a flat mandrel-face, with a cone-base in place of the cylinder-base.

(*d*) The coned mandrel-face.

Upon a mandrel running in its own bearings, it is quite practicable to make a screw-nose so accurately as to centre a chuck; but as a manufacturing process no one has ever yet succeeded in making chucks transferable on this plan. The back-centre of the simple lathe-head used to be a screw; but of late years, in good work, it has been superseded by a cylinder-fitting.

The cone-face fitting is open to objection because, except by the process of grinding-in, it is extremely difficult to make counterpart surfaces bear upon cone and face simultaneously. It is only single fittings for which the grinding-in process can serve. With multiple fittings, as when a score of chucks are made for a single mandrel, to grind-in the second chuck would be to alter the bearing surfaces to which the first chuck had been ground, and so on for every successive chuck. Multiple fittings, therefore, cannot be made by the grinding-in process.

The coned mandrel-face was carefully discussed two years ago, and the result of recent discussions has not altered its position. The objections are that to make multiple cone fittings is extremely difficult as a manufacturing process; that the coned face acts as an abrading slide when the bite of the screw-thread urges it to resolve the divergences of the chuck. The cylinder-face fitting, on the other hand, acts in two separate rectangular directions, and in each by a mere abutment contact. In such contact abrasion is almost infinitesimal.

If we look at the practice of eminent tool makers, we find that the American chucks sent to this country in such large numbers are all prepared for our lathe-mandrels by means of the cylinder-face fitting. The ornamental-lathe men have never been able to make screw-noses interchangeable for delicate work, and their practice in order to secure accurate alignment for work transferred from one nose to another is to interpose what they term "the transfer chuck." In a paper on "The Transfer Chuck," published by myself in the ENGLISH MECHANIC two years ago, I showed that the critical feature of this "transfer chuck" is a cylinder-face fitting. I also showed that what has thus been done, in a rickety and imperfect manner, by means of a separate transfer chuck for each tranferee, my cylinder-face fitting upon the mandrel will do universally and perfectly. I can only add that, after again considering all the proposed alternatives most carefully, I am convinced that the cylinder-face fitting, with the respective surfaces in the position in which I have located them, is the fitting which will best help us to make interchangeable mandrel-heads.

2. *Nose-thread Form.*—Upon this question we shall look with great interest for further observations from our skilled friend "J. K. P." With the cylinder-face fitting the function of our nose-thread is to serve as *a mere holdfast*—its duty being to bring up to, and retain the chuck in, such position as is determined by the cylinder-face bearings. Centring action by reason of conicity in the screw-thread would be a mere disturbing factor, and is not wanted in the screw-nose of a mandrel furnished with the cylinder-face bearings. From one of the propositions of Euclid—that of the areas of triangles between the same parallels and upon the same bases—it follows that the cross section of the buttress thread will be precisely equal to that of any other triangular thread of the same height and base. Therefore the buttress thread will contain the same quantity of metal as any other triangular thread of the same depth and the same pitch. But when we regard the disposition of the metal, we see that as against a shearing force the buttress-thread metal would, when partly sheared, still be in the position of a V-thread. It therefore follows that the buttress thread will make a longer resistance to shearing force than any other triangular thread. Moreover, when we consider the angle at which the thread-face acts, we find that the V thread-face resolves a large part of the force into a radial wedging action which serves only to jam the threads against each other, to abrade their surfaces, and to waste the power which they are asked to transmit. In the buttress thread this radial wedge action is eliminated, and therefore the force applied is more faithfully transmitted, while the endurance of the threads is not shortened by the surface-abrasion and longitudinal jamming which is caused by the radial wedging of the threads. I have no hesitation in hoping that we shall adopt a truncated buttress thread for the nose of our model mandrel.

3. *Nose-thread Rate.*—This must depend upon the diameter of the screw-nose. Four turns upon a 1·5in. nose is as long a thread as six turns upon a 1in. nose. In a thread of the same rate the effective *pitch* or inclination of the thread is diminished by every increment in the diameter of the nose. Upon a 1·5in. nose three or four turns would be an ample and enduring hold-fast. If a whole number of thread-turns are used, I fancy that the opposite parts of each turn counteract each other in the slewing action to which "J. K. P." has referred, and that this slewing action is all resolved into a simple tendency to unscrew; but, as "F. A. M." says, this thing is not very "thinkable," and the action is not a very easy one to realise. "J. K. P." will doubtless succeed in screwing the conception clearly into all our heads, and I wait for the full development of his views. The point is of mechanical interest, and of some importance.

4. *Nose Diameter.*—Mr. Gray's recent suggestion of a wide nose is a solid advance. He has completely convinced me on this point, and I can only account for my previous blindness partly by my habit of working with the puny ornamental mandrel-nose and partly by my desire to conciliate the ornamental-lathe men. But the ornamental-lathe trade has been resting upon its laurels for a whole generation. Lacquer, shininess, and high prices, with a complication of apparatus which gives scope to the genius of a salesman—these have long been its leading characteristics. A mistake into which I at first fell was pithily pointed out to me by one of our teachers who, when he could not answer my arguments, angrily exclaimed: "Dr. Edmunds, you are entirely mistaken; these ornamental lathe threads are not a question of principle but a question of property." The explanation was complete, and I soon discovered that if we want simplicity of construction, and the modern principle of working to gauge, with standard sizes, so as to allow of the cheap multiplication of good designs, we must study the works of our great engineering tool-makers, rather than the lacquered chucks and absurd screw-rates of the ornamental-lathe trade.

The bore of our model mandrel was limited to ·4in. because no more coning-out could safely be inflicted upon an inch screw-nose. But with Mr. Gray's wide nose our limit is transferred to the mandrel-tail, and we at once get a full ½in. bore without weakening our mandrel. We are at liberty to shape the interior of our mandrel-head as we please. Our whole mandrel-head and front bearing also may be left *hard*, as we are under no anxiety about chipping or breaking off so massive a nose. We now finish our mandrel-head, when finally settled in its own bearings, by just grinding up its nose-thread and bearing surfaces to gauge, as if it were a hard steel cutter. We thus get a mandrel-head whose form and surfaces are practically indestructible. It is by the wide mandrel-nose that we gain all these advantages and without a single drawback, unless it be that we shall need some modification of the eccentric plate of the ellipse-chuck.

The full measure of strength in the nose comes when its stem is as large in diameter as the front bearing of the mandrel. But there is no reason why we should not widen our nose still more. I am inclined to take a screw-nose of 1·5in. in diameter outside the thread, and a cylinder-base of 1·55in. or 1·5625. This would give us a round measure for our screw nose, afford all the marginal face-bearing that we require, and would lighten our chucks fully without weakening them. The precise diameter needs further discussion; but widening our nose involves no need to increase its length, and 1in. should remain as the full projection of the nose from the mandrel-face.

5. *Diameter of Front Bearing.*—It seems to be thought that a front bearing of 1·2in. will give a surface velocity inconvenient by reason of a consequent increase of friction. Obviously, the larger the bearing the higher its circular velocity for a given number of revolutions per minute, and, for continuous work, at a thousand revolutions per minute, as in the dynamo, circular velocity is important. But our lathe-mandrel will never be continuously running at high speeds and, as increasing the circumference of the mandrel diminishes its pressure, we may afford ourselves a shorter bearing. On the other hand, rigidity of the mandrel under the action of its band, a sound keying, and a proper shoulder for the gear-wheel, proper substance in the mandrel-tail, and a large bore, are our essentials. It is not at all clear to me that, within the limits of speed usually needed for such a lathe-mandrel, a moderate increase of circular velocity is necessarily attended with increased resistance. For some years I have had the pleasure of owning and working with a very fine 6in. back-geared sliding-mandrel lathe, by Kennan and Son, Dublin. On carefully measuring the mandrel-shaft, I find that the front bearing is 1·227in. in diameter, and that, behind the pulley nut its shaft measures ·937. Kennan and Son have thus consumed nearly three-tenths of an inch (·29) in fixing the front gear-wheel and the pulley. Then they have reduced the back bearing and slide to ·82in., and the change-wheel portion to ·75. But this mandrel is not bored throughout, and Kennan and Son—having secured a good fixing for the gear-wheel and a stiff shaft between that point and the chuck-thread—seem to have quickly let down the diameter to ·75in. for their change-wheels. I have to-day again carefully tested this mandrel (lubricating with sperm oil), and I find no perceptible difference in driving it at the highest or lowest speeds when there is no cut on. At the highest speeds I find that I do wood-turning perfectly, and leave a beautifully polished surface if only my tool is in proper condition and properly placed. I therefore see no objection to a mandrel-shaft 1·2in. at the front bearing. All we need is to have bearings properly made, finely ground up and polished true to gauge, after hardening, not too long, and properly oil-borne. Mr. Gray's propositions on friction seem to me to need further consideration, both in regard to theory and to practical design. This friction question is one of great import and of general importance. I should add that my Kennan bearings are parallel, and with a flat shoulder in front, as advised by Mr. Newall. But the short 45° front cone, with the rest of the bearings parallel, as used in our ornamental lathes, also runs very light, and I think this cannot be improved upon.

Light-running lathe-heads are one of the specialties in which the ornamental-lathe men excel our scientific tool-makers. They have had for many years to study the laziness and want of muscle which we amateurs exhibit, whereas our engineering friends have had a steam-engine or a muscular mechanic always on hand, and light-running mandrels have not been so vital to their success in business.

6. Mr. Newall has favoured us with a drawing for a mandrel-head, for which we have to thank him, and which contains valuable suggestions. Unfortunately, his design gives us neither a back-gear motion, nor a sliding mandrel. Now, we need the back-gear motion, not merely to get an increase of power for metal turning, but also to get a decrease of velocity for work of another character.

Then, again, it is often imagined that the slide-the supersedes the sliding mandrel. That o. The sliding mandrel—under the influ- a swash-plate, of screw-guides whose return into each other or vary in pitch, ary screw-threads, of cam-plates, and other which are improvised and adjusted on the e of a sliding-mandrel with facility—may to travel backwards and forwards so as to much very beautiful work that I know of of producing by means of the ordinary the; therefore, we require not only the r but the sliding mandrel, and, for a com- he, also the ordinary change wheels and ew by which the slide-rest may be actuated rdination with the revolutions of the

Newall has done good service in calling to the greater value of the strap-belt gut cord upon the pulley. The strap-belt greater hold with less tension; but for rk this is of less importance, while that tion, both of the driving-wheel and is unsightly for an amateur's lathe. eat length also to which the model led with back-gear, and with the append- ded for amateur purposes, seems to shut advantages which we should gain by the strap-belt pulley. Still, some scientific s prefer it, and one friend, some time since, e lathe made from Whitworth's with my andrel, and in which he insisted upon their him a flat-belt pulley. He likes the lathe

enture now to submit for criticism an g of what seems to me to be a good back- ey fixing. We have to provide against s torsional stress between the large gear- d the chuck thread. Our first point in ion, therefore, is to key the large wheel to the mandrel, but without incising the so deeply as to weaken it or unduly lower ty. For this purpose it will be seen that it the key-way out of the undiminished of the mandrel shaft, and that I have key very long by means of an extension- ront of gear-wheel. This boss comes for- siderably, while the gear-wheel is made to only by means of its last ¼in. In this preserve undiminished the diameter of drel shaft until the torsional stress gear-wheel has been taken off, and the greatest strength out of the diameter of front bearing. A sound thus got with a reduction of only ·1in. in neter of the mandrel-shaft. Behind the nd small gear wheel a further reduction of gives us a long screw-thread of 20 turns nch, and ·05in. deep (a sharp V-thread of its top just flattened down smooth). eaded portion carries the nut which fixes es the pulley upon the mandrel-shaft. it carries two lock-nuts, designed to ad- ard steel sleeve against the collar of the ring. This sleeve is keyed across the last the screw-thread, and thus is prevented ning. The two lock-nuts are designed the sleeve exactly transfer the first end-thrust to the back poppet of the lathe-head, where greater rigidity can be got than in front. Thus the back collar at first, takes all end-thrust; but the sleeve should be adjusted so as to let in the assistance of the front collar upon the slightest yielding of the back collar. In this way the mandrel would run very light, while supported by both poppets, against severe end-thrust. The tail-piece is left free from incumbrance, and still has a diameter of 1in. available for its back bearing and sliding portion. Its back bearing will, of course, have to be hardened, and then ground up and polished true to gauge, as with the front bearing.

EXPLANATION OF DETAILS OF ENGRAVING.

The object is to show how the mandrel-shaft between the front and back bearings may be treated, so that, with an ultimate reduction of only ·2in., we may secure upon an unweakened shaft a firm keying and shoulder for the gear wheel, pulley-fixture by means of back nut, and end-thrust thrown at first upon the back collar by means of a steel sleeve and lock-nuts. Beginning with a portion of the back poppet, on the left we have:—

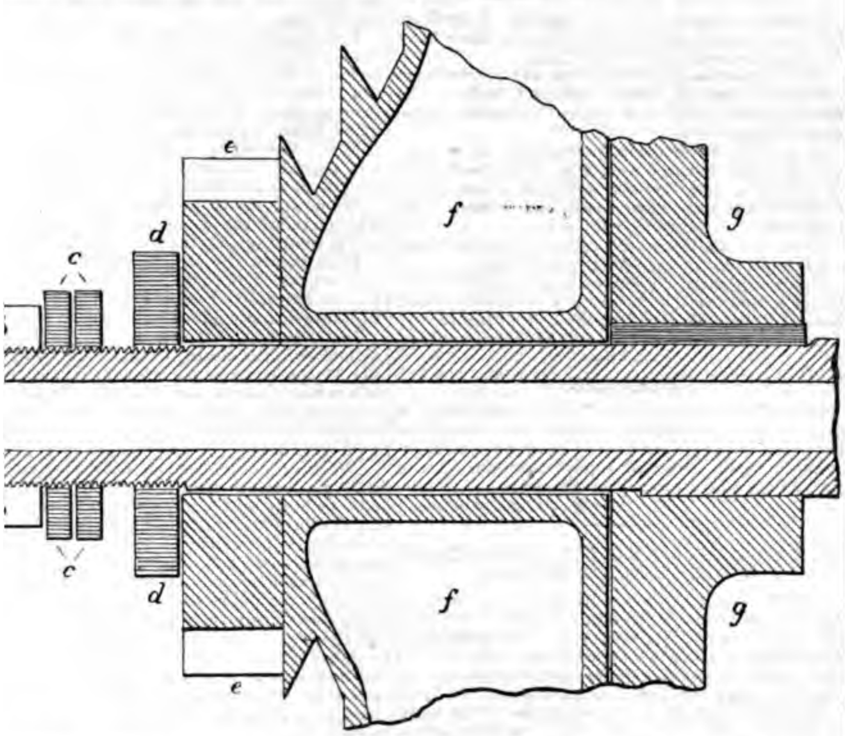
(*a*) Part of the back steel collar.

(*b*) Hard steel sleeve to work against collar.

(*c*) Lock-nuts for adjusting and fixing sleeve, the sleeve being keyed upon the last turns of screw-thread.

(*d*) Nut for fixing or releasing pulley upon mandrel-shaft.

(*e*) Small gear wheel.



(*f*) Pulley attached to small gear wheel.

(*g*) Front gear wheel with extension-boss and long key into undiminished diameter of mandrel-shaft, and, behind, shouldered all round against ·05in. shoulder upon mandrel-shaft.

The engraving is about two-thirds the real size. Diameter of mandrel shaft, 1·2in. in front bearing and up to front gear-wheel shoulder; inside pulley and outside thread of screwed portion, 1·1in.; in back bearing, 1in. The bore of the mandrel is a full ½in. throughout. If ·9in. should suffice for back bearing, the mandrel shaft might be reduced ·1in. throughout.

The full plan of the back-bearing slide-gear and tail-piece will form the subject of discussion after our pulley-fixing and mandrel-head details have been finally settled, and when we see what diameter of tail-piece we have in hand.

James Edmunds.

8, Grafton-street, Piccadilly.

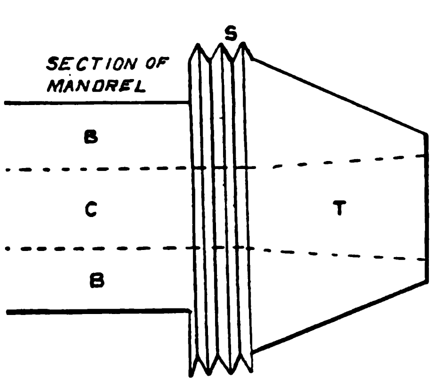
STANDARD LATHE MANDREL.

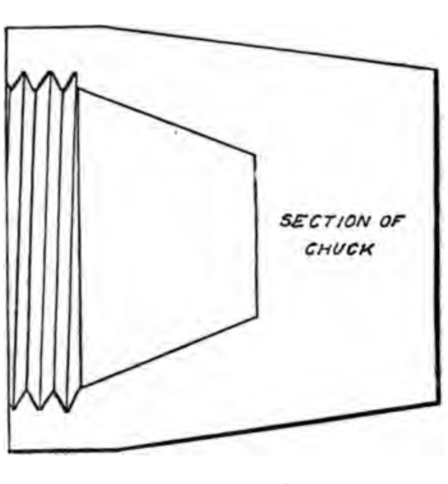
[27296.]—A FORM of standard lathe mandrel for interchangeable chucks has occurred to me after reading some letters in "Ours." It will fulfil Dr. Edmunds' requirements as to cylindrical centring, and the broad base to secure angular accuracy. I adopt Dr. Edmunds's form of mandrel, except that I leave the nose a plain *unscrewed* cylinder; but on the *periphery of the flange* I would cut a *coarse* thread, and the base of the chuck would have a cylindrical ledge to go over this flange, with a corresponding female screw to engage with the screwed circumference of the flange; thus the chuck would be drawn tight up against the broad flange by this screw, and, if accurately fitted to the nose, must always run true. The screw should preferably have a *loose fit*, its only use being to draw the chuck up and hold it tight against the flange. I would slightly round off the end of the nose so that no sharp corner might injure the cylindrical bore of the chuck, or the flat surface that comes against the flange when putting it on. I would also round off the angle between the bore and the flat surface at the base of the chuck to prevent the cylindrical nose being injured.

I think 1¾in. or 2in. would be sufficient diameter for the flange, the nose being ⅞in. There being no screw cut on the nose would leave it much stronger than usual. Chucks could be made anywhere for such a simple standard mandrel, and, if accurately fitted, *must* run true on *any* such mandrel.

A modification of the same idea would be to make the nose in the form of a truncated cone, having a flange ⅜in. thick and ¼in. greater diameter than the base of the cone, which would leave ⅛in. all round for the depth of the thread. The chuck should be formed with a hollow conical base and a cylindrical ledge, tapped inside to fit the thread on the circumference of the flange. Given the size and angle of the truncated cone, and the pitch of the thread on the cylindrical part, any manufacturer could make a chuck or chucks which *must* run true on every such mandrel.

I send you a drawing of this conical form of





mandrel and chuck. The cylindrical form hardly requires a drawing. B, bearing of mandrel; C, bore through ditto; S, screw to hold chuck; T, taper hole.

Though I have never before troubled you with any suggestions, I have been for many years a delighted reader of "Ours," and prize my 39 back volumes as a most useful and interesting part of my little library.

I would like to know what Dr. Edmunds and other experienced workmen think of my suggestion.

Joseph Rawlins, M.R.

THE LATHE AT SALTAIRE.

[27297.]—WILL some one who has seen it report on the lathes at the Saltaire Exhibition at Bradford? Surely there are novelties there worthy of special notice. A friend, who is, however, too lazy to write a substantial article, tells me that the exhibit of our mutual friend, Evans, of Wardour-street, is exceptionally fine, and that the Saltaire Lathe is also there—the most complete tool ever built—the said Evans being, I believe, the master-builder, if not the designer. The chucks are mostly of steel.

It seems a pity not to have in our paper a complete, and, partially at least, illustrated article giving full details, such as we all long for, and such as I am sure our Editor will gladly accept.

O. J. L.

THE ESSEX CHUCK.

[27298.]—IN last week's issue of the "E. M.," letter 27250, "F. A. M." asks if the Essex chuck can be fitted into a bored mandrel. Two or three years ago I turned up an Essex chuck to a taper fitting in place of the loose centre of a 5in. engineer's lathe. It is used for driving twist drills from ⅜in. to ¼in., and answers perfectly. The same lathe has also a cast-iron chuck 5in. long, bored taper, which, when in place, forms a continuation of the taper hole for loose centres. This chuck is used for driving a set of twist drills ¼in. to 1in. diameter, the sockets supplied with the drills being turned to fit accurately in the conical chuck.

The smaller sizes never slip in any work; but in fibrous iron the larger sizes above ⅝in. will sometimes do so. A very simple contrivance of a driving-pin gets over the difficulty; but by far the larger portion of the work the drills have done is by the unassisted adhesion of the cone. It is a very convenient and efficient arrangement for driving drills.

R. R. N.

COUNTERBALANCING FLYWHEEL OF LATHE.

[27299.]—I SHOULD like to know the opinion of some of your readers as to the advisability of counterbalancing flywheel of lathe. Of course, I mean weighting it more than enough to merely balance treadle.

It seems to me there would be an advantage while it is being worked, but would cause joltings when foot is removed. My wheel is about 50lb. in weight and 26in. diameter.

Loxley.

JUBILEE SCIENCE.

[27300.]—THE suggestion recently made in one of the evening papers to celebrate the Jubilee year by marking out the meridian lines and parallels of latitude which intersect the British islands, and planting the same with trees, each by some eminent personage of this reign, or his representative, is both a good and a unique suggestion. Such a number of mementos of the great and good who have lived and laboured for the advancement of the happiness, peace, and prosperity of our nation and its dependencies, could not fail to inspire as well as perpetuate.

One good part of this idea is there need not be any expense to the public. What landowner would not take a pleasure in giving a yard of land and a sapling for so grand an undertaking? And in marking out the lines, which might be done this summer, Her Majesty's Astronomer Royal would be able to command the service of a staff of able mathematicians, to each of whom it would be an honour to be allowed to volunteer their services for so noble a work.

Collectively these lines of living witnesses would form a grand national scientific memorial, useful, interesting, and enduring; worthy of the great event of the year, which it would commemorate for ages, as well as the memories individually of those whose good and noble deeds have contributed to the glory of the reign of the Queen.

C. Henry.

AQUEOUS VAPOUR—BURNT AIR.

[27301.]—IT is not worth space merely to prove that my statement, quoted by "F. C. S.," p. 118, is correct. Anyone sufficiently interested can judge for himself upon referring to letters on pages 12, 103, 129.

"F. C. S." unintentionally misrepresents me in the last paragraph of his letter; this, however, had also better be passed by. I will only say that he is mistaken in thinking that the hydrogen is transferred from positive to negative plates. It is certainly given off at the negative plate; but the apparent effect is said to be caused by the polarisation of intermediate molecules.

It is clear, however, that the alleged impossibility of decomposition of water in presence of free oxygen is a matter of opinion only. I cannot agree with "F. C. S." Yet the opinion he gives, coming from one so well qualified, is valuable to me, lacking, as I do, such qualification. I heartily thank him for it, and also for his courteous letters.

"Burnt Air" (27265). In reply to "J. Q. D.," I do not think that there is any chance of free hydrogen being found in any appreciable quantity in an occupied room heated by a stove. Hydrogen may be liberated, but would probably all recombine with free oxygen, as explained by "F. C. S." The percentage of oxygen in such a room would certainly never be "very greatly reduced," in the ordinary sense of those words. Normally, oxygen forms 21 per cent. of air, and, under conditions stated, it is not likely to get below 20 per cent.; indeed, ventilation is bad when it reaches 20·5 per cent.

According to Angus Smith, air containing 17·2 of O was difficult to remain in for more than a few minutes. As any hydrogen present would replace an equal amount of air, I think that the deprivation of O would be felt long before the physiological effects caused by breathing hydrogen. Dr. A. Smith for a short time breathed a mixture of 4 parts of H and 1 part O. He said that the effect was much the same as that of ordinary air.

Further, hydrogen diffuses so rapidly that it would pass out of room, through ceiling, &c., too quickly to allow of any accumulation from such a source. On the other hand, the temperature being kept the same, there will be no increase of aqueous vapour, since after the air is saturated, and that would soon be the case, an amount of moisture equivalent to that thrown into the air will be condensed on walls, &c.

Kensingtonian.

[27302.]—IN reply to "J. Q. D." (27265), if we assume that the temperature of a room heated by an iron stove should be gradually raised, and also that at the same time the proportion of moisture in the air should be increased while that of the oxygen was diminished, there is no question whatsoever that long before the point could be reached at which free hydrogen could be produced human life would have become an impossibility.

F. C. S.

DIATOMS IN THE THAMES.

[27303.]—SINCE about the middle of April, an immense number of discoidal diatoms have been floating in the estuary of the Thames.

Mr. Kitton has identified them as Coscinodiscus concinnus (Smith), which species I believe has recently been included in Count Castracane's new genus, Ethmodiscus.

If any "E. M." readers have noticed them elsewhere on the British coasts, I hope they will give information, and thereby assist in determining from whence they have come, and within what limits they have been distributed.

Eucampia zodiacus and Rhizosolenia setigera are also present in very small proportion.

Later on, I shall be pleased to give further particulars, and to try to show how largely these beautiful little plants affect the fishing industry.

Sheerness-on-Sea. **W. H. Shrubsole.**

DIATOMS.

[27304.]—"DIATOMISTE" will be glad to know that the plate powder sold by the Pure Peat Plate Powder Company consists of a very pure diatomaceous deposit that will repay attention. I can furnish the address to any advertisers.

W. H. Shrubsole.

THE SEXTANT AND ITS USES—STARS VISIBLE FROM WELLS.

[27305.]—WILL you kindly allow me to point out several errors which occur in letter 27237 over the signature of "Edward A. R." It is there set forth that "it is *because the distance of the sun is so much greater than the diameter of the earth* that we are able to measure infinitesimal angles, &c." The writer then proceeds to demonstrate (?) the truth of his proposition by means of two diagrams, which prove nothing save that were the earth less in diameter, then would a degree of latitude be less in length—a startling discovery truly; but where does the bearing of the distance of the sun on the question come in? It (the sun's distance) might be ten times or only one quarter as great as it is without in any way affecting the matter. In the latter case the diameter of the earth (as compared with the sun's distance) would be four times as great as now; but I fancy we should be able (other things being the same) to obtain our latitude with the same accuracy as at present. By the way, does "E. A. R." imagine it possible to ascertain the latitude to within, say, half a degree by a meridian altitude of the moon?—a body at only about $\frac{1}{390}$th part of the distance of the sun.

Then, "allowance is made for the motion of the earth in its orbit by correcting the declination; *but, in the case of a star, this correction is so small that it* is hardly *necessary*" (the italics are mine). Now, whatever does Edward mean by this? The correction is required because of the continual change taking place in the declination of the sun, arising from the want of coincidence of the plane of the Equator of the earth with that of the Ecliptic. If these two planes were coincident no correction would be required, even though the rate of motion of the earth in its orbit were much greater than at present it is. How this correction can in *any degree* apply to a star lying altogether and at all times *outside* of the earth's orbit, I am utterly at a loss to comprehend.

May I ask "E. A. R." what authority he has for the statement that the duration of sunlight is much longer in the Torrid than in the Frigid zone? I am
under the impression that places of all l
have the sun above their horizon for six
every year, the only difference in this respec
that while places near the Equator get t
divided pretty equally into twelve-hour
those near the poles have it, so to say, all of
—*i.e.*, six months of sunlight, or day, and six
of night.

"Dubitans" (letter 27238) reminds me
Cockney who, "on being told that crabs were
in the sea," went and looked in the sea,
crabs, and straightway came to the sage con
that he had been fooled. I can quite und
that one might look up a chimney every
one's natural life without chancing to see a
the first or second magnitude in transit over
chances are a thousand to one against it; b
such a star in transit at the time, it would be
never fear.

Norwood Junction, S.E. **James Ad**

ON THE LAWS, REACTIONS, CONSTRUCTION OF SOME F OF PRIMARY BATTERIES.

[27306.]—BY some oversight my last
letter appeared under the wrong title.

The next source of loss is *want of self-re*
power. According to Ohm's law, the interna
ance remaining constant the current and
are both affected by any change in the e
resistance. This does not apply to accum
for in them the resistance *falls* as the di
increases, and this is what renders the
regulating.

In these, too, we do not find that the re
is affected, as it is in primary batteries, by
crease of current, which in primaries tends
the resistance so long as increased curre
through them. This want of self-regulating
by necessitating adding more cells to maint
E.M.F. constant, is wasteful of zinc, and
but partially avoided by reducing the i
resistance to a minimum.

We now come to the mechanical imperf
which reduce the commercial success of b
and militate against their economy.

First comes the *defective arrangement*
nections, which, if badly protected, become a
by the chemicals creeping up the plates,
the fumes, if any, given off from the cells.

Next, *breakage of porous cells*, or, an
serious evil, the closing of the pores by salt
ing in them, largely increasing their res
When these salts accumulate in sufficient q
they crack or break the cell, wasting z
solution by allowing the oxidant to come in
with the zinc.

Defective filling arrangements also caus
through causing splashing of solution, w
either simply wasted, or, worse, is splashed i
other solution contained in the cell.

Defective insulation of the cells is a ver
source of waste, as the current leaks both
night, and sometimes in seriously large qua
wasting zinc and reducing E.M.F. In a pr
constructed cell such leakage should be,
impossible, at least reduced to a minimum.

After reading this long string of cause
militate against economy, the reader will n
ask what he should look for in a cell, an
points are of most importance to consider in
a battery.

A good battery should be well cons
mechanically, so as to admit of a moderate
cell being easily charged and emptied. I
visedly that a cell should be large rather tha
as we do not (I am speaking of house li
wish to move the cells once they are fixed,
is of no disadvantage where filling and empt
rendered easy. My experience is that pu
desire to have the fewest possible number
that will do the work to look after and
empty. For the same reason it should ha
E.M.F. and (a natural consequence when c
size) low resistance.

Its insulation should be good, independe
what it is stood on. It should be of the s
possible construction, and the connections
be large and easily got at. It is also advi
have it covered in. It should not give off
It should not require constant amalgamati
should run for a long time without requir
attention.

It should not form crystals on either
plates, or in the porous cell. It should giv
commercial efficiency—that is, it should no
much zinc in local action, and the oxidant
be pretty well exhausted before the E.M.
seriously. (It is always necessary to hav
spare cells, to add, one at a time, as the
begins to fall.)

This last condition is really nearly th
thing as saying that the internal resistanc
not vary during discharge. This is very
to obtain in practice. Finally, it is hig
visable that the waste products should hav
mercial value.

We now come to the economy of primary bat- ies. I think we may assume that no primary ttery will come into use in which a depolariser is pensed with.

We have, then the following causes of expense in ordinary cell:—Consumption of zinc; consump- n of acid or other solution in which zinc is dis- .ved; consumption of depolariser.

We will take a Grove cell as the one from iich to make our calculations. Here we have ic in dilute sulphuric acid, and platinum in con- ntrated nitric acid. Now, 64·9 parts of zinc are solved by 98 parts of anhydrous sulphuric acid; erefore, with commercial acid, we should add out 110 grammes of acid to every 65 grammes of ic, to avoid waste. This, of course, does not suit practice. Now, 64·9 parts of zinc combine with parts of sulphuric acid, thus: $Zn + SO_2HO_2 =$ $)_2ZnO'' + H_2$ (we may neglect the OH_2), and form 0·9 parts of zinc sulphate (neglecting water). A ttery of perfect efficiency should give one ampère ur for 1·2133 grammes of zinc consumed, or ould give, in plain English, 375 ampère hours for b. of zinc consumed.

The quantity of zinc consumed to give one ampère ur is constant in whatever form of battery it is ed (neglecting local action), and is quite inde- ndent of the E.M.F. of the cell, which is de- ndent on the difference of potential between e + and − electrodes, and practically also on e activity of depolariser and other interfering uses.

The E.M.F. is actually produced by, and is pro- ortional to, the amount of chemical energy run own in the cell in its production. It is evident at the higher the E.M.F. of the cell the greater ill be the amount of work got out of it for a iven consumption of zinc: hence a Grove cell ives nearly twice as much power as a Daniell r the same quantity of zinc.

Now 64·9 parts of zinc form, with 98 of sul- uric acid, 160·9 parts of zinc sulphate, and set ee 2 parts of hydrogen.

To obviate polarisation (previously explained) e oxidant or depolariser (in this case nitric acid) ust convert or oxidise the hydrogen into water s fast as it is liberated. Now, 2 parts of hydrogen quire 17 parts of oxygen to form water; nitric id (NO_2HO) is split up by this hydrogen into trous acid (NOHO) and oxygen, thus: H_2 $NO_2HO = NOHO + OH_2$. Now, as nitrous id in the free state is very unstable, this splits as follows:—$3NOHO = NOHO + N_2O_2$ OH_2. This N_2O_2, or nitrous oxide, is a colour- s gas; but, on meeting with the oxygen of the r, it causes it to combine with it, thus: N_2O_2 $O_2 = N_2O_4$, which is a heavy, nasty-smelling, ldish-brown gas, so that a Grove cell is best aced out of doors.

Having written more than usual, I must post- ne the remainder till next time.

Electrician.

Electrolysis of Alkaline Solutions.—ccording to M. Duter, in the electrolysis of ueous solutions of the hydrates of any of the alies the volume of oxygen disengaged is always nsibly less than half the volume of hydrogen. he discrepancy augments as the size of the posi- ve electrode is increased in comparison with the gative. When a large sheet of platinum was used r the anode and a fine wire for the cathode, one lume of oxygen was obtained for *four* of drogen. It seemed probable, therefore, that me new oxygen compound was formed in the ectrolyte, and, if so, probably the conditions hich would most favour the continuation would that of a very dilute solution traversed by a ble current for a long period of time. In an ex- riment the electrodes were separated by a rous partition, and after a current of 0·3 ampère d passed through the solution for several days me of the liquid around the anode was drawn off, d heated nearly to the boiling point. Oxygen me off freely. In repeating the experiment with ch of the alkalies in turn it was found that the oportion of oxygen evolved was sensibly con- stant. The oxygen cannot exist in the form of simple solution, for it is less soluble in the alka- s than in pure water. After the gas has ceased come off from the heated solution, a further antity is evolved on the addition of a small antity of acid. It appears probable that the ygen exists in the form of peroxide of hydrogen.

New Method of Preparing Oxygen.—Into a itable generating apparatus introduce two pints commercial solution of peroxide of hydrogen per cent.) and a pound of dilute sulphuric acid 5). Into this mixture allow to enter gradually rough a safety funnel a solution of 800 grains of tassium permanganate in 28 fluid ounces of ater. Oxygen will be rapidly disengaged with- t application of heat, the yield from the above antity of materials being five gallons.—*Bulletin Pharm. de Lyon.*

INSECTS lay from two eggs to many million eggs r annum.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61863.]—**Roses.**—The following remarks about the cultivation of roses, which are extracted from a communication to the *Journal of Horticulture* by Mr. D. Gilmour, jun., may be of use to the querist and other readers, though it should be mentioned they are extracted from one of a series of articles:—"Many cultivators talk much about roses on their own roots, and though a good number of varieties are said to do well grown so, there are, on the other hand, many that will not. One of the principal advantages of budded plants is that they are cheap, and in an age like this, when quality seems to be entirely left out of the question, and when, as happens in very many cases, the price of the article is apparently the only consideration, budded plants must be first in the field. These latter remarks are not intended to mean that I prefer own-root roses. I admit they might be interpreted so. I am in favour of good well-budded plants; life is too short for the others. Another advantage that budded plants have is the amount of time that is saved by the purchaser. As far as price is concerned, some reader may say, 'I can buy own-root roses for the same money as I can get seedling briars.' Granted that is so, we must remember that seedling briar roses are large well-grown plants when delivered; own-root roses at the same price are generally little better than rooted cuttings, and if these make as good plants by the end of the following season as the others are to begin with, the purchaser may think himself fortunate. Some of the newer roses, yes, and some of the older ones too, the flowers of which are very desirable, are such puny growers that they must be budded plants. We shall have to take them in this form or else go without them altogether. I will give as an instance of this the fine new rose Lady Mary Fitzwilliam, which with me did not make enough wood all last season to give one really good cutting per plant. 'But,' says somebody—some Manetti man probably—"budded plants are always dying and leaving gaps to be refilled." Well, you will not avoid this by having own-root roses; these die sometimes too, more especially in the young state. When once established I admit that they take a lot of killing; the winter frosts may cut them down to the ground, but every bit of root is of the same breed as the parent, and spring sees the apparently dead plant return to life in the sending up of a lot of new shoots. Budded plants under the same circumstances would give us a rich harvest of suckers probably, but these would only be briars or Manettis. Of course I am assuming that the plants are killed outright, but where they are planted properly frost in these parts rarely kills dwarf roses on the briar. Again, the uprising of suckers, which have to be contended against and removed in the case of budded plants when they occur, becomes here a blessing instead of a curse, as all the suckers that arise from own-root plants must naturally be of the same varieties as the plants themselves. Here the only care necessary is to remove late sappy shoots as soon as they appear—shoots which experience tells us can never be expected to ripen before winter. I cannot see why the vigorous growing roses grown on their own roots should not do quite as well as they do when budded on stocks, the greatest disadvantage being, in my opinion, the length of time that the plants occupy the ground before we can hope for any result. Somebody has argued somewhere that if we compare the date of the putting in of the cutting which is to form the future stock, or the sowing of the seed of the seedling briar for the same purpose, with the date of the making and planting of an own-root cutting, that we shall find that no time is gained by having budded plants. Possibly not, but we can go into the market and buy stocks ready for budding the same season we plant them, or we can buy plants to give us blooms at once, thus repaying the nurseryman for occupying his ground growing the stocks or the roses for us, while our own gardens may be better utilised by being kept gay with roses in the mean time. If a beginner wishes to make a collection of own-root roses, the best plan for him to follow is to propagate his own; for the time, cultivating plants on other stocks. In this way he will not sacrifice the present for the sake of the future, while, on the other hand, he will be gaining useful experience as the days pass by. The most certain way of getting roses on their own roots is to have a stock of dwarf roses planted and in full growth. The business is best done about midsummer. It is done by bending down a branch of the growing rose, after making a cut under and beyond a bud. The cut part being pegged down about an inch below the ground, and a piece of flower pot or something similar having been inserted in the cut to keep it open, after which the soil should be drawn over, roots will in due time be emitted from the severed bud, and the branch when cut away with the newly-made roots attached to it will become an independent plant. If the layering is done in early summer it will generally be the case that roots will have been formed by autumn, and, that being so, the branch may be cut off and planted. Where it is found that roots have not made their appearance, the cutting off of the branch had better be deferred until the following spring. In bending the branch down in the first instance, great care must be exercised so as not to break it clean off, the wood of many roses being very brittle. When a branch is cut half through to start with, very little pressure is required to snap it off altogether. For holding the branches down I find wire pegs, which can be easily made, answer best. The smooth-barked roses strike readily; such varieties as John Hopper, Etienne Levet, and Ulrich Brunner are good examples of the section. One or two shoots of nice firm half-ripe wood should be cut off where they can best be spared, without crippling or disfiguring the plants. If they can be cut with heels to them, all the better. The shoots should be cut up into pieces about 10in. long, rejecting the soft unripe tops; each cutting should have two good leaves to it, and be cut close up to a bud at the base. In the case of those with heels there are always a lot of buds, although they are not visible, round this part of the branches. I may say here for this very reason that briar cuttings are not advised to be cut with heels. It is not necessary to remove the lower buds from the shoots of roses, as advised in the case of briar stocks, because in the latter case suckers would be simply a nuisance, being part of the stock only, while in the case of own-root cuttings suckers could only be part of the roses themselves, and therefore welcome. Still, I think some successful rose-growers recommend the removal of these lower buds, and so the beginner had better take his choice, either to plant the cuttings as taken from the tree, removing all the leaves but two at the top, or else to cut out all the lower buds, as directed in the propagation of briar cuttings. A cold frame in a shady place and a bed of sandy soil will be great aids to arriving at a successful issue in this matter; but if these cannot be obtained the cuttings should be put in very firmly—planting them as deeply as possible, still allowing the leaves to be above ground—somewhere where the sun cannot shine on them. If they can be lightly syringed with cold water for a few days after planting this will assist them to retain their leaves, which is desirable. Under these circumstances a fair percentage of the cuttings will grow; but a cold frame will add to the number very considerably. Where a frame cannot be had, sometimes a square wooden box might be available. If a piece of glass be procured to fit the top of this, and if, after knocking the bottom out, the cuttings are put under this box, the glass being afterwards made air-tight, or nearly so, by means of strips of paper pasted round the edges, nearly all the cuttings put in will strike, and the dead ones will be the exceptions. Mr. Taylor, the great grape grower, is, I believe, the author of this very excellent plan; at any rate it was, I feel certain, from his writings that I picked it up. Cuttings must be put in while the leaves are on the trees and the sap in motion, if we intend to be successful with them." The above remarks seem to me to put the would-be rose-grower in possession of the principal points to be observed, and any further information should be looked for in the paper from which I have taken the liberty of extracting them.—JOHN HOPPER.

[61903.]—**Harmonium.**—Although this query has been partly answered by one correspondent, I do not think that the "mystery" (if I may so term it) has been yet explained. "Queen" complains of the bottom octave of the 16ft. not vibrating properly. I am somewhat inclined to think it probable that the querist expects too much in the way of tone and power from these large and heavily-loaded vibrators. Broad reeds are considered by most people to require a greater pressure of air than that required by reeds of narrower scale. I will refrain from expressing any individual opinion on this point; but I will suggest one or two causes from which the defect complained of by "Queen" may proceed. It may proceed from—first, insufficient wind pressure; second, too much wind pressure; third, wrong setting of the vibrators; fourth, reeds not lying perfectly level on reed veneer; fifth, reeds not been screwed sufficiently tight on the pan; sixth, imperfect action of the pallets, such as when the pallets are not allowed to rise sufficiently; seventh, too shallow a touch, as when the keys are not allowed to drop sufficiently, by which means the pallets are not actuated to the extent required. It may be as well for me to note that neither of the above-quoted defects will be found in any instrument of good manufacture; but, if people do not give a reasonable price for an instrument, they cannot expect to have everything in first-rate working order. The defect in "Queen's" harmonium may proceed from more than one cause. I have not attributed the cause of the defect to the condition of the pan, as

"Queen" has informed us that he purchased his pan from a good maker. Such being the case, we can, I presume, take it for granted that the pan is all right. If "Queen" had said nothing in commendation of the pan, I should have suggested other causes (pertaining to the soundboard) which may, or may not, have been the cause of the defect. In this reply I have merely suggested as to what may be the probable cause of the defect; but to arrive at a definite conclusion, and also a correct one, it is essential that the instrument should undergo a personal examination by a competent workman. The reeds being Esteve's (which are as good as money can procure) the only way in which the defect could arise from the reeds is in the wrong setting of the tongues; but I learn on page 109 that "Queen" has set the tongues all right (at any rate, according to his own judgment), so that the defect does not proceed from any condition of the reeds themselves.—G. FRYER.

[62055.] — **Musical Clock.** — Would "Fish" kindly inform me what size he made his barrel for playing piano, and if made of wood or metal? as I have seen a very old one made of wood, and playing four tunes, with double levers and hammers to each note.—J. W.

[62090.]—**Estimation of Nitrogen and Phosphoric Acid in Manures.**—I suppose by Kjeldhahl's method of nitrogen determination is meant Kjeldahl's. This method, I think, would hardly be applicable in the case of nitrogen determinations in manures. By far the most accurate process is that of combustion with soda-lime. "A. M. M." does not state whether he wants to estimate the soluble or insoluble phosphoric acid, or both. If he will kindly let me know what he requires I shall be very pleased to help him.—HENRY J. HARDY, F.C.S., Sheffield.

[62122.]—**Caen Stone.**—It would be difficult to apply steam. Painting with water-glass or paraffin wax is out of the question, as, even if allowable, it has not got over the difficulty of cleaning, which must be done first. The stone is not painted or enamelled. I did not know such a course was ever adopted in the case of Caen stone. The bowl for the water was originally lined with lead, but this has been removed. It is on the sharp corners the soil shows most. Are any of the courses recommended by Saml. Ray ever adopted in a case of the kind?—F. C.

[62123.]—**Mounting Emery Wheels.**—My wheels were obtained at Buck's, Holborn, and are not at all so hard that the hole could not be enlarged without recourse to a diamond tool. I understood that each set of two or three wheels, as recommended by "Eos," was to have its own spindle. Thus the objection of the emery wearing the nuts loose would not apply.—F. C.

[62124.]—**Sluice Gate.**—Dimensions of sluice gate are 2ft. by 2ft. I am afraid gutta and pitch cement would not stick on the wet sides of the gate, for as it is in a tidal river it is never dry. I do not know what hydraulic cement is; some have spoken to me of Roman cement. Portland cement does not set quickly enough; besides, the side cannot be made so dry or free from oozing moisture to let it set, even when pure cement is used. I have used tarred canvas, but it only lasts a short time. I shall be much obliged to "Nun. Dor." for any further information.—F. C.

[62127.] — **Finishing Repousse Work.**—Thanks to "Fal" for second reply. I should be much obliged for a small sample of brass in the different stages of polishing. I do not live near London, as he will see below; but I would be glad of the name of the professional he mentions, as before writing my query I had applied in vain to the professional mentioned by Haslope, and could not even learn from him what kind of scratch-brush was most suitable. I got a very good polish by the use of flour emery and a woollen mop. Is a calico one better suited for the work?—F. C., Inver Glebe, Donegal.

[62164.]—**Dead-Beat Galvanometer.**—I cannot give "Shunt" the precise details he requires for making a dead-beat galvanometer; but if he refers to Prof. Ayrton's "Practical Electricity," I think he will find what he requires on pp. 76—79. I have waited to see whether any of your correspondents would send the information required, and am rather surprised that some of those who are so familiar with electrical terms have not given the information asked for, instead of repeating elementary statements which can be found in any textbook.—NOT AN ELECTRICIAN.

[62165.]—**Time-keeping in a Factory.**—Should not this querist ask to see the time-book at some factory? The question can be of little interest to readers, and really if I wanted such a book I should sit down and arrange one myself. The names of the men would be entered in the first column; the time lost in another; the time actually worked in another, with still another for overtime, which is presumably paid at a higher rate. There should be two lines for each name, so that the items can be clearly entered, and a balance struck at the end of the columns. But, seriously, is it worth while keeping a time-book at all? Why not pay for work actually done, or if by time, trust to the men to make out correct bills? The workman who cannot be trusted to make out a correct bill should not be employed: in fact, an employer should scorn to make money out of a man who would defraud him.—NUN. DOR.

[62167.]—**Chamber Organ.**—The space occupied by any organ should be as much as will allow each pipe to speak properly. "Pan" only gives one dimension—6ft. width—which will be ample, as the bigger pipes (for the pedal) can then form the sides of the organ. If he can also allow 6ft. extreme depth and 12ft. in height, that will do; but he can't have a 16ft. open unless the pipes are elbowed. As the organ is for a "chamber," 16ft. stopped (8ft. long) will be all that is advisable. If "Pan" can refer to p. 246, No. 1129, he will find a very good specification for a two-man. with ped., which he can vary in some stops to suit his taste. —N. E. CHILD.

[62171.]—**Turning Chilled Iron Rolls.**—Perhaps querist might succeed with Mushet's steel, or diamond (bort) tools; but why not use emery wheels?—J. C. T.

[62191.]—**Dies for Screw-threading.**—The important points are to have good metal, with edges properly formed and relieved behind. Should think that querist's best plan would be to buy a few of Whitworth's as samples; he can get them up to 1¼in. at most tool-shops.—F. G.

[62194.] — **Lunar Sketching.** — The details given in the "E. M." report are about all that can be said. Lunar sketching is like other work of the kind, and all that seems to have been suggested was that it would be better to sketch on a large scale, so that the minute details could be shown larger than they usually are.—J. R. H.

[62195.]—**Colliers' Grease.**—I don't know this grease by the name; but perhaps it is this: Tallow, 8lb.; palm oil, 1gal.; mineral oil, 1gal.; plumbago, 1lb. Melt and mix thoroughly in the open air; or, dissolve ½lb. of soda in a gallon of water, add 4lb. tallow, 6lb. palm oil, and a gallon of mineral oil. Melt and mix. Perhaps this one will be better: 7lb. of tallow, 1lb. of sugar of lead, 1½lb. of black antimony, melting and stirring well together until cool. There are many others in back numbers; but the querist should really say what the grease is intended to do.—NUN. DOR.

[62196.]—**Post Office Battery.**—The battery generally employed in this country for post-office telegraphy is the Daniell. A trough made of teak, measuring 2ft. in length by 6in. in width, and 5½in. in depth, is divided into ten cells, the partitions being of slate. It is coated throughout its whole interior, including the partitions, with marine glue. Each cell is subdivided by a piece of porous porcelain, about 3-16ths of an inch thick. The zinc plates measure 3½in. by 2in. The copper-plates are 3in. square. The copper-plates have a strap 2½in. long by ¾in. wide riveted to them, and bent into a ∩-form so as to hang on the partitions. The other end of the strip is well tinned, and is connected to the zinc plate by running molten zinc into a closed mould. These elements are made up in couples ready for use, and are hung over the slate partitions, so that the zinc is in one cell and the copper in another. The zinc division is then filled up with pure water to within a quarter of an inch of the top of the plate. The copper division is about half-filled with crystals of sulphate of copper, and is supplied with water to about the same level as the zinc division. Binding screws are attached to the end plates, and the circuit completed. In about two days zinc sulphate has been formed, and the battery is ready for work. Other forms occasionally used are the Leclanché and the Fuller cells. I do not know what cells are used by the German and French offices.—NUN. DOR.

[62198.]—**Light.**—What is there to explain? The question is, what did the lecturer mean? for it is quite certain that one can look through a sheet of glass at white paper without finding one edge red and the other violet.—T. P.

[62228.]—**Algebraic Geometry.**—ERRATUM. On page 252, second column, line 47, the second italic "*a*" should be the indefinite article. In third column, line 12, after "of another," add "or of any others."—VLADIMIR.

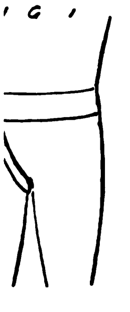
[62235.]—**Honey.**—I think there is a simple test, as follows:—Mix a spoonful of the so-called honey in water until it has dissolved, then allow it to stand for a time, and if a powder or sediment forms at the bottom of the glass, the composition is not pure. This will not apply to honey partially or wholly crystallised; this would be one of the test signs (the crystallised, I mean) of pure honey. But there is a difference between solidifying and crystallising. I would refer Mr. Shakespear and others to the analysis of about 80 samples of honey of English and foreign production, which is fully reported on p. 138, No. 144, Vol. XII. *B. B. Journa* 1884; or to a pamphlet, "Adulteration of Honey, by Otto Hehner, Esq., F.C.S. and F.I.C., publishe by the British Bee-Keepers' Association, price 6d from J. Huckle, King's Langley, Herts, Englan The above is, I think, a reprint from the *B. B. J* and is interesting to all consumers of so-calle honey. It is such abominable compounds as M Shakespear refers to that disgust the public wit honey, which, if genuine, is a healthy, wholesom and pleasant food, and should be used in eve household, and I would advise all to procu another pamphlet from the same source, entitle "Honey as Food," by F. Cheshire, Esq., F.R.M.S price 3d.—NO SIG.

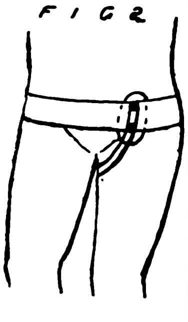
[62264.]—**Duodecimals.**— Allow me than "Theta Phi" for his exhaustive reply on du decimals. It fully confirms my opinion that 10 i a bad number as a base for counting, and ha practically failed because it is not divisible by without a remainder, whereas 12 represents ½, ⅛, 1/16, &c., the fractions used in almost every eng neering shop in England with facility. There a other advantages which would be secured by th adoption of 12. Now, if it were asked what is th number requiring the fewest coins, weights, c measures in actual practice, the answer would b 3—for example, the ratios 1, 3, 3^2, 3^3, would giv every number from 1 to 40 inclusive. So agai with a circle, the commonest and most useful of a curves. It can be divided into six equal part more quickly and more accurately than into an other, the next being 3 and 4; and also in th counting of time by taking 12 as a base, the ob jectionable a.m. and p.m. could be abolished scales, too, could be more gradually divided. Whe it is considered how easily all our tables could b converted into duodecimals, and what a larg amount of time, trouble, and annoyance in learnin arithmetic would be saved to the individual, it is matter of surprise that some effort has not bee made to secure its adoption in England. As there a already in existence 12 months in a year, 12 hours in day, 12 pence equal one shilling, 12in. equal 1ft., 1 lines equal 1in., and in troy weight 12oz. equal 1lb and the ounce avoirdupois being 1/16lb. could also b utilised. The pence table is 12 times in anoth form, and all children at school are taught to 1 times, and then there is the dozen and gross, be sides halves, quarters, and eighths innumerabl The conclusion one arrives at is then that twelve i the best practical number as a base for counting that our present heterogeneous systems of mon weights, and measures, which would puzzle Philadelphia lawyer, could easily be converted that base; and that its adoption in England wou save much time, expense, and annoyance to th individual, and would place us in a fair position compete with other nations.—S. H.

[62270.] — **Parochial Law.** — Get "Ov Overseer's Manual," price, 4s. 6d.—IVY.

[62316.]—**Storage Cell to Electric Boat** You can get a very good non-fuming solution obtaining Sullivan's chromo-sulphuric acid, a adding cautiously twice its bulk of water. Do t slowly, and do not let it over-heat. The solut I use for my batteries is superior to this; but cannot publish the composition of it. Accu lators of best make, taking a charging curren 2 to 4 amp., and giving 3 amp. at 2 volts for hours, weigh 4lb. per cell. They give hig E.M.F. than three Bunsens. These cells are the "grid" pattern, and consist of four plates, rather grids, 3½in. by 5in., or thereabouts. If y make cells, make Planté type, and do not use lead. If Messrs. Shippey will supply you w their Woodward plates cut to your size, say, plates 3in. by 4in. active surface, you can get a c to suit weighing about 4lb., or a little less if y use an ebonite containing cell. Failing this y had better use plain lead plates, exposing abo double the surface, or 96sq.in. surface. Then p chase a small pattern "diaper tool," as used b wood carvers, and punch all the active surfa (both sides of plates) with this to give increa surface. Use lead about 1/10in. thick, and do n charge above 15 ampère hours capacity. Use p sulphuric acid diluted to 6, and separate the plat carefully by slips of paraffined wood. In cutting out your plates, leave lugs on them, and submerge the whole plate in the acid. A good plan to sea the cell is to pour melted paraffin ¼in. thick on th surface of the acid, and let it set. Then with a ho wire make two small holes through this to allow gas to escape. The heating of the cells in chargin remelts this paraffin, which is an advantage. I you buy the cells, charge as follows. Take six lamps (about 110 volts), and arrange in parallel, but in series with cells—i.e., carry a wire from + dynamo brush to one of the binding screws on each lamp holder. From the other binding screw on each holder carry another wire to the three cells arranged in series, and then on to – brush. You thus give 3 ampères; charge six hours. If you form your own accumulators, give 2 amp. for ea hour first; then run down the cells through 1 ohms until there is no current, and charge in s irection. Remember to reverse, and charge qual amount in the opposite direction takes mes as long as original charge.—ELEC- N.

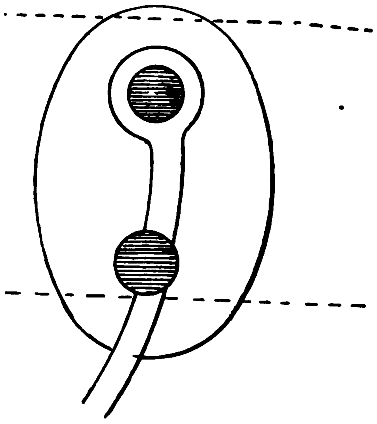
0.]—**Rupture Truss.**—A dummy figure doll would better illustrate the merits of ss than a very rough pen-and-ink sketch;





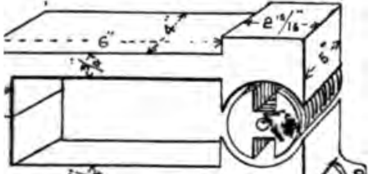
, I send it. No. 1, back view; No. 2, ew; No. 3, the pad, with cross-strap pass- hip and buttock between thighs looped on

FIG. 8.

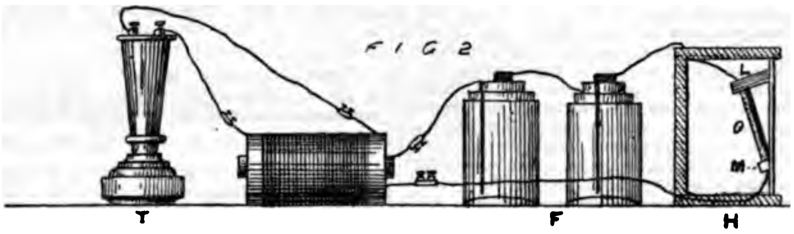


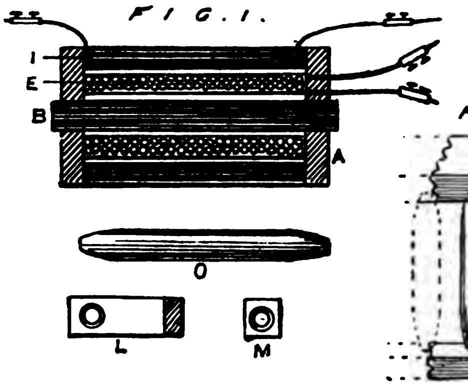
stud. This being done, and the pad care- ced on seat of rupture, the said cross-strap with the fingers (just below the loop), trap passes and rests against the neck of ad. This is a left-side inguinal rupture very severe and painful one for many red long ago—but the truss has never been as a precautionary measure; a good fit is sable. Persons with prominent buttocks y fitted; the lower edge of the belt should rted by the hip bones. For thin men I straps made of solid rubber; these exer- eat pressure on the pad, besides yielding nents of the body, and a loose covering of leather will render them more comfortable earer. In all the more accessible forms of and particularly in umbilical rupture, the pad I lately described can be substituted russ-pad and worn on same belt. Those not like the trouble of making the latter ave it made of solid rubber, with vulcan- erial at the top to carry the studs; this st a lifetime if washed once a week.—

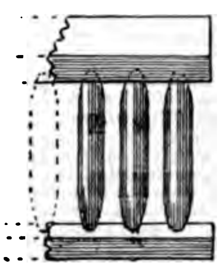
]—**Dynamo** (80c.p.)—TO MR. BOTTONE. length of F.M.'s, inclusive of pole pieces, ; pole pieces, 2 1/16in. long; width of F.M.'s pieces, 5in.; thickness of F.M. cores, ¾in.; yoke, 4¾in.; diameter of armature, 2¼in.

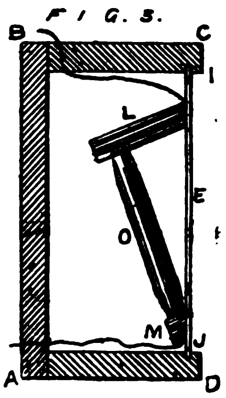


t be laminated). Wire on fields, No. 20, re on armature, 1lb. No. 20 d.c.c. Yes, a gine would drive it easily. Cannot say you would get sufficient steam up from gas. price of machine, if all be home-made, S. BOTTONE.









[62336.]—**Microphone Coil and Telephone.**—Having tried the experiment myself and obtained good results, I will explain to "R. E. M." how I constructed the coil and how I connected it with a microphone and a Bell telephone. Make, as shown in Fig. 1, a hollow cylinder A, in which is a bundle of iron wires B. Coil round it a first helice of copper wire E (isolated with silk) about five yards in length and ½mm. in diameter. Coil on the top of the first helix a second wire I, the diameter of which is ¼mm., and 50 yards in length or more. The coil is then ready for the experiment. Connect the first helix with a microphone H (Fig. 2), and a battery of bichromate of potash F (one or two elements—Bunsen will do as well), and the second with the Bell telephone T. I have tried different kinds of microphones, but the one sketched in Fig. 3 was the most successful as telephonic transmitter. Its arrangement is due to a Belgian telegraph operator, and adopted by several telephonic companies as transmitter. An ordinary box A B C D (Fig. 3), of which one side E is a very thin pine-wood plank (only fastened by the sides I J), on which the microphone is attached. O L M are the three gas-carbon pieces. By augmenting the number of pieces *o*, as in Fig. 4, the microphone is more sensitive. The part *o* (Fig. 1) of the microphone vibrating removes the current, which gives rise to a direct or inverse induced current. This last acts on the Bell telephone. The coil can be dispensed with; no greater battery power is necessary, and it is most likely that the wire of the Bell telephone would be damaged by sparking. The interposition of electric coil is used for long-distance telephony.—CHARLES DE HAESE.

[62339.]—**G.E.R. Locos.**—I think it is probable that the loco. to which "J. T. L." refers is one which is employed on the G.E.R. tramways at Great Yarmouth during the herring-fishing season—viz., October to Christmas—as the date and description given correspond with that of an engine I saw in use there about that time. I believe it is only used during the herring season, horse-power being in use at other parts of the year to convey the trucks of fish from the fish wharf to the goods station. It is fitted with an alarm bell instead of the usual whistle, and works very silently.—J. HUGHES.

[62350.]—**Dead Black on Brass.**—I am obliged to "Hendon" for his reply; but it is not what I require. The method he mentions is well known to me, and is the correct thing for blacking the inside of tubes, &c., used for optical purposes. What I require is a metallic deposit produced either by dipping or by action of a battery, and should not come off or turn bright by rubbing.—SM.

[62352.]—**Antiseptic Dressing.**—I always carried with me a bottle of carbolised oil—pure almond oil and pure carbolic acid. This must be properly prepared by a good chemist, the bottle warmed, and shaken briskly before use. For very slight cuts I use chloralum—styptic, antiseptic, and astringent. A rag dipped in this, and kept wet with the same, heals like magic—one part chloralum to three parts water. Chloralum wool is also sold: this is merely cotton wool ready prepared for application.—EOS.

[62352.]—**Antiseptic Dressing.**—My object in giving a reply is principally to insist on the necessity of avoiding as much as possible the stitching of wounds in the dressing of them. This barbarous mode of treatment should have been superseded long since in the progress of the times. I always consider it a very dangerous treatment for a tender wound, as the stitching must excite more or less powerfully to inflammation. Theory is not to be depended upon at all in medicine, for the operations in the living body transcend our powers of theorising. Thus, common salt is a strong antiseptic; therefore, theoretically, salt when put into a wound ought to have a beneficial and soothing effect, instead of having, as it does, an injurious and very irritating effect. Considering the antiseptic power of the mild boracic acid, we should expect that the liquid impure carbolic acid, that black venomous divinity of the present time, ought soon to become a broken and fallen idol. It is to the antiseptic action of the blood alone that the cure should be left as much as possible; and accordingly the blood's curative action should be assisted by inducing easy circulation in the sore flesh with emollient ointments. I agree with one correspondent that cold water should be avoided, for though cold itself is beneficial, yet I look upon the astringent principle of water-dressing as not only a humbug, but as to some extent injurious. Astringents are of the opposite nature to emollients, and if emollient spermaceti ointment is found so serviceable in external inflammation, by what reason can it be supposed that astringents, producing the opposite effect, can also be of service in the same cases? The astringent effect impedes the circulation of the blood through the injured flesh, whereas the emollient effect promotes its circulation; and which, I would ask, is the better principle according to reason? Cleansing, however, with tepid water and soap-lather is often beneficial. I do not agree with another correspondent that sticking-plaster should be discarded, for it is often very useful, both on account of the protective mechanical coating it supplies, and by its keeping the edges of a wound close together. I would not think of putting sticking-plaster on an inflamed skin; but I find that nothing is so good for a skin affected with itching. Perhaps, in general, the best soothing application for wounded or inflamed parts is vaseline. This substance is perfectly free from any acrid or irritating quality; it never becomes rancid, contains no oxygen, and has a strong penetrating power which makes it soak into the flesh. For avoiding the unsightly appearance of a sore lip nothing equals vaseline, when early applied, as my experience teaches me, since it cures the sore without giving it the "raw" appearance that the other unguents give it. In all cases I should be strongly against using irritating applications of any description on inflamed surfaces, as I am convinced that they have caused the loss of many a limb, and even many a life.—AN APOTHECARY.

[62357.]—**Levelling Machinery by Spirit Level.**—Say casting is a large marine cylinder, weight 30 tons or so, to be laid down and levelled for erection of engine. Get chocks of about the right height to suit the level of the floor, and cut to suit the shape of under side of casting (some castings have a rounded or angular shape to suit lines of boat), try chocks over with straight-edge and level—anything within ⅛in. will do. On the top of each chock put an iron plate, and on top of plate a large iron wedge; let casting down on these, lay a straight-edge across (a plane face), and try with level; if low at one part, ease the weight off wedges with crane, and drive wedges in under low part with fore hammer, then try again; keep on thus till true. It is best to just ease the weight off wedges with crane, as else it is very slow and hard work; but, of course, keep a good part of weight on chocks and wedges. A rope sling, or slings, is the best for this job, as the elasticity of rope enables you to regulate the easing strain with great nicety; while with chains there is a solid lift or nothing. Of course there must be two planed horizontal faces at right angles on top to level from; centre lines would do, but with planed faces there is no mistake if planing is true, as it should be.—G. S. PARDOE.

[62363.]—**Income-Tax.**—I would advise F. Korner to write to the solicitor to the Commissioners of Income-Tax at Somerset House; he will then get a satisfactory reply about which there will be no mistake, and then communicate the information to the ENGLISH MECHANIC, as I feel sure it will be useful to many of its readers.—AN OLD ASSESSOR.

[62369.]—**Silk Underclothing.**—Some years ago, when I landed in England after a long sojourn in sunny lands, I got an attack of bronchitis lasting many weeks. I bethought me of the electrical virtue of silk vests (or rather non-conducting and calorific properties, as described by medical writers), and have worn spun silk undervests ever since, without any recurrence of my troublesome disorder. Twelve years have passed, or more. They are rather expensive, but will save medical visits. Several ladies from warm climates have followed my advice, and always wear this material, of which they speak highly.—EOS.

[62376.]—**Accumulators.**—For obvious reasons I may not mention makers' names; but taking the usual type, giving about 2 volts per cell, and using cells having plates about 10in. by 5in., you would need three cells if you run your lamps in parallel circuit. There should be at least four pairs of plates in each cell, so as to get sufficient duration of current. The charging current should be about 7 to 8 ampères; the discharge can be as much as 12 ampères. Outside measure of cells, 10in. by 13in. by 12in.; price, with plates ready formed, from 45s. to 60s. per cell of nine plates.—S. BOTTONE.

[62376.]—**Accumulators.** — TO ORMOND. — Depends on the maker of your lamps. If of Shippey make they take about 1·4 to 1·5 ampère each; but if of Swan make, about 1·8 ampère (I do not know if the Edison Swan Co. can make low-resistance lamps without infringing other patents, as they only gained the day for high-resistance lamps, for patenting which Edison would undoubtedly have been the first in the field but for Lane Fox). I will, therefore, treat the lamp as Shippey's. Six lamps will in this case take 9 ampères, and the nearest storage cells to those you require will cost you 17s. each, or £8 10s. for the ten cells you will need (they give two volts per cell). If you want portable cells they will cost 18s. each, or £9 the set. Your dynamo, if shunt-wound, is just the thing. You will obtain full instructions on purchasing the cells. Size, 3 by 8 by 10½in. over all per cell; weight (charged with acid) about 32lb.—ELECTRICIAN.

[62377.]—**Inhalent.**—Those most in use are carbolic acid, creosote, and turpentine. The best inhalers are made like respirators to cover nose and mouth, with valves of indiarubber so as to cause only the inspirations to come through the box in front, which contains the inhalent (mixed with 50 per cent. spirits of wine), poured on cotton wool. Some chemists keep them in stock; and most surgical instrument makers have them. For acute bronchitis iodine tincture poured on a jug of hot water and inhaled, is very useful. For my own use I find turpentine used with a respirator as above (but without spirits of wine), combined with ten drops of pure terebine, taken on sugar three times a day, very efficacious.—B.SC., Plymouth.

[62379.]—**Acoustic Telephones.**—Why does Mr. W. E. Rogers occupy space with an engraving and complain that instructions privately received have failed to enable him to carry out his desires? He could have found full particulars by referring to the indices of back volumes. The wooden pulleys will not do at all. The brackets should carry a piece of rubber rod (a rubber cork) through which is passed a wire loop, so shaped that the line wire makes two bends of 45° instead of one of 90°. If necessary, use two wire loops, but on no account bend the line at an angle of 90°.—NUN. DOR.

[62393.]—**Pump.**—The best rotary pump I have used for oil is of American make, and consists simply of two tooth-wheels gearing into one another. The wheels are nicely turned and pitched, and of coarse pitch, about 5in. outside diameter and 4in. wide, the whole fitted in a case singly, and the spindle of one wheel projecting through a stuffing-box for driving handle. Suction at bottom, delivery at top. The suction is formed by the teeth leaving each other, and the forcing by them meshing together.—T. C., Bristol.

[62391.]—**Engine Query.**—Area of cylinder $= 42^2 \times {\cdot}7854 = 1385{\cdot}4$sq.in., and the average pressure of steam of 45lb. absolute pressure cut off at $\frac{1}{3}$ stroke $= 45 \times \dfrac{1 + 1{\cdot}0986}{3} = 15 \times 2{\cdot}0986 = 31{\cdot}48$lb., from which resistance of atmosphere (if a non-condensing engine) + 2lb., or a back pressure of 2lb. of a condensing-engine, must be deducted for effective pressure. In the former case the work done through a space of 5ft. $= 5 \times 1385{\cdot}4 \times 14{\cdot}48 = 100{,}706$ft.-lb.—T. C., Bristol.

[62391.]—**Engine Query.**—I do not exactly understand what is here meant by theoretical calculation, as the method implying the use of the hyperbolic logarithm of 3 can be fairly called a purely theoretical one. According to the latter method, we first calculate the mean pressure p—

$$p = \frac{P}{3}\ (1 + \text{log. hyp. } 3).$$

Here $P = 45$, and log. hyp. $3 = 1{\cdot}09833254$, therefore $p = 15 \times 2{\cdot}09833254 = 31{,}475$lb. Pressure on a piston 3ft. 6in., or 42in. diameter, $42^2 \times 0{\cdot}7854 \times 31{\cdot}475 = 43606{\cdot}734$lb., and the number of foot-pounds for one stroke $43606{\cdot}724 \times 5 = 218033{\cdot}62$, from which, however, there should be deducted the negative work on the other face of the piston.—E. GOBERT.

[62394.]—**Planing Casting.**—I have just got over a similar difficulty by fixing a vertical cutting frame in holder with a suitable milling cutter on end of spindle (which projects through frame at both ends), and on top I fixed a handle. With one hand I gave a steady pull at handle of table, and with the other drove the cutter. I could do the hole out the size you indicate in about an hour and a half thus, and make a good job.—T. C., Bristol.

[62395.]—**Siemens-Alteneck Dynamo.**—The reason why your dynamo does not work is self-evident. You are running it as a series dynamo, when, from the great resistance of the field-magnet coils as compared to the armature coils, it should be run as a shunt dynamo. Couple one field-magnet wire to one brush, and the opposite field-magnet wire to the other; then connect each brush to one of the terminals. Rotating now, either in one direction or the other, will cause the dynamo to work. Which direction you must rotate will depend on which wire you have coupled to the upper brush. This machine, all being correct, will probably light four or five 5c.p. lamps of 6 or 7 ohms resistance.—S. BOTTONE.

[62396.]—**Mercury.**—Strain through leather, treat with HNO_3, and wash with water. Have you tried distilling it with a retort?—ALAN.

[62396.]—**Mercury.**—This is purified by distillation in an iron retort, the mercury passing over in vapour and re-liquefying when cool enough, Beware of the vapour, which is poisonous. It should be collected in an iron receiver, kept cool by cold water. It should be done in the open air, if possible.—ELECTRICIAN.

[62397.]—**Engine and Boiler.**—If the engine is run at 200 revs., and with 80lb. steam, cut off at ¾ stroke in h.p. cylinder, it would indicate about 2H.P. or a little less. I think the boiler is about right if I correctly understand it as regards size; but should not care to work it above 60lb. if only of $\frac{1}{8}$in. copper. I cannot answer your question *re* propeller, as it is out of my line. Perhaps "Engineering, Manchester" will answer this.—T. C., Bristol.

[62398.]—**Fluorine Isolated.**—To obtain pure fluorine HF is decomposed by electricity. As pure HF does not conduct electricity, a little KHF_2 is added to the HF, and the mixture placed in a U platinum tube, so as to fill the bend of the tube. The limbs are closed by stoppers of fluorspar, and the electrodes of a battery pass through the stoppers into the liquid. The electrodes are made of platinum with 10 per cent. of iridium. The U-tube is placed in a cooling mixture, and kept at 23° C. The pure fluorine thus obtained explodes with H even in the dark. Free fluorine possesses all the properties of Cl, but in a stronger degree. It is kept in leaden bottles, as it attacks the silica in glass.—ALAN.

[62398.]—**Fluorine Isolated.**—Some state that they have obtained fluorine in a free state; but whether they have actually done so or not it is difficult to say. A method by which it is stated to have been obtained is by heating in a glass tube hermetically sealed, and fro[illegible] the air has been exhausted. absolu
with its e[illegible] pro
iodine
iodir
tair
foll

Th

have no action on glass, except in the pr
moisture, when its action is similar to
hydrofluoric acid. It is stated to be s
potassium hydroxide with the formation
sium fluoride.—HENRY J. HARDY, F.C
field.

[62398.]—**Isolation of Fluorine.** -
Comptes Rendus for July 19, 1886, is a
M. H. Moissan, containing an account o
periment of submitting hydrogen flu
electrolysis: At the negative pole hydr
lected, and at the positive pole a gas hav
properties was disengaged. This
colourless; crystallised silicon burnt ir
great brilliancy, sulphur took fire, iod
bined, losing its colour. It decompos
producing ozone and hydrofluoric acid.
bodies were violently attacked. Metals
roded; but chiefly on the surface or
author concluded that the gas was eithe
or a perfluoride of hydrogen. In
periodical for Nov. 8, 1886, is a repo
chemical section upon these experiment
opinion given is that the gas is fluorine.—

[62399.]—**Tallow.**—I believe that k
stirred until just ready to set is a practica
this.—T. C., Bristol.

[62401.]—**Thermo. Battery.**—Should
be thermo-pile? If so, I may say I co
one precisely as directed in the
MECHANIC, Vol. XXIII. No. 590, p
which, when heated by placing a 1½i
burner paraffin lamp alight in the inside,
a beautifully steady current of 12 to 14
If you have not access to the above nu
again, and I will write out a condensation
benefit.—S. BOTTONE.

[62402.]—**Model Loco.**—You had bet
this a model of broad-gauge loco. so as to g
of room for fire-box, which may then
square, body of boiler 12in. by 5in., with
tubes. You will then be able to burn c
T. C., Bristol.

[62402.]—**Model Locomotive.**—I re
"Chemin de Fer" to increase the dia
cylinders to 1¼in. if possible. The boil
be 5in. diameter and about 12in. long, out
box 6¾in. long by 4¾in. wide and 5½in. d
centre line of barrel; inside box copper 6i
4in. wide and 6in. deep; metal all $\frac{1}{16}$in.
water space of ¼in. should be left all roun
increasing to about ½in. at top. There
ten brass tubes ¾in. diameter and $\frac{1}{32}$in. t
about 12½in. long. Total heating surfac
about 400sq.in.—E. L. P.

[62406.]—**Pulleys.**—The distance s
sufficient between the centres. Try a bro
A smaller pulley would make but little
with 10ft. centres. Crossing the belt mig
matters, but would reverse the direction.
pulley-grippers might get over the diffic
would absorb more power.—ELECTRICIA

[62406.]—**Pulleys.**—Rosin, in my opin
abomination for belts, and if used alone
becomes glazed and lets belt slip. Mel
tallow and rosin together—this is better, a
oil still better; but crossing the belt is b
centres are not too close, nor reduction
pulley too great for such a distance, about
If you drive with open belt, keep the slac
top.—T. C., Bristol.

[62408.]—**Dynamo, Weight of Ir**
TO S. BOTTONE.—The weight of the
ployed in the 20 c.p. dynamo (describ
book) is, inclusive of armature, field, and
but exclusive of driving-wheel, 12lb. Yo
able to get about 3oz. of No. 22 on y
armature, 2in. by 1in., and to balance this
advise you to wind the fields with abo
the same gauge wire, and connect the m
a shunt machine—that is, bring each e
field-magnet wires to opposite brushes, t
current for the outer circuit from the
also.—S. BOTTONE.

UNANSWERED QUER

The numbers and titles of queries which rem
swered for five weeks are inserted in this list, a
unanswered are repeated four weeks afterwards.
our readers will look over the list, and send what in
they can for the benefit of their fellow contributors.

61913. Brass Standards, 42.
61914. To Mr. Edward Conry, 42.
[illegible]15. Kilns, 42.
[illegible] [illegible]o, Objectives, 42.
[illegible] Wheel, 43.
[illegible] Lantern Lens, 43.
[illegible] Coil, 43.

[illegible] p. 137.
[illegible], 137.

QUERIES.

–Income-Tax upon Property, and ed House Duty (Distraint for). — 'e is a bill of sale upon furniture, can it be dis- on for the above tax and duty, and when they subsequently paid (but not the "expenses" of nt), can such furniture be legally, some con- ime afterwards, or a portion of it, seized, in of the Inland Revenue, for the said "expenses," of which go into the pocket of the collector? ore, when the said tax collector shows favouritism, ie cases does not insist upon the expenses at es at which he has distrained, but accepts the and duty in full settlement, can other people discovered the said favouritism legally claim to upon the same footing?—VICTIM.

–Calcium Light.—Will some fellow-reader orm me what spirit should be used for the oxy- ght?—H. B.

-Zeta Bootis. — Will "F.R.A.S." kindly is present pos. ang. of this double, and also part of its components? The latest record in 7, gives angle as 299·8°, and 1″ distance. My n last night—May 16—shows considerable both respects to those given, and I saw what is a *comes, n.f.* about 80 which is not mentioned -OPHIUCHUS.

–Brasses.—Would "T. C., Bristol," or "Clay- ly give best instructions how to smelt together boring and turning when they cannot be done earings? Also the easiest and most correct way e out the cylinder of portable and other engines, n off for repairing, and to set slide of inverted st cover.—YOUNG ENGINEER.

–Engine for Canoe.—Can any reader tell ize engine and boiler will be required for my . long, 2½ft. beam, to drive it 8 miles an hour. ller is a three-bladed screw, 6in. diameter. I ave a loco. boiler; length not to exceed 18in.—

–Secondary Battery. — Having six flat lls at my disposal, I wish to use them for making named battery. The cells are 3 by 5 and 6in. ave cut the lead plates to the size; but wish e following, how to place them in cells? and to put between to prevent short-circuiting as ssible, as they will have to remain some time rged, before being used? I have access to r forming, so shall have no difficulty on that ould also like to know what current in ampères st from each cell, having six plates in each, three. I may state that the plates are about ek, and are plain.—HENRY CARTER.

–Screw Cutting.—Can 23, 29, 31, 33, 37, 39 53 threads per inch be cut with a leading screw nch, and the following change wheels, 21, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, ese being the number usually supplied with an athe).—JACK CADE.

Photographic.—Will some of "ours" kindly opinion on the relative merits of pyro ammonia sulphite developers? I have tried both in mulas, with the result that in the former case much density and in the latter too little.— PHOTOGRAPHER.

–Wood Boring.—Can any of "ours" kindly ie best way to bore ¾in. holes through wood 1. long, the best bit to use, bit or block, to run to be done quickly?—(36.)

–Photographic.—1. Is it possible to over-ex e until its behaviour in developing is like an under- ate, i.e., image coming out slowly. 2. Are the plates suitable for instantaneous work with the hutter? If so, what exposure is required with us 7 by 5 R.R. lens full aperture?—J. W. SIN-

— Oval Turning. — Would some corre- give me some information on oval turning for k? Should I have to have a fresh lathe head chuck or some arrangement be fixed to the ead to do the work required?—LEARNER.

–Printing.—What alkali must I use to get a ack tone with the silver paper? Please give d method to obtain this.—J. W. SINBOLD.

–Mechanics.—Would "T. C., Bristol," kindly iswer to the following question, given in the y examinations in applied mechanics? A rail- exclusive of engine, weighs 150 tons, and in ong a level line from rest it attains a speed of a hour in five minutes. What has been the l between engine and train, the resistances n at 10lb. per ton.—STUDENT.

–Motion of Fixed Star.—Can a "Fellow al Astronomical Society" give me some simple obtaining the proper motion of any fixed star? d Mr. Sadler's notes on the proper motions of in the *Journal* of the Liverpool Astronomical ut he does not give details as to how he got , and I do not understand what he means by ic corrections." Some simpler method would ble to me.—H. ATKINSON.

–Painting Designs on Cloth. — Will tell me of a material with which to paint lesigns on cloth and for needlework? I have y kinds of chalk and paint, but they rub off and eless.—SUBSCRIBER.

]–Electric Tricycle. — Can any of your elp me? I wish to have an electric tricycle thought of having a ½H.P. motor, and using ac- rs. The roads I should want to use it on are ay, but not very hilly. How many accumulators P.S. pattern should I want to make the machine ree hours at about ten miles an hour?—OXFORD.

]–Valve Gearing.—Thanks to "T. C., Bristol," Gobert for replying to my query; but would ly explain what they mean by "tendency of the lip," as I don't understand that action, and as I have not the back number mentioned, could they kindly recommend a good practical work on the valve gearing of steam-engines?—ENQUIRER.

[62427.]—**Spectrum Analysis.**—In Kirchoff's map as shown in Schellen's "Spectrum Analysis" the distances in millimètres which are quite filled with iron lines are, 21mil. in the yellow, 45 in the orange, 84 in the violet and indigo, and 41 in the blue. Have these distances ever been compared with the time that the evanescent tints remain on a piece of polished steel whilst tempering, viz., pale straw, golden straw, purple, blue.—ELLORE.

[62428.]—**Woodturner's Stand Planer.** — Will "Eos," 27182, kindly help me as regards this? What is the best way to attach brass plate D? Would conical-headed bolts be best? I do not quite understand the gap E for quick escape of shavings, the gap E in the drawing seems to have a square top, as though a piece of wood were inserted in it; but I do not suppose that it is so intended, as that would not leave a free passage for shaving. Is the gap cut at an angle downwards on each side from the centre of edge of plane iron? What is the double line between C and B? Also the single line in the direction of the length of brass wedge A?—G. M. S.

[62429.]—**Delta Ursæ Majoris.**—Will "F.R.A.S." or some friend who possesses the needful apparatus, kindly oblige me by making a photometric observation of this star? Smythe quotes it of the third, and the *comes* of the ninth magnitude, and suspects variability. It is suggested to me the pair have recently diminished in lustre; but my instrumental means do not enable me to apply the only satisfactory test.—FRED WM. NASH.

[62430.]—**Faulty Coil.**—I have made an intensity coil from the instructions given by "Dyer," and in the mean time I use one of Smee's batteries, and find when taking a shock, that it is stronger in the one arm than in the other, and it is quite the same when any other person tries it; so if it is not working right, you will greatly oblige by letting me know.—W. NEWLANDS, JUNIOR.

[62431.] — **Aerostation.** —I want to construct a balloon to lift about 500lb., including car, net, and envelope, and shall feel much obliged if anyone can give me any of the following or other particulars: What should its cubical content be, what would be the best and cheapest material to make it with and cost of same, also how much would be required? Regarding the car, I should like size of same and lightest material for construction, and lastly, the probable total cost and weight.—COLOSSUS.

[62432.]—**SS. "Glen Fosa," of London.**—This fast steamer has only a single-cylinder engine for her paddle wheels, which has a very curious starting and reversing gear. A sketch and description of this gear would doubtless interest many, and would be of much value to—SHINY BOOTS.

[62433.]—**Radius of Lens.**—1. Is the radius of curvature of a plano-convex lens equal to the focal length? 2. If a plano-convex lens, having a certain curvature, has a certain focus, has a plano-concave lens of the same curvature also the same focus? 3. Given the radius for the concave surface of a diverging meniscus and also the focus, how can the radius for the convex surface be found? 4. Can you recommend me any practical books which treat of lens-grinding, &c.?—LENS.

[62434.]—**Painting Roofs.**—Will someone kindly oblige me with a rule for estimating the quantity of lead paint required to give three good coats of paint to a given superficial surface of roofing made of wood or Willesden paper.—RAFTER.

[62435.]—**Water Filtration.** — Can any of our chemical readers give me information as to best method and filters for filtering large quantities of river water, say 60,000 gallons per 24 hours? The water comes from a shallow sandstone stream, and is very soft. I want to remove the organic matter, as the water is used for paper-making processes.—HALIFAX.

[62436.] — **To Metallurgists.** — I don't know whether there has been any correspondence on the subject of impurities in forged bar-iron and the consequences of these, as I have not taken the "E.M." for more than a year. Perhaps some one can help me out of this. What is the cause of the large blisters on the puddled bar generally seen when the bar is being rolled, or after the rolling? A forge foreman told me it was sulphur. Is he right, and if so, what reasons are there for his theory being upheld?—J. HY. T.

[62437.]—**Photographic.**—I want to intensify the densest portions of a negative and reduce those where there is just a visible deposit without the aid of local manipulation and by a purely chemical process. Perhaps "B. Sc. Plymouth" or Mr. Bottone will say something on this subject. How would either of these gentlemen treat the negative of a dark red rosewood piano, the image being flat and ill-contrasted.—SOLAR RADIANCE.

[62438.]—**Pipe Clay.**—Can pipe clay be fired?—*id est*, supposing I have a mould in this clay, can I bake it in a clear fire? Does it assume a rougher surface after this process? What is pipe clay used for except to whiten leather? What is French chalk?— SOLAR RADIANCE.

[62439.]—**Electrical Business.**—Would ordinary galvanised iron wire do to connect two electrical bells, say twenty yards apart, and should I absolutely require a return wire? What are the essential parts of a photophone, and what theoretical solutions were thrown out to explain the phenomenon that light passed through a plate of ebonite? I believe Professor Graham Bell on a visit to England showed this as a lecture experiment.— SOLAR RADIANCE.

[62440.]—**Power of Telescope.**—I possess a telescope with powers 50, 100, 150, and desire to know by how much the distance of any celestial object—the moon for instance —is apparently reduced by each power respectively. Will any of "ours" oblige?—QUILL.

[62441.]—**Luminous Paint.**—I have got some of Judson's luminous paint, which I believe is composed of small particles of gelatine mixed with the luminous principle. How can I coat a glass plate evenly with this paint? Of course it is mixed with hot water, and when I have coated a plate à la collodion, and it is dried, the paint peels off. I have also tried a brush, but the results are too streaky. To prevent the paint from peeling, I have coated a plate previously coated with gelatine; in fact, an old negative, but still it comes off in pieces, and it is not equally luminous. Should I try a film of collodion over the paint afterwards or coat a plate holding a substratum of chrome alum and gelatine, and then flood with a solution of albumen? Could I separate the calcium sulphide from the colloid body, and use it mixed as an oil paint? How do they coat luminous tablets generally (as in Warnerke's sensitometer) so evenly? The particles of calcium sulphide are so large that they sink to the bottom of the gelatine film when in the fluid state, that it prevents the latter from having a firm hold. Would chrome alum in small quantity (as used in aforesaid substratum), affect the spectrum of the luminous paint?—SOLAR RADIANCE.

[62442.] — **Arc Light Machines.** — Will Mr. Bottone please give me size and particulars for a dynamo to give 50 volts and 10 ampères for arc light? Quantity of wire and size of pulley? Prefer Mather and Platt type. Also please say what wire for F.M's, if shunt-wound for incandescent lights, as an alternative. I don't want it to heat with 10 ampères.—CARNWORTH.

[62443.]—**Acute Spasmodic Asthma.**—Will one of our medical friends kindly advise as to the best remedy for this? A lady (aged 40, married and with family) suffers severely. Believe the case to be allied with weak digestion. The paroxysms are frequently, although not always, accompanied or preceded by an altogether abnormal belching of wind and a harassing cough. Cannot take anything salt without great aggravation of the symptoms. The saliva remaining intolerably salt and irritating for a long time afterwards. For purposes of relief, the powder called "Himrod's Asthma Cure" is burnt, and the fumes inhaled. Considerable emaciation. Upper teeth practically all gone, and adequate mastication impossible. Expectoration principally a glairy froth. Tolerably well in the intervals of the attacks.—COSMOPOLITAN.

[62444.]—**Bill of Sale.**—When a bill of sale has been duly registered, and re-registered within the required period of five years; but a second re-registration is forgotten to be made when a second period of five years has elapsed, does the document become practically and legally non-existent, and do I, the holder of it, lose my hold upon the property?—IGNORAMUS.

[62445.]—**Stoppage of Drain.**—The fatty matter from the kitchen solidifies in the cold weather, and the accumulation thus formed stops the drain. There is no possibility of getting a better fall under the circumstances and at present the only remedy is to take the pipes up occasionally and clean them. Can any of our readers suggest a remedy or a chemical solvent that will not injure the pipes and joints.—C. H. G.

[62446.]—**Equations to Curves.**—Having begun the study of analytical geometry, and having read that the object of the equation to a curve was to enable us to investigate its figure, I am at a loss to understand the principle of the method, and would be obliged for information from any correspondent. — ARCHITECTURAL STUDENT.

[62447.]—**The Bansoolah.**—"Eos" would add greatly to the interest of his paper on Primitive Tools, if he would supplement his description of the "Bansoolah, or native adze," with details of size, shape of hole, and size of handle, &c. I should much like to get one made, and will feel obliged for information as to above.—ANGLO-CELTIC.

[62448.]—**Governors.**—TO T. C., BRISTOL.—I have a horizontal engine running 225 revolutions per minute. The cylinder is 3in. bore, 5in. stroke. I want to put governors on it, the same shape as illustrated on page 237 of the last number. Will you please inform me, 1. What weight balls I shall require? 2. What dia. pulley on engine shaft? 3. What dia. pulley on spindle? 4. What length should spindle be, and (5) what diameter? 6. What length arms from top of spindle to top of balls. 7. What length connecting rods? 8. What distance from balls? I may tell you that I work at 60lb. pressure in boiler, and the throttle valve I intended using is ½in. The spindle of valve is 6in. above bedplate and 26in. from engine shaft.—W. I. I. GOVERNORS.

[62449.]—**Flour Machinery.**—Will any reader be good enough to inform me how to obtain an approximate development of a conveyor screw-blade, such as used in flour machinery. I am aware that it is impossible to do it by a strictly geometrical method.—C. N. P.

[62450.]—**Boiler.**—I have made a boiler 18in. high by 10in. diameter, from ½-plate iron, double riveted. Could you kindly tell me what pressure it would stand, being well made? Also what size engine it ought to drive?— J. GRAHAM.

[62451.]—**Chemical.** — I want to make a sol. that will produce a jet-black colour on brass. I have seen the sol. made that I require, but could not get any information about it. It was evidently an acid, from the smell and the fumes given off. The sol. itself was perfectly black in colour, and was applied with a brush, and one coat was sufficient to produce a good black. I have tried perchloride of iron, but that does not give the colour I want, and is not the sol. I mean. A brown sol. was also used, and by mixing a little of each, various shades were obtained, similar to the colours seen on Japanese bronzes. —J. ARTHUR.

[62452.]—**Liquid Gelatine.**—My brother, who is an invalid, is ordered to take cold jelly; but he has taken a dislike to the "size," as he calls it. Will any of your readers please say how it can be kept in a liquid state cold?— THANKFUL.

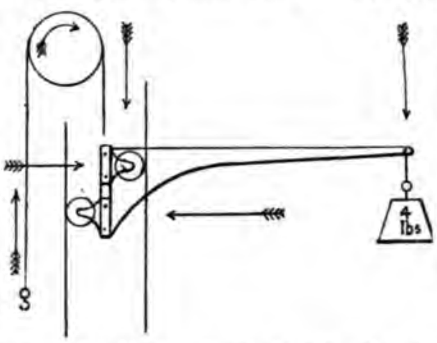
[62453.]—**Natural Philosophy.**—The following two questions were set at the Sound, Light and Heat examination, held lately under the Science and Art Department. Will anyone kindly show how they are to be worked out? 1. Four strings of the same material and length, but of thicknesses, 1, 1·5, 2·5, 3, are stretched on a violin and tuned so as to give successive fifths. Compare the tensions of the several strings (the thinnest string is to give the highest note). 2. A copper calorimeter having a mass of 125 grammes, contains 400 grammes of water at 15° C., into this are placed 556 grammes of copper at a temperature of 95° C. The final temperature is 24° C. Find the specific heat of copper.—J. B.

[62454.] — **Correction of Telescopes.** — Three terrestrial telescopes give excellent results when used with their respective eyepieces. They are nearly the same aperture and power, and represent, perhaps, the best work of Munich, Paris, and London, respectively. When the objectives are tried on an artificial star with an achromatic eyepiece, and power of about 35 to the inch, two give the expanded disc, similar on both sides of focus, and colours apple-green and lilac, showing, I should judge, perfect correction; while the third is decidedly over-correct, and of little use, astronomically, with the above eyepiece; but with its own terrestrial eyepiece, it is, if anything, more perfect than the other two. Is it the usual practice with certain opticians to compensate for the under-correction of the four-lens erecting eyepiece by making an opposite error in the objective?—HARD CROWN.

[62455.]—**Spots on Sensitised Paper.**—Will "B.Sc., Plymouth," or some other subscriber, kindly inform me what causes small black specks? I notice a few on the albuminised paper, but a great many more after sensitising; but they don't show badly until washing, and toning; sometimes they have a metallic appearance. I advertise my address in case someone will write to me.—S. B.

[62456.]—**Heating Small Hall.** — Would some practical correspondent kindly advise as to the above? We are getting a small hall built, which we want heated as economically as possible. The size is 23,184 cubic feet. It is proposed to put in a coil boiler, and 332 lineal feet of 1in. iron tubing; this will go twice round the room. I may mention there is 160 square feet of glass. Will this raise the temperature to say 55° or 60°?—FAIR CITY.

[62457.]—**Leverage.**—To Mr. FRANCIS CAMPIN, C.E. —Will you kindly inform me if a truck with four wheels, when placed on a perpendicular tramway with a lever one foot long attached to the truck and a 4lb. weight suspended on the end of the lever, will it descend freely? If so, what weight will it hoist? I send a rough plan to explain the scheme.—JOHN. W. HILLIER.

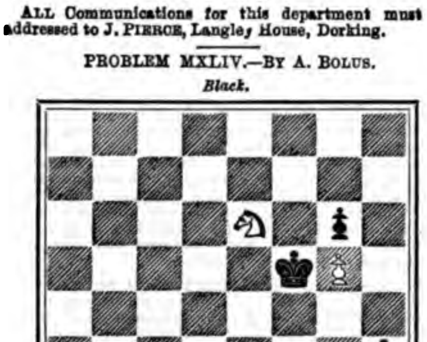


CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXLIV.—BY A. BOLUS.

Black.



White. [4 + 2

White to play and mate in three moves.

SOLUTION TO 1,042.

White.	*Black.*
1. Q-Kt 7.	1. Anything.
2. Q or Kt mates.	

(Three variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,042 by A. Bolus, Black Pawn (mates fairly clear; key move not first-class), Harold Norton, Lancaster, Link, F. Krasser, A. Dean, W. Hewson-Kilbee, A Beginner, T. H. Billington (pretty and elegant), Major (weak), V. S. Pochin, E. C. M. (Ipswich); to 1,041 by J. Mackenzie, V. S., Pochin, Link, A. Bolus, Black Pawn (very good); to 1,039 by Link (omission rectified).

H. N. LANCASTER.—If in 1,040 1. $\frac{}{\text{K takes Kt at K 4,}}$ 2. $\frac{\text{Q-K 6 (ch),}}{\text{K-B 5}}$ 3. $\frac{\text{Q-K B5}}{}$ mate.

V. S. POCHIN.—A problem which has more than one solution is reckoned in the competition, and every additional solution sent in counts. This was stated at the outset.

J. MACKENZIE.—In your attempt at 1,042 you put 1. Q-Kt 2 (we presume you mean Q-Kt 7); you then add 1. $\frac{}{\text{B-B 3}}$ 2. *K-KKt 4; of course intending* Q-KKt 4 *mate.* You also omit the variation arising from all moves of the Bishop except to B 3. How many marks do you expect to score for this?

WE have now published the last problem in A and B. A terminated in 1,041 and B in 1,043; the results will be announced in a fortnight.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, May 18, and unacknowledged elsewhere:—

H. MILNES.—W. H. Smith and Son.—C. J. Jones.—Eos.—W. Hume.—J. Epps and Co.—36.—Dusty Miller.—A. W. —Baker.—Electric.—Walter.—E., St. Mary Church.—F. G., Birmingham.—W. G. Bull.—Silke.—W. A. W.—W. Tilley.—Tukang Besi.—Londiniensis.—T. R. Clapham.—Orderic Vital.

A SUBSCRIBER, C. HAY—SIE. (See a reply on p. 254. We cannot agree with you that "perpetual motion is becoming an interesting science, and many wish to become more acquainted with it," for perpetual motion is not a science at all, and is rather too old to interest any one who has the slightest acquaintance with the elements of physics. If you wish to know what has been done in years gone by, read Dircks's "Perpetuum Mobile," published by E. and F. N. Spon.)—MESMER. (Consult the indices, and read what has been said in back volumes. It cannot be used as a cure for diseases because it is not exactly an entity that can be handled and measured; but there is no doubt that some persons possess the peculiar power, and can exercise it upon some others.)—AMATURE. (Your question is too vague. You will find information in back numbers about making a dynamo, and as to the lamps, it is cheaper to buy than to attempt to make.)—DOUBLE YOU DEE. (You have only to put the bell in circuit, and you seem to have done that. If it failed, the battery was not strong enough, or the connections were defective.)—JNO. BUCHANAN. (The only way is to apply at the places where moulders are employed—say, Woolwich Arsenal—taking any letters of recommendation you can procure. There is no lack of applicants for such situations. See Hints No. 5 above.)—EMERY. (See indices for methods of making emery wheels; but anything of the makeshift kind should be confined to wooden wheels covered with glue and emery. See p. 334, No. 1083.)—CANTER. (The cards are good ones; but why not learn to understand the subject for yourself. You will find plenty of information in back volumes—see pp. 130, 244, 272, Vol. XXXVII., for instance—or any of the manuals now published on the subject.)—S. BULL. (The usual plan is to drive in a brad when the corner is glued; but there are special cramps, to be obtained at any toolshop. 2. No; see any of the cheap handbooks of photography, and many notes in back numbers.)—R. LORD. (You are mistaken in thinking that plumbago is recommended for the purpose, or else we misunderstand what it is you want to do. Plumbago is an excellent conductor; but wherever it is applied the deposited metal will separate from the mould coated with the blacklead. See an article in the last number.) —J. HY. T. (Fresh charcoal is said by the workers to act "too finely" on the iron, and the period of conversion is prolonged, as it is necessary to keep the furnace at a lower heat. 2. Muck-iron is usually bar iron which has passed once through the rolls; it is then cut up, piled, and re-rolled.)—J. B. (See many recipes in back numbers. See p. 84, Vol. XXXVIII. for instance, or specify the kind of composition required. The "few hints on the management" might extend into a treatise.)—P. (Any of the ordinary polishing agents; but the principal ingredient is elbow-grease. Use Water of Ayr stone first, with water, until all scratches are removed, then rottenstone and oil, or lampblack and oil, finishing with the hand. If in the lathe, run at a slow speed.) — READER. (Principles cannot be patented unless the patentee has discovered them and invented some means of utilising them. The cases mentioned are utilisations of old and well-known principles, and cannot be claimed. The special means of utilising them is what is patented.)—DONE BROWN. (Consult a medical man.)—4 YEARS' READER. (Merely examination questions, of no interest to our readers. Consult some textbook—say, Guthrie's "Electricity and Magnetism.")—W. AYLWARD. (See index of last volume; p. 348, No. 1083, p. 390, No. 1085; and p. 510, No. 1091. Look through the indices generally for a great deal of information on the subject.)—APPRENTICE. (It will depend on the wording of the indenture to some extent. If the term stated was seven years, then seven years must be served, or damages could be claimed.)—HENRY JONES. (We do not recognise it by that name. To insert such a query would be to give a gratuitous advertisement of an apparatus with which full instructions should be sent out by those who sell it.

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—FOREIGNER. (The three R.'s are Readi
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rent, and Free sale.)—HIBERNIA, Bristol.
not a small or low-priced work on the subj
ston's "Introduction of Conchology," Van V
suit you. It cost a guinea. Procure a catalo
Voorst's publications. The address is Pater
E.C.)—PONTO. (It means the application of t
current, and when the term "general" i
means that one pole is in a fixed position—e
on which the patient stands—while the other
over the whole body. See indices of back v
H. FRYER. (See "Gun-Barrel Browning
volumes. A full description in No. 1,035, p.
haps a coloured lacquer would answer your
H. H. B. (Any geological works bear upo
haps Woodward's "Geology of England a
published by G. Philip and Son, would give
formation desired, though what that is you d
—TYPO. (They are not hardened. They are
with an alloy of tin, antimony, and lead. Th
saturated solution of sulphate of copper, w
sulphuric acid added. 2. There are severa
for brassing, for which see Watt's "Ele
sition," or the indices of back volum
or Daniell battery is suitable for the
G. W. L. (Simply guesswork? How do y
he could tell?)—A NOVICE. (See indices. W
the batteries direct? Such questions
answered many times recently, and you wil
find replies even in this number.)—T. H.
(Sulphuretted hydrogen is made by placing s
of ferrous sulphide in a bottle with water, an
sulphuric acid on them through a funnel tu
through the cork. As the gas is poisonous, an
not know anything of chemistry," you had
attempt its preparation, or your workmates
thank you for the endeavour to benefit the
must make it, however, you can procu
apparatus at the dealers.)—E. A. B. (See pp
455, last volume. Joy's valve-gear has been
and described several times. See No. 954, p.
XXXVII., or No. 806, p. 611, Vol. XXXI. 2.
or immerse in boiling water. Bend to the
curve, and clamp it in that position until dr
birch would be a suitable wood, so would oak.)
(Thanks; but we have already devoted all
we can spare.)—A. SOUTHGATE. (We can mak
of the sketch sent.)

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and healing agent in cases of bad legs, bad breas
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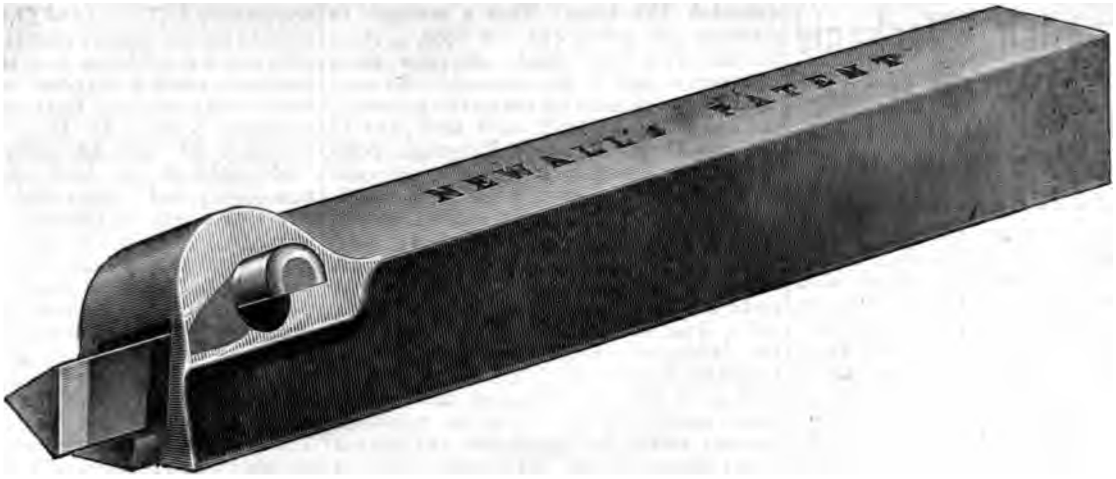
The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MAY 27, 1887.

THE JUBILEE OF THE TELEGRAPH.

AS most of our readers are aware, 1887 is the jubilee year of the electric telegraph, the first practical trial having been made between Euston and Camden stations on July 25, 1837, by Messrs. Cooke and Wheatstone. Other inventors—notably Davy—had been experimenting on lines which ultimately led to success; but the first public or semi-public trial was that which took place on the short length of the London and North-Western above mentioned: hence it is literally true to say that 1887 is the jubilee year of the electric telegraph. As a matter of fact, however, if we were to date the birth of the telegraph from the year when it was first brought into public use, its jubilee would come in the nineties instead of the eighties; for, as Mr. Preece stated, in his paper read the other night before the Society of Arts, nine tedious years were spent in endeavouring to create enthusiasm among financial circles for this young and novel means of communication—for this, as he might have said, most useful invention, which was pooh-poohed by the Admiralty authorities as a device which they did not require, as they already had an excellent semaphore telegraph system, which, by the bye, they could not see in misty weather. The manner in which the electric telegraph, the screw propeller, and the breech-loading rifle were treated by the Government departments is well known; but notwithstanding the lessons taught by those inventions, it is not improbable that similar treatment would be accorded to any other device which had at once the merit of novelty and great utility, unless the officials were compelled to see its advantages by what is commonly known as "powerful influence." The first company formed to develop the business of transmitting and delivering telegrams was the result of a public endeavour to utilise a great invention, which received no assistance whatever from the Government, and was known as the Electric Telegraph Company. It was incorporated in 1846, and its wires were speedily extended to every great centre of trade along the railways that were then in existence or being developed; but it was not until 1851 that the business could be described as fairly established. Telegraphs and railways may, in fact, be said to have developed side by side, the one helping the other, neither receiving much assistance from Government departments, while limited in their action by the necessity for obtaining Parliamentary sanction for everything that was done. In 1851 the possibility of working submarine cables was demonstrated, and in the next two years cables were laid between this country and France, Belgium, Holland, and Ireland. By the time that had been accomplished, the value of the electric telegraph had become widely recognised, and the pioneer company found itself confronted by many imitators, who did not hesitate to contest the validity of patents which it had then been demonstrated were commercially valuable. The monopoly of the pioneer company was upset; but the public gained by the active rivalry, and thenceforth the development of the electric telegraph was assured. At first the rates for transmitting messages were based on a sliding scale, the datum being twenty words, which were sent at one penny per mile per word for distances under fifty miles, a halfpenny per mile for distances up to 100 miles, and one farthing per mile when the distance exceeded 100 miles. Thus a message to Glasgow cost nearly 8½d. per word, to Manchester 5·1d. per word, addresses being reckoned as part of the messages. As competition and demand for the service increased, reductions in the tariff were made, and in 1861 the United Kingdom Telegraph Company was formed to introduce a universal shilling rate. The severity of the competition was, however, too great, and in 1865 that spirited company had to submit to a general tariff which fixed the rate for twenty words at 6d. within town, at 1s. for distances under 100 miles, at 1s. 6d. for less than 200 miles, and at 2s. for greater distances, but addresses were taken free. The telegraph companies being purely commercial bodies, it followed that offices were established only where profitable business could be tapped, and the smaller towns were neglected. The neglect was felt all the more because the posts and wires often passed through the towns or near them, and as the necessity—or at least the advantage—of the telegraph to business men became recognised, public opinion was soon developed to such an extent that the Government were forced to purchase and absorb all the companies and unite them in one service for the benefit of the whole country. That took place in 1870, on Feb. 5, and the telegraph service became again a great monopoly—this time, however, with a difference; for a monopoly controlled by the Government and exposed to keen criticism from its masters is bound to do its best, whereas a private corporation studies only its own financial interests. It may be said that the public, or at least the business portion, are not yet satisfied with the Post Office management of the telegraphs; but it may be as well to remember that they compare very favourably with those of any other nation, and that the business has reached its present enormous dimensions because the work has been done well, and, as Mr. Preece is not slow to acknowledge, the work has been done well because the mode of doing it has been so thoroughly supervised by the public. Complaints are still numerous, and there are not a few who think the public would be better served if the telegraphs were in the hands of competing companies; but Mr. Preece says that there was no thought of introducing a uniform sixpenny rate by any of the companies, and that even where that rate was adopted in town limits, another sixpence had to be paid for the messenger. The uniform tariff advocated by Parliament was a shilling for twenty words, addresses being sent free, and that tariff remained in force from 1870 until October, 1885, when the present sixpenny minimum was adopted, with a simple word tariff of one halfpenny for each combination of letters recognised by the authorities as a "word"—the success of which has, according to Mr. Preece, exceeded all estimate and anticipation. Previous to the transfer of the telegraphs to the Government, the average cost of transmitting a telegram was a little less than 2s. 2d.; after the transfer it was reduced to one-half, and it is now only 8d. Prior to 1870 the number of offices open to the public was 2,932, but as the three companies had each an office in several towns, the actual convenience to the public must be discounted by at least 10 per cent. In 1887 there are 6,514 offices open, and the miles of wire have increased from 68,998 in 1871 to 170,196 in 1886. The development of the telegraphs cannot, however, be rightly gauged by number of offices or by miles of wire; but as a public department, the number of messages gives an accurate idea of the benefits conferred. Thus, in the year 1870-71 the number of messages was less than ten millions, the receipts were £612,301, and the expenditure £350,376. In 1885-86 the number of messages exceeded 39,000,000, while the receipts and expenditure were respectively £1,787,264 and £1,832,401. The account for the present year is not yet available, but it is probable that the number of messages exceeded fifty-two millions, or an increase of more than forty-two millions in seventeen years. In 1816, however, the Secretary of the Admiralty wrote that "telegraphs of any kind are now wholly unnecessary, and that no other than the one now in use will be adopted." The official, no doubt, meant that the war being over the Admiralty had no immediate necessity for improved telegraphs, although they might be worked by day or night at small expense; and yet if the Admiralty had but accepted the invitation of Ronalds we might have had the electric telegraph years before Cooke and Wheatstone, Davy, Henry, or Morse demonstrated its capabilities. The growth of the business in the metropolitan district is remarkable, for the average is 15,000 messages a day, or about ten times the number received in 1871. One great advantage of the transfer of the telegraphs to the Government is the facility now offered for the transmission of news, although the imagined difficulty which the Government would find in doing such work was urged as a great objection to State control of the telegraphs. The rate charged to the Press for messages sent between 6 p.m. and 6 a.m. amounts on the average to a little more than 2d. per 100 words; but as the work is done there is a loss of about £200,000 a year to the Department, due mainly to the large amount of matter which is sent and to unnecessary repetitions owing to competition amongst newspapers. As Mr. Preece says, much of the matter finds its way into the waste-paper basket. Thus, the number of words delivered in one week of the present year as Press messages, exclusive of those sent as "prepaid Press messages," was 9,265,315! On one evening (April 8, 1886) the postal telegraphs sent out 1,050.500 words from the central station, which is, we believe, the largest number on record. In the early days of telegraphy it would have been impossible to accomplish such a feat as that. The rival companies employed various kinds of apparatus—the simple needle system, the bell sounder, the Bain printing, or Morse dot and dash, and the type-printer of Hughes, perhaps the most beautiful of all the early systems. When the Government took over the telegraphs they took with them a heterogeneous collection of instruments and operators, and it was some years before the Department could determine which instruments should survive. According to Mr. Preece, the predominant instruments of 1887 are the simple sounder and the fast-speed automatic recorder; but from a comparative return, we find that in 1886 there were 384 automatic instruments, 3,181 sounders, 1,368 printers, 4,003 needles, 388 bells, 3,883 A B C's, and 5,179 miscellaneous instruments in use in the United Kingdom. It is not a little singular that in the two leading telegraph nations—the United Kingdom and the United States—the method of reading by sound should have been so widely adopted, while there is scarcely a sounder to be found in the offices of the Continent. As Mr. Preece says, this is very remarkable, for the sounder is simpler, more expeditious, and more accurate than any other key system. Important improvements in the carrying capacity of the telegraphs have been found in duplexing, quadruplexing, and latterly in the multiplex or synchronous system of Delany, which we described in Vol. XXXIX., p. 69, and Vol. XLIII., p. 269. The duplex method of working two messages, or sending in opposite directions at the same time, was devised by Gintl, of Vienna, in 1853; but the actual system adopted was that of Stearns in 1872, when the necessity for doing something to increase the capacity of the wires had arisen. That was followed in 1877 by a practical



THE "ONGAR" TOOL-BAR.

system of quadruplex working, devised by Edison; but Muirhead and Meyer had also invented practically successful methods of duplexing, and in 1885 Delany developed the synchronous multiplex system. As a rule, these inventions were developed in the United States, where the want of increased capacity in the line was experienced more severely than in this country. Here the greatest advance has been in connection with automatic telegraphy, for, while in 1870 eighty words per minute was the maximum sending power, in 1887 no fewer than 450 words per minute are transmitted. The desire to attain the greatest speed of working has had some effect in preventing the more extended use of underground wires; but experiments are continually being made with various systems of underground wires, and in London alone there are 255 miles of pipe containing over 10,000 miles of wire. Mr. Preece says all the great trunk lines are free from risk of stoppage by the effects of storms, and there are now 213 offices in London served wholly by buried wires. An adjunct to the electric telegraph of no little value is the device known as the pneumatic telegraph, first introduced by the Electric Telegraph Company to connect their offices with the Stock Exchange. It consists of a tube of lead having a smooth interior which is passed through iron pipes, and laid, as a rule, beneath the footpaths. The written messages are collected together and placed in "carriers," which are blown or sucked to the different stations. At the time of the transfer nearly three miles of these pipes were in existence; but now London has more than 32½ miles, while Liverpool has nearly six, and Manchester more than two miles. Pneumatic telegraphs are also in use at Birmingham, Dublin, Glasgow, and Newcastle. The longest tube is that between the central station and the House of Commons (3,859 yards), and altogether 112 tubes are now in use, of a total length of almost 45 miles. The monopoly controlled by the Postmaster-General applies only to the land lines, and those only so far as message-carrying for profit is concerned, while there are many miles of telegraph beneath the ocean over which the Post Office authorities have no control. Each railway company has a telegraph system which is used for the purpose of regulating the traffic, and which it may fairly be said renders the safe working of the enormous traffic possible. It is estimated that there are at least 80,000 miles of wire used for railway purposes, and probably 20,000 instruments. Although the systems adopted vary, they mostly work well, but in time the fittest will no doubt assert itself. As to submarine telegraphy, no fewer than nine cables now cross the Atlantic, while the total mileage under Government administration and private companies amounts to 112,673 knots, representing an expenditure of thirty-seven millions sterling. Telephoning has little to do with the jubilee of telegraphy, and it is scarcely probable that it will in 41 years from the formation of the first company show such remarkable progress as the telegraph; but it should be mentioned as a useful rival for some purposes, which may perhaps develop into importance when the patent rights expire, though there is not much likelihood of the Department taking it up as a substitute for the telegraph, except perhaps for working local business. Altogether Mr. Preece is justified in saying that we can now add telegraphy to Adam Smith's dictum that the Post Office was the only kind of business the Government had always managed with success.

THE "ONGAR" TOOL-BAR.

THE "Ongar" is a distinctive name given to a tool-bar made by Mr. J. W. Newall, of Bow, E., which he has used with much satisfaction in his own works, and which he offers to the engineering public in the confident assurance that it is a first-class cutting tool, and that it will quickly find its way into all establishments which aim at rapidity and economy of work. It is so shaped as to be almost a facsimile of a knife roughing tool, which, taken all round, Mr. Newall considers to be the most effective roughing tool there is. It is strongly supported almost to the very point. The cutters are readily ground, and as the grinding is all done on the end and side, a good cutting lip is screwed without any attention or skill on the part of the grinder; yet the shape of the point can be varied to suit different classes of work. A long piece of steel is used for the cutters, which is more convenient to grind than a short piece, is considerably stiffer, and is more economical, as only one end is wasted, against three or four where short pieces are used. The wedge used to fasten the cutter holds it firmly and securely, and is easily replaced at a nominal cost if lost or worn out. The bottom of the holder is flat, so that, if desired, its whole length can rest on the tool slide. The immense gain in stiffness, as compared with all tool-holders having a large excrescence in front overhanging the rest, is an advantage which those who have used other tool-holders will appreciate. The steel used for the cutters is of ordinary three-square section, but for the convenience of customers Mr. Newall supplies cutters, ready cut to lengths, either of a first-class quality of cast steel, or of special Mushet steel, so that absolutely no smithing is required. There is an advantage to be derived from the use of Mushet steel in these holders. Owing to the great speed (30ft. per minute of cast iron) at which work can be turned, a gain of 30 to 50 per cent. in time can certainly be made by its use, and, as with these holders no smithing is required, the only obstacle to its use is removed. The bars are made right and left hand, and, if desired, a screw can be supplied for locking the cutters instead of a wedge.

ASTRONOMICAL NOTES FOR JUNE, 1887.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noo		
		Right Ascension.	Declination North.	Sider Tim
	h. m. s.	h. m. s.	° ′ ″	h. m.
1	11 57 31·76 AM	4 36 9	22 3 10	4 38
6	11 58 20·65 ,,	4 56 40	22 39 13	4 58
11	11 59 17·42 ,,	5 17 20	23 5 21	5 18
16	0 0 19·81 PM	5 38 5	23 21 21	5 37
21	0 1 25·02 ,,	5 58 53	23 27 5	5 57
26	0 2 29·71 ,,	6 19 40	23 22 29	6 17

The method of finding the Sidereal Ti Local Mean Noon at any other station w found on p. 382 of Vol. XLIV.

The Sun may be examined from time to for the spots, &c., which have so sudden appeared after the recent protracted per premature and abnormal quiescence of hi face.

At 6 p.m. on June 21st the Sun is said, nically, to "enter Cancer," and summ supposed to commence. In reality, at instant he will be found somewhat t North-West of η Geminorum. The 21 theoretically, the longest day; but no d ence in this respect will be perceptil London from the 19th to the 22nd, on v days the Sun will be 16h. 34m. abov horizon, and, of course, only 7h. 26m. bel There is no real night throughout the n in any part of the United Kingdom.

The Moon

Is Full on June 5th at 10h. 38·3m. p.n enters her Last Quarter at 1h. 34·8m. i afternoon of the 13th. She will be New a 52·8m. a.m. on the 21st, and enter her Quarter at 10h. 1·0m. on the 28th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	9·5	8 25·1 p.m.
6	14·5	*12 3·7 ,,
11	19·5	4 27·3 a.m.
16	24·5	8 2·6 ,,
21	0·0	0 4·0 p.m.
26	5·0	4 38·5 ,,

* After midnight on the 5th.

The Moon will be in conjunction with Ju at noon on the 2nd; with Mars at 7 a. 20th; with Saturn at 5 a.m. on the 23rd; Mercury five hours later; with Venus at night on the 24th; and once more with Ju at 5 p.m. on the 29th.

Mercury

Is an Evening Star throughout the mont as he does not set until nearly 10 p.m. abo

Occultations of (and near approaches to) Fixed Stars by the Moon.

Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
2	94 Virginis	6	8 29 p.m.	Dark	343	335	8 39 p.m.	Bright	326	319
4	49 Libræ	5½	7 55 „	Dark	13	345	8 30 „	Bright	308	284
5	29 Ophiuchi	6	8 52 „	*Dark	87	60	9 59 „	Bright	243	224
6	B.A.C. 6081	6	8 40 „	Bright	54	20	9 39 „	Dark	286	258
10	45 Capricorni	6	11 49 „	Bright	77	42	12 53 „	Dark	305	275
10	44 Capricorni	6	†11 58 „	N. by W.	191	156				
27	10 Virginis	6	†11 36 „	N.N.E.	160	199				
30	ξ^1 Libræ	6	†12 52 „	N. by E.	165	201				

But apparently bright. † Near approaches. A description of the construction and use of this table, with a diagram, will be found on p. 383 of Vol. XLIV.

Jupiter's Satellites.

Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
4	III	Oc D	12	49	p.m.	13	I	Oc D	11	0	p.m.	21	*I*	*Tr E*	12	18	p.m.
5	*II*	*Tr I*	1	46	a.m.	14	*I*	*Tr I*	8	15	„	22	III	Tr I	9	39	„
5	I	Tr I	11	58	p.m.	14	*I*	*Sh I*	9	19	„	22	II	Sh I	10	7	„
5	I	Sh I	12	55	„	14	I	Tr E	10	27	„	22	II	Tr E	10	21	„
6	*II*	*Oc D*	8	24	„	14	I	Sh E	11	31	„	22	I	Ec R	10	36	7„
6	*I*	*Oc D*	9	11	„	15	*I*	*Ec R*	8	41	36„	22	III	Tr E	11	45	„
6	I	Ec R	12	18	33„	15	II	Sh E	10	7	„	22	*II*	*Sh E*	12	41	„
6	II	Ec R	12	54	29„	15	III	Sh I	10	26	„	28	*I*	*Tr I*	11	57	„
7	*I*	*Tr E*	8	37	„	15	III	Sh E	12	20	„	29	*I*	*Oc D*	9	8	„
7	I	Sh E	9	36	„	20	*I*	*Oc D*	12	49	„	29	II	Tr I	10	12	„
8	*III*	*Sh E*	8	22	„	21	I	Tr I	10	5	„	30	*I*	*Tr E*	8	38	„
13	II	Oc D	10	49	„	21	I	Sh I	11	13	„	30	I	Sh E	9	50	„

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

18th of the month, may at this time be caught with the naked eye after sunset, glittering over the N.W. by W. part of the horizon. His angular diameter increases from 5·2″ on June 1st to 8·0″ by the 30th, and he is now generally as well placed for the observer as he can be.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	5	1·7	24	4·0	0	23·0 p.m.
6	5	47·8	25	14·1	0	49·3 „
11	6	30·7	25	18·2	1	12·4 „
16	7	8·8	24	28·2	1	30·8 „
21	7	41·6	22	59·3	1	43·9 „
26	8	8·9	21	6·2	1	51·4 „

Commencing in Taurus, the path of Mercury, as shown in the above ephemeris, extends right across Gemini, and terminates in Cancer. He will not, however, approach any conspicuous star. But he will be in conjunction with Saturn at 9h. p.m. on the 20th.

Uranus

Is so rapidly approaching the West, that he must be looked for as soon as ever the twilight deepens enough. He is in quadrature with the Sun at 2 p.m. on the 30th.

Day of Month.	Right Ascension.		Declination South.		Souths.	
	h.	m.	°	′	h.	m.
1	12	32·1	2	42·4	7	52·3 p.m.
6	12	32·0	2	41·4	7	32·4 „
11	12	31·8	2	40·8	7	12·6 „
16	12	31·8	2	40·8	6	52·9 „
21	12	31·8	2	41·4	6	33·3 „
26	12	32·0	2	24·4	6	13·8 „

It will be seen, from the above ephemeris, that the minute pendulum-like arc described by Uranus this month lies to the S.W. of γ Virginis.

Venus

Is an Evening Star all through June, and continues steadily to grow in size and brilliancy. As she is, moreover, now losing her gibbous aspect, and becoming more nearly dichotomised, she greatly increases in interest as a telescopic object. Her diameter, which is 16·1″ on June 1st, becomes 20·6″ by the 30th. As in the case of Mercury, she is above the horizon latest about the 18th, about which time it is 11 o'clock at night before she sets. She is a most brilliant and conspicuous object to the North of West after sunset.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	7	36·2	23	56·1	2	57·1 p.m.
6	8	0·2	22	58·9	3	1·4 „
11	8	23·6	21	37·8	3	5·1 „
16	8	46·2	20	9·1	3	7·9 „
21	9	8·0	18	29·4	3	10·0 „
26	9	28·9	16	40·1	3	11·2 „

Starting thus from a point below κ Geminorum, Venus crosses the entire constellation of Cancer, and is found in Leo at the end of the month. As in the case of Mercury, she does not approach any conspicuous stars.

Mars

Is still invisible.

Saturn

Has, for all practical purposes, left us until the autumn, and

Jupiter

May be seen during the earlier portion of the amateur's now short night; but as he Souths at 9h. p.m. at the beginning of June, and in bright sunlight (soon after 7h. p.m.) at the end of that, he must be looked for as soon as ever it is dark enough. His angular equatorial diameter decreases from 39·5″ on June 1st to 36·6″ by the 30th.

Day of Month.	Right Ascension.		Declination South.		Souths.	
	h.	m.	°	′	h.	m.
1	13	40·9	8	59·6	9	0·8 p.m.
6	13	39·9	8	54·7	8	40·1 „
11	13	39·1	8	51·5	8	19·7 „
16	13	38·5	8	49·8	7	59·5 „
21	13	38·3	8	49·8	7	39·5 „
26	13	38·3	8	51·4	7	19·9 „

This very short retrograde arc is described to the E.N.E. of Spica Virginis.

Neptune

Is still invisible.

Shooting Stars

Are most likely to be seen on the nights of the 6th and the 20th.

Greenwich Mean Time of Southing of Eight of the Principal Fixed Stars on the Night of June 1st, 1887.

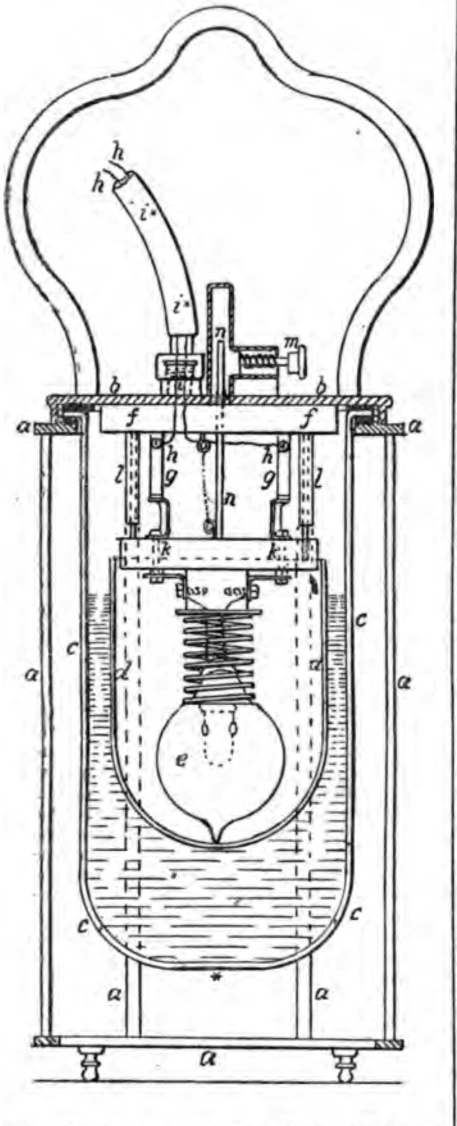
Star.	Souths. h.	m.	s.
η Ursæ Majoris	9	3	0·61 p.m.
Arcturus	9	30	21·42 „
α Libræ...	10	4	23·56 „
α Coronæ	10	49	32·49 „
α Serpentis	10	58	19·03 „
Antares...	11	41	58·97 „
α^1 Herculis	12	28	51·76 „
α Ophiuchi	12	49	0·06 „

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above List for any other night in June, as also that of determining the Local instant of its Transit at any other Station, will be found on p. 384 of Vol. XLIV.

SETTLE'S ELECTRIC SAFETY-LAMP.

As many of our readers are aware, Mr. Miles Settle, of Darcy Lever, near Bolton, a practical mining engineer, has been devoting much attention to the perfecting of an electric safety-lamp for use in fiery mines. He has patented his invention, and in the annexed engraving we show in section the lamp in one of its forms, as improved on previous designs. Instead of having a separate reservoir above or below the lamp to contain the float (as described in an earlier specification), he places the latter in the water contained in the outer glass casing and between it and the globe of the lamp as shown in the figure, and in order not to obstruct the light the float of glass is made in the form of a cup open at the top (or closed), in which *a*, *a* is the metallic framing of the lamp, *b*, *b* the screw cap or head, *c*, *c* the outer bell glass containing the water, *d*, *d* the internal glass or cup which forms the float, and *e*, *e* the incandescent electric lamp. The water may be introduced by means of a funnel and tap (not shown in the drawing) or by unscrewing the head *b*, *b*, and an opening may be made at *, closed either by a tap or plug, for allowing of the escape of the water when required. To the inside of the head *b*, *b* of the lamp he affixes a block *f*, *f* of wood, vulcanite, or other suitable material, to which are affixed (by screws or otherwise) two metal contact pieces *g*, *g*, which are in electric contact with the main conducting wires *h*, *h*, which enter the lamp through a stuffing box at *i*, *i*, and are inclosed in an elastic tube *i*×, *i*×, which may be filled with water or other protective medium. Inside the top of the internal glass cup or float *d*, *d* is a movable piece of wood, vulcanite, cork, or other suitable material *k*, *k*, which is provided with two similar contact pieces *g*×, *g*×, in electric connection with the wires of the electric lamp *e*, *e*.

This piece *k*, *k* may be placed loosely in the mouth of the cup *d*, *d*, or it may be fixed liquid and gas tight therein, and it works in or upon tubular or other slides *l*, *l* attached to the block *f*, *f* so as to be capable of moving towards or from the latter, so as to make and break contact between the contact pieces *g*, *g* and *g*×, *g*×. In the modification shown, the globe of the electric lamp *e*, *e* rests upon the inside of the glass cup or float *d*, *d*, and supports the movable piece *k*, *k*. In another modification the electric lamp is suspended from the movable piece *k*, *k*, which closes the top of the glass float *d*, *d*. It will be evident that so long as the water in the outer glass bell or case *c*, *c* is at or above the normal level the float *d*, *d* will sustain the electric lamp *e*, *e* and keep the pieces *g*, *g* and *g*×, *g*× in contact with each other, as shown: hence the electric current will remain unbroken and the incandescent lamp *e*, *e* will continue to burn; but if, from breakage of the outer glass *c*, *c* or from leakage or other cause the water should escape from the outer casing, then, as the level of the water falls and lowers the float *d*, *d*, the incandescent lamp *e*, *e* will fall with it, and will break contact between the pieces *g*, *g* and *g*×, *g*× and the light will be immediately extinguished.



If the movable piece *k*, *k* be made of cork or other equally buoyant substance, it will act as a float, and the glass cup *d*, *d* may be dispensed with. The water employed may be impregnated with carbonic acid gas, or other suitable liquid may be used instead thereof, or, if preferred, any suitable gas or aëriform fluid (under pressure or otherwise) which will produce the same result of sustaining the movable piece to which the incandescent lamp is suspended (so as to keep up the electric contact) may be employed in this lamp in the place of water. In order to prevent the possibility of accidents by the contact pieces *g*, *g* and *g*×, *g*× being brought together after the glass has been broken, he uses a spring bolt *m*, *m*, which, when the pieces *g*×, *g*× have once fallen out of contact with the pieces *g*, *g* and extinguished the light, locks them in that position until released by hand. In the modification shown, the spring bolt *m*, *m* shoots above the top of a rod *n*, *n* attached to the movable piece *k*, *k*, and thus holds the latter down until the bolt *m*, *m* is withdrawn by means of the button. In another modification the spring bolt is held up by means of a pin, which is withdrawn by levers when the float falls, and cannot be replaced until the spring bolt is raised up by hand.

MAGNETISM IN WATCHES.

A RESULT of electric action, which is probably but little known or appreciated by the mass of the community, is its effect upon the timekeeping qualities of watches; but it is, nevertheless, true that electric and magnetic influence have a much greater effect on the rate of a watch than either temperature, position, or isochronism, and with all the perfection which has been attained in watchmaking there is a mysterious and subtle influence which disturbs and destroys the mechanical accuracy which should result from such perfect work. This question of magnetism has been brought prominently before the horological fraternity, and it has long been considered that the great desideratum to be found was a correct timepiece, which should be proof against magnetic action. Many attempts have been made to produce such a watch. Gold balances and hair-springs have been employed, but they could not be adjusted to temperatures, and in time the gold hair-springs lost their elasticity. A watch provided with a non-compensating balance loses from ten to eleven seconds in twenty-four hours by an increase of heat of one degree Centigrade, and therefore could not be depended on for correct time.

The first step towards success in this direction was the invention of a palladium hair-spring by M. Carl A. Paillard, a celebrated adjuster of Geneva, and this has been completed by the Non-Magnetic Compensation Balance, also invented by M. Paillard, which entirely overcomes the difficulties heretofore encountered from magnetic action. The invention consists of making the compensation balance and hair-spring of an alloy of palladium which is not affected by magnetic action, rust, or by moderate acids, and yet retains those qualities necessary for the closest adjustments to temperature and isochronism. Careful tests have been made with scrupulous exactitude, and the bulletins obtained at the Geneva Observatory with watches possessing these hair springs and balances have confirmed in a most striking manner all the calculations and fondest hopes of M. Paillard.

If the regulating part of a watch, that is to say, the balance, together with the hair-spring, should be badly affected by magnetism, which happens very often, it is clear that the going of the watch will suffer more or less, according to the fineness of construction and the delicacy of its adjustment. There are two great destroyers or enemies of all the most delicate steel parts of these little machines we call watches; one is corrosion, or rust, and the other magnetism, with all its pernicious and erratic influences. The necessity of protection for watches against magnetism has called forth inventors of machines and devices for demagnetising watches that had become affected, and of a sort of soft iron shield or armour, for enveloping the watch as a defence or preventive against electrical and magnetic influences. But all these are defective, for most are cures after harm has been done, and the defence provided would not stand against powerful currents.

The facility with which magnetism is developed in watchmaking is very great, and the causes which increase its prevalence abound more every day, so that it is easy to understand the value of the discovery of M. Paillard and the importance which it represents for the maintenance of a uniform rate in chronometers and high-class watches. It necessitates a very considerable amount of magnetism to cause a watch to stop; in fact, this rarely happens from magnetism alone, but its presence, even in a minimum force under most conditions, is sufficient to cause a complete disarrangement of its timekeeping qualities.

When the balance-wheel of a watch is exposed to magnetic action, its motion is retarded or accelerated as it crosses the lines of magnetic force. The wheel, composed of brass and steel, swinging rapidly over and near to other pieces of metal, encounters a certain amount of electric or magnetic resistance. These influences are intensified by the thermal currents induced by the heat of the body, the electricity and magnetism produced by the motion of the body, friction of the clothing, influence of magnetic belts, electric pads, and like appliances. In many persons this magnetism is so strong that it is impossible to regulate a watch closely in their pockets.

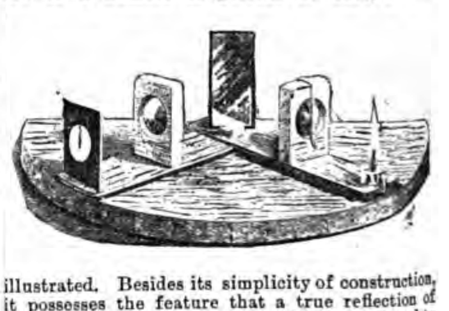
The compensation balance and hair-spring are the parts fatally affected by magnetism and electricity. The balance becomes a compass, whose poles tend to point north and south, thus interfering with its free and regular action; the coils of the hair spring are attracted towards the balance-wheel, and stick to it or themselves, and the regulation of the watch is destroyed and it usually stops. The introduction of a piece of magnetised steel, a case-spring, for instance, inside of the case, is sufficient to destroy its accuracy as a timekeeper, as the balance and hair-spring will be attracted by the case-spring, and their regular action impeded. A watch is the most delicate known piece of mechanism; it has been pronounced the culmination of mechanical skill in the adjustment of balance and hair-spring, which were, up to a recent period, of necessity, made of metals the most susceptible to the forces of electricity and magnetism.

If we submit to the influence of a rather powerful magnet a piece of steel from a watch movement, the neutral state ceases immediately, for the piece instantly becomes permanently magnetised. This new state is easily proven in the presence of a magnetised needle; a light and very sensitive mariner's compass is a cheap and reliable instrument for this purpose. This subtle agent for mischief in watches—magnetism—can be produced in a great variety of ways, and one can say without fear of misstatement that it does exist in nearly all finished watches, and this is particularly true of these that are fine and complicated. It is manifestly difficult, if not impossible, for the modern artisan and citizen to always keep his watch outside the electrical danger line, for some of these great machines have an electrical field of great, if not unknown, extent. In view of all this it is easy to understand the importance of M. Paillard's invention of a balance and hair-spring wholly unaffected by magnetism. In this age of the universal use of electricity this is indeed a matter of no mean importance to the art of watchmaking, and to employés of railroads, electric and telephone work and offices, engineers, conductors, and all whose business calls them among the multiplicity of electrical devices, the invention is of inestimable value.

Great credit is due to M. Paillard for this discovery, made only after long years of patient, persistent toil and application. Many years were devoted to the experiment before he succeeded in producing a non-magnetic hair-spring possessing the other essential qualities of a balance-spring. This great application on his part illustrates the zeal and love of their art which characterise the Swiss watchmakers and which will always enable them to stand at the head of their profession in the manufacture of fine watches. A company has been formed, with headquarters in New York, and factories in Switzerland, for the purpose of manufacturing and supplying the trade with watches of all grades, containing Paillard's non-magnetising balance and hair-spring, and it is expected these watches will be on the market during the coming fall, and as prices of non-magnetic watches will be no higher than those of ordinary watches, they will be within the reach of the masses. We believe we are right in saying that M. Paillard has enabled the modern horologist to introduce into watches and chronometers a new element of accuracy and preservation, and has supplied a want actually existing.—*Electrical Review* (N.Y.)

APPARATUS FOR ILLUSTRATING THE LAW OF THE REFLECTION OF LIGHT.[*]

A SIMPLE apparatus for illustrating the equality of the angles of incidence and reflection, and which can be used to demonstrate the law to a number of persons at once, is here illustrated. Besides its simplicity of construction, it possesses the feature that a true reflection of light is used. Sometimes a marble is employed to represent a light ray, and is shot against a flat surface from which it rebounds, and the angles are determined. This gives a representation of the law only, not a demonstration. The methods involving the production and reflection of a parallel beam of light, either from the *porte lumière* or the calcium light, are very beautiful, but demand a somewhat extensive apparatus or sunlight. These are not always attainable. In the apparatus shown, a candle is the only source of light needed, and it is sufficient to show the experiment to a roomful of auditors. The room need not be darkened, although a slight degree of obscurity is



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[*] By T. O'CONOR SLOANE, Ph.D., in the *Scientific American*.

Such as can be produced by ordinary ' shades is enough.

ɔce of wood is sawed out into a portion of) slightly more than a semicircle. At the of the diameter, which is parallel to the ne, an inch hole is bored. Into this a : pin of wood is fitted. The upper portion ɔin is cut away, back to its diameter, so as e exactly one-half of the cylinder intact. ɔrtion should be about an inch long.

placed in the hole, and is made exactly l by wedging if necessary. The plane , where the half cylinder is cut away, faces ular and front portion of the board, and by of a straight-edge is placed as nearly l as possible to the line of the back. The st be fixed very securely in this position, ɔy glue or by a screw driven in from the

ıall piece of looking-glass in temporarily d to the flat surface of the pin. A fine, ly straight wire or delicate plumb line is front of it near the line of the circle, and is until it covers its reflection in the mirror. ition it occupies is the zero of the divisions, o marked on the edge of the circle. From a starting-point equal divisions are laid off ight and left, and numbered in correspond- es. If divisions of equal linear length are ey will necessarily be equi-angular.

strips of thin wood are peforated near one :h a hole just fitting the round portion of . Near the front of one strip, a hole is ɔf such size as to hold a candle. Near the f the other, a screen of wood with ⅛in. hole ed, over which hole a piece of white paper d. 3in. or 4in. back from the candle on one nd from the screen on the other, wooden are secured, which are perforated, and re- ɔnvex lenses of corresponding short focus. ıs lenses such as used by spectacle makers perfectly. The holes in which they are set ɔe recessed with a shoulder for the glass to ıst, or rings of pasteboard may be glued on ide to hold them in. A tolerable fastening obtained by gluing each lens to the face of ɔd, the holes being made slightly smaller. ır preferable to use the other method of them in the wood. As one strip rides upon ·r, its outer end, by a batten or brass-headed erer's tacks, must be raised to keep it level. ıses must both be at the same elevation. for the reason just mentioned, one must set lower in its block. The centre of the hole creen must correspond with the height of re of the lenses.

:ce of wire, which should be of spring is bent so as to spring over the lens on the bar across the centre of the face of the ut not touching it. Finally, to secure ·ss, the board should rest upon three feet. eaded tacks such as already mentioned will for this pupose. In general terms, the from the candle to its lens, and from the ns to the screen, should be equal to the stances of the lenses. The exact relative is best found by trial, the blocks not being fixed until the position has been experi- y verified. The apparatus is used in the now to be described, and the relative posi- the lenses are tried in the same way.

andle is lighted, the mirror is put in place, strip is moved until its end comes over any ıumber. The other strip with the screen ıoved around until over the corresponding on the other side of the zero mark. As it this position, the aperture in the screen be- rightly illuminated, and the shadow of the ɔears crossing the centre of the circle. Thus, es being equal, the light is manifestly re- t an angle equal to that of its incidence. The ust be set so as to bring out the projection ar sharply, and to secure good illumination lle must be placed well below the bottom ɔns. The strips may be moved about from to number, but the shadow or projection wire will only appear crossing the illu- disc when the numbers correspond.

:e of looking-glass 1in. wide and 1½in. long ɔnough, but a larger one is to be recom- By a rubber band or other fastening it secured with its back firmly against the 'ace of the pin. It should correspond in ·ith the lenses, and the plane of the quick-silvering on its back should correspond true diameter of the circle.

CONDUCTIVITY OF METALS.

: a copper ball about 3in. in diameter, and ·er it with a piece of muslin or a fine handkerchief. Upon the ball thus covered glowing coal taken from the fire with a ongs, and then blow on the coal, in order : it incandescent. The coal will continue brightly without in any way burning or ; the fabric upon which it lies. The reason of this is that the metal, being an excellent conductor of heat, and having, at the same time, great calorific capacity, absorbs all the heat developed by the combustion of the coal, and the fabric, taking up scarcely any of the heat, remains during the entire experiment at a temperature less than that at which it would be harmed. This experiment can be performed in a more remarkable manner. Take a cambric handkerchief, and cover a gas-burner with it. It is indispensable that the tip of the latter shall be of metal. If the cock be turned on and the gas be lighted; the latter will burn above the handkerchief without harming it (Fig. 2). In order to succeed in this experiment, it is necessary that the handkerchief shall be applied closely to the metal, and that there shall be no wrinkles in it where it covers the tip of the burner. It is well to hold it in position by means of a fine copper wire, as shown in the figure. In these experiments, we would recommend our readers to use nothing but very fine cambric, and that which is not of service, so that they will not have to regret the ruination of a good handkerchief in case of want of success. These experiments, when properly performed, succeed perfectly. We have tried them several times ourselves.—*La Nature.*

FIG. 1.

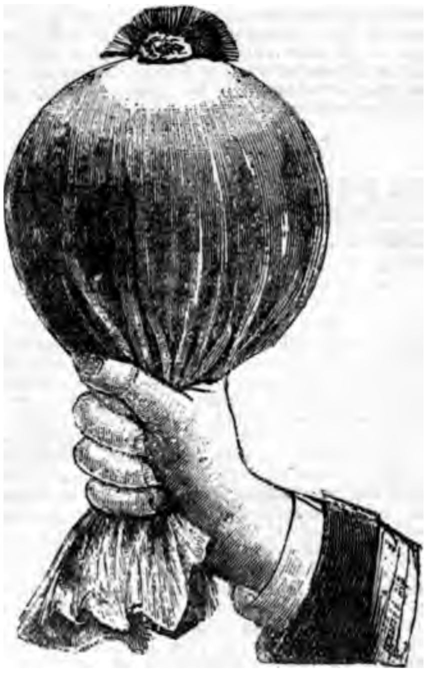
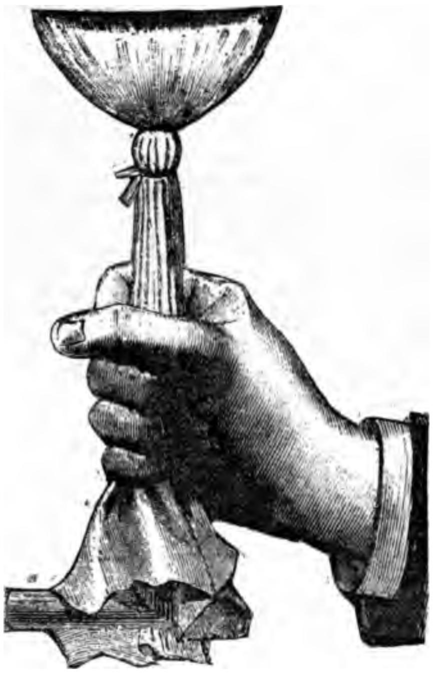


FIG. 2.



TRACTION INCREASERS.

TRACTION increasers, their uses and best forms, will be discussed at the next master mechanics' convention. No better subject for discussion could be found for such a body of men as will then be present—men who are intimately acquainted with the locomotive, and those who are acquainted with traction increasers in everyday use, as well as those who are interested in the manufacture of these devices. The advisability of using some device for increasing the weight upon the drivers in nearly all the older locomotives and many of the newer ones is beyond question. Few locomotives exist which would not do more work with greater economy if they had greater adhesion to the rails. That is, the cylinders are larger than need be to do the work with the steam pressure carried. The amount that the adhesion may be economically increased varies with the different locomotives; but in many instances can be so increased as to add 20 per cent. to the hauling capacity, and this without decreasing the economy of the locomotive. For those who have not been able before to look into this subject, a notice of a few of its leading features will be necessary to put the matter in its true light. Traction increasers may be divided into two distinct, wholly different, and antagonistic classes. In one of these the increase of traction is produced by adding to the locomotive a permanent load over and above the weight of material necessary to construct all its parts with perfect safety, thus obtaining an increase of adhesion. In the other class a portion of the weight of the tender is added at the rear of the locomotive by a device, consisting of levers or their equivalent, on the rear of the engine or front of the engine. The greatest difference between the two methods is, increase in the total weight of the locomotive and tender in the first case, and non-increase in the second. There is, of course, beyond the question of safety and convenience, only one side from which to look at these methods, and that is the comparative final expense. The cost of the first method, or permanent type, will of course vary with the cost of the material used to produce the extra weight. This is almost always cast iron, and costs the locomotive manufacturers and railroad companies owning foundries about two cents per pound, as the iron is of the lowest grade. The first cost of the shifting device will vary with the competition. The cost of maintaining the permanent type will be almost nothing, while the shifting type requires repairs and attention. The wear and tear of roadbed due to the constant additional load in the permanent type will disappear in comparison to the total load passing over the road, and for both types may be neglected.

The cost of transporting the additional load in the permanent type is against its use. The cost may be called its maintenance, which it really is, and as such may be compared to the maintenance of the shifting type. The cost of transporting this additional load is less than the cost of the same weight on any other part of the train, for two reasons:—First, because the resistance of each ton additional after the locomotive has reached its normal weight does not increase the total resistance as much as the average resistance of the total locomotive per ton; that is, the average resistance of locomotives thus loaded to increased adhesion is less than the average before such load is added. Second, because the load is nearer the point where the power is applied and is carried easier, particularly on curves. The probable average resistance on a level of this additional load is 2lb. per ton. The only outlay to overcome this resistance is in the fuel furnished to the locomotive, and the amount required is about 2,900lb. per year, determined as follows:—

2lb. at rim of a 5½ft. wheel will overcome the resistance of 2lb. per ton. This causes about 10lb. additional presssure upon the crank pin; distance travelled by crank pin per mile = $\frac{2}{5\frac{1}{2}} \times 5{,}280 \times$ = 1,920ft.; ft.-lbs. of work per mile = 10 × 1,920 = 19,200; mileage per year = about 60,000; ft-lbs. of work per year = 19,000 × 60,000 = 1,152,000,000; allowing 5lb. of coal per H.P. per hour = $\frac{1}{12}$lb. of coal per each 33,000ft.-lb; pounds of coal used per year = $\frac{1}{12} \times \frac{1{,}152{,}000{,}000}{33{,}000} = 2{,}909$lb.

Assuming the cost of the coal to be 3dol. per ton, we have the cost of the fuel per year to be about 4·35dol. The interest on the first cost of the additional metal will be about 2dol. per ton, making the total average cost per year per ton of metal added to be 6·35dol. Ten thousand pounds, or 5 tons, is about the amount of additional weight desirable on the average locomotive. This makes a total cost of 31·75dol. per year for the permanent type. There seem to be no objections to this method of increasing the adhesion, unless it be the heating of the driving journals; but this is unnecessary, as nearly all the driving journals are capable of running cool and withstanding an additional load of 10,000lb. In favour of the permanent type is the increased safety of the engineer when the additional weight is put into the cab-stands and in the running boards. Their solid and heavy masses will resist the blows of a broken rod and thus protect the engineer. The cost of the maintenance of the shifting device is difficult to determine. The original cost is also impossible to state, as competition would soon reduce it below its present figure. The objections to this device are not many, but of some moment. The variation in the pressure upon the driving springs will cause the locomotive to ride hard, if it can withstand the increased load when added by the increaser. The variation in the weight of the tender is great, and it may be that at all times it would not be safe to remove from the tender trucks all the weight that might be called for by the locomotive. Any device that blocks up or otherwise calls for space under that already crowded place, the under side of the foot-plate, is asking much, and will not please constructors of locomotives.—*Master Mechanic.*

SOLDERING LEAD SEAMS.*

THE mechanic often has sheet lead to solder, and without going properly to work, this is apt to prove an awkward job at best. Suppose two plain pieces of sheet lead are to be soldered, and the two pieces are loose on the bench. First, flatten both pieces with a mallet, then trim the edges to be joined until they are straight, or until they will fit each other nicely. Next, bevel the two edges, by scraping the upper corner of each, until they lie a suitable distance apart when the lower edges are in contact. Scraping back the metal about one-half its thickness leaves a suitable channel for the solder, and when both pieces of metal are thus treated, the space left will be about in section like an equilateral triangle—that is, the place for the solder will be three-cornered. By using a flat soldering copper, or a "hatchet copper," as commonly called, it is easy to heat both sides of this space very quickly, especially if the copper be dressed to fit snugly therein. The next operation is to fasten the pieces of lead firmly in position, either by clamps, weights, or by nailing. Give the edges a final touch with the mallet, to make sure that they lie quite flat, then dust on a little powdered borax. Have the copper at just the right heat to melt the solder easily. If too cold, the lead cannot be sufficiently heated to enable the solder to unite, while if the copper be too hot, the lead will be melted away, to the destruction of the whole job. An experienced man will easily judge the requisite temperature by holding the copper within 2in. or 3in. of his cheek, as he removes the copper from the furnace. The temperature can be approximated to a great nicety in this manner, and also done very quickly.

With the sheet metal fastened in position and the coppers all hot, then proceed to draw a seam. Wipe off one of the coppers on a piece of wet rag, and touch the copper to a bar of solder. Now place the copper in the seam and run it slowly backward and forward until the solder "takes" to the lead. Make the movement of the copper only about an inch, until the seam is started, then draw the tool slowly along toward the opposite end of the seam, at the same time touching the copper, just above the seam, with a bar of solder. Just sufficient solder must be allowed to melt down to fill the seam. If too much or too little solder be used, the seam will be overflowed and bungling, or it will be scant and only part full. Here is where skill and experience come in. The copper must be just hot enough, moved just fast enough, and the solder melted into the seam just right. A great deal also depends upon the quality of the solder used. It must contain the requisite quantity of different metals to make the solder melt at a temperature below the melting point of lead, which is about 600°F. Common solder, composed of two parts tin and one part of lead, melts at about 340°F., and will do very well for soldering lead. Don't get stingy enough of tin to reverse the rule and use two parts lead to one of tin; this makes a solder which requires 441° of heat to melt it. Lead may be be soldered without resin, by using tallow as a flux. In fact, tallow is the natural flux of lead, just as resin is of tin, sal ammoniac of copper, and borax or lime the flux of steel. For "wipe joints" tallow is used exclusively, and works perfectly; but the addition of a little resin in many cases improves the working of the tallow.

Solder joints in sheet lead are best made while the metal is lying level; but a man can drink while standing on his head, and so lead joints may, if circumstances demand, be made in perpendicular sheets of lead, with seams running both perpendicular and in a horizontal direction. As an extreme illustration of what can be done, a joint can be made overhead. To make a joint on a perpendicular sheet of lead I like to have a piece of smooth, cold iron or steel, and with this tool follow immediately behind the soldering copper to chill the solder before it has time or opportunity to run away from the copper. If the cold iron be followed up within ⅛in. or ¼in. of the copper it will hold the solder and prevent the least particle from dropping. Overhead seams must be made differently, and it is a slow and tedious process. Mix the resin with a little water to make it adhere to the seam, then take up a little solder on the copper, and let it melt on to the lead of the seam. After one drop of solder adheres take up another drop and proceed likewise. The best way to solder overhead seams is to avoid them entirely by fitting the lead so they are dispensed with, by fitting the lead and by removing for soldering, or by turning the work upside down while soldering.

THE PHYSIOLOGICAL CONNECTION BETWEEN THE HEART AND THE LUNGS.

THE Vienna correspondent of the *Lancet* writes:—Prof. Ernst von Fleischl, the well-known Vienna physiologist, has recently put forward an ingenious view concerning the influence of the heart beat on the respiratory changes in the lungs. His theory is based on a very interesting, but hitherto unknown, physical phenomenon he had occasionally observed. If a liquid containing an absorbed gas be exposed to negative pressure—to a vacuum—only a small quantity of the gas absorbed can be extracted, ascending in visible bubbles through the liquid; but if the liquid had been shaken by a single blow or impact just before commencing the exhaustion process, nearly the whole of the gas absorbed is rapidly set free, the liquid assuming a froth-like appearance. The quantity of the gas thus exhausted is one hundred times larger than that withdrawn without impact. This action of the impact on solutions of gases in liquids is, as I believe, somewhat analogous to the well-known phenomenon of rapid solidification of water cooled below the freezing point, or of instantaneous crystallisation of hot saturated and then slowly cooled solutions of Glauber's salt, also initiated by a sudden impact. At a recent meeting of the Vienna Society of Physicians I had an opportunity to see some of Professor von Fleischl's experiments, which can easily be repeated by means of a hypodermic syringe furnished with a stopcock. By a slow upstroke of the piston the lower portion of the syringe is filled carefully with water which has been exposed to the air for a short time; the orifice is then closed by turning the stopcock. The piston is now drawn upwards as far as possible, and then released slowly and cautiously until it touches the water again. By this exhausting action some gas bubbles are formed, which are to be expelled by opening for a moment the orifice and inverting the syringe. Then the liquid is shaken by a single blow exerted against the piston, or by releasing it suddenly. If a short time (half a minute) after the concussion of the liquid the piston is drawn upwards again as far as possible, the previously clear liquid becomes rapidly white, like an effervescent mixture, by the froth formed by the sudden and copious escape of the gas. In explanation of this phenomenon, Professor von Fleischl suggests that by the impact the physical connexion of the molecules of the gas and of the liquid is altered, and that the real solution of the gas in the liquid is transformed into what he calls a "molecular mixture," wherein the gas molecules, previously closely connected with the molecules of the liquid, are lying free in the interspaces between the molecules of the liquid, from which they can easily be withdrawn if the liquid is exposed a short time after the impact to a vacuum or to the process of diffusion. Now, the blood is also a liquid containing absorbed gases. The entrance of oxygen can be easily explained by the properties of the coloured blood-corpuscles, but the exit of carbonic acid has till now received no elucidation, for the rate of pressure of the alveolar air is not sufficient to secure the diffusion of the gas from the blood serum wherein it is dissolved into the air. The Professor assumes that the diffusion of the carbonic acid of the venous blood into the air of the alveoli is only made possible by the action of the impact imparted to the blood in the pulmonary artery by the systolic contraction of the right ventricle of the heart. By this impact the physical condition of the blood entering the alveolar capillaries of the lungs is changed, the solution of carbonic acid in the serum being converted into a "molecular mixture" from which the gaseous carbonic acid can diffuse freely through the alveolar walls into the air. He believes also that cyanosis is due to a weak action of the heart muscle, which cannot impart to the blood an impact sufficient for preparing it for diffusional exchange, so that its carbonic acid cannot be fully discharged. This view of the action of the heart on the respiratory changes seems also to be supported by facts of comparative anatomy.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE eighth meeting of the session was held on the 11th inst. at King's College, Strand, the President (the Rev. Dr. Dallinger, F.R.S.) in the chair.

The President said that some time ago an alteration was made in the by-laws, under which 100 presidents of other scientific societies were eligible for election as ex-officio Fellows, and 78 presidents were so elected. It seemed, however, that the presidents of the Royal Society, the Linnean Society, the Royal Society of Edinburgh, and the Royal Irish Academy had not been included, probably because the eminence of these societies would cause it to be assumed that their presidents would be elected as a matter of course. The meeting now, no doubt, would be pleased to agree that the presidents he had mentioned should be added to the list. This was agreed to unanimously.

Mr. Crisp called attention, amongst the donations, to Dr. Crookshank's new work on the photography of bacteria; also to a number of slides of hair which Dr. Ondaatjee, of Ceylon, had forwarded to the society with a request for information as to its peculiarities of structure. If any Fellow would take the slides for examination and report to the next meeting, they would be glad to lend them for the purpose. Attention was also called to the intended re-delivery by the President on the 16th inst. of the lecture which he gave with such success at the meeting of the British Association in Canada.

Mr. Deby presented 62 slides, chiefly of micro-hymenoptera, which came from the collection of the late Mr. Frederick Smith. There was also amongst them a complete series of slides illustrative of the development of the larva of a *Pediculus* from its first coming out of the egg to its mature condition.

Prof. Bell said that the late Mr. Frederick Smith was so careful an observer and collector as well as so skilful a mounter, that he felt sure that the present they had received was even of greater value than perhaps could be gathered from what Mr. Deby had said about them.

The President thought that the best thanks of the society were due to Mr. Deby for his valuable donation, and a vote of thanks to him was unanimously carried.

Mr. J. Mayall, jun., said that he took it for granted that the Fellows were interested in whatever concerned the history of the microscope, and would therefore be glad to know of any new facts which tended to throw light upon the subject. They were told by some of the best authorities that the notes by Roger Bacon could hardly be considered as demonstrating that he had a practical knowledge of the use of magnifying lenses, and that his claim to be the inventor of them must be set aside. Fracastoro, the eminent Italian physician, had referred to the magnifying power of lenses in a vague manner in his "Homocentrica," published in Venice in 1538; but this reference did not point to practical knowledge. Giovanni Baptista Porta had also been credited with the invention; but later writers, including Poggendorff, were doubtful if such was the fact. Libri was inclined to credit Galileo with the authorship—at least, of the combinations forming telescopes and microscopes; but, on the other hand, it was certain that telescopes were known in Holland before Galileo's construction of these instruments. The evidence which he had come across lately conclusively showed that magnifying glasses were used at least as early as 1513-1520, for in the celebrated portrait of Leo X. by Raphael the Pope is shown holding one in his hand. This picture was painted between 1513 and 1520, as the Pope was elected in 1513, and Raphael died in 1520. He had brought to the meeting a large volume which had been lent for the purpose by Mr. Quaritch, and which contained an engraving of Raphael's portrait of Leo X., so that the Fellows would be able to inspect it after the meeting. During a recent visit to Florence he also paid some attention to the microscopes which had been attributed to Galileo. It was, of course, rather difficult to say in such matters what was really authentic and what was not; but when these instruments were shown at the Loan Collection at South Kensington, there were suggestions made that they had been prepared for that exhibition, though he was assured by Prof. Meucci that they could be identified certainly since 1670, if not earlier. He could not, however, help noting that all the early telescopes made in 1660, or about that time, had cardboard tubes, and wood or horn cells for the lenses, whereas these microscopes were made with substantial brass body tubes with strong and well-made screw threads and firm tripod support. He could only say, therefore, that if the microscope makers had arrived at that stage of perfection in Galileo's time, they had reached a point not attained by his successors until many years afterwards.

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* By JAMES F. HOBART, in the *Manufacturers' Gazette.*

Mr. Mayall, in reply to an inquiry as to the apposed lens from Nineveh, said he could not add ore to what he had already stated in the Cantor ectures, that he did not find this so-called lens ufficiently clear to be used for magnifying purposes. t was made of rock crystal, and he thought that hoever intended to use it as a lens would have elected a piece without the veins across, which so narred it for that purpose, though, regarding it as n ornament, they rather added to its beauty. He hought Sir David Brewster had been rather hasty n coming to a conclusion about it. There had een also two pieces of glass found which had een taken for lenses, being plano-convex. One it vas not possible to see through, the other was artly polished and might have been used as a urning glass; but he had spoken to many uthorities about them, amongst others to Mr. ladan, and they seemed of opinion that they were ntended to be used as ornaments for the person, ossibly for the helmet, or for the shoulder of the unic.

Mr. J. Mayall, jun., also exhibited a microscope hich had come from Japan. It was made after ne of the old upright tripod models, and had a ing of inlaid silver ornamentation at both top and ottom, which was made with characteristic skill; ut the person who had produced the instrument, hough he had provided a place for the objective, ad omitted to make any provision for the eyeiece.

Mr. Crisp remarked that though there was no lace for eyepiece lenses, yet there was an eyepiece uard to keep the dust out.

Mr. J. Beck said he had been examining the nicroscope, and he could only say that he thought a great libel upon the Japanese to attribute such thing as that to them—a bogus microscope. He ould only suppose that it was the work of some mateur who got some Japanese rings of inlaid opper, and made the rest himself. Anyone had nly to look at the so-called fitting of the tube—hich was no fit at all—to see the class of work, nd for his part he did not believe it was Japanese ork at all; there was English milling on the illars. He had a large number of Japanese nstruments, the workmanship of which was as fine s anything produced here.

Mr. Mayall said it would be folly to declare ithout actual knowledge that it was Japanese ork, but it was quite certain that it was obtained rom Tokio, and that it came direct here from okohama. Probably milling tools of English nanufacture might have been used, as many other inds of tools were used in Japan, and the ornanentation was undoubtedly Japanese work.

Mr. Deby said that many scientific instruments f English make were sent out to Japan, and he emembered seeing on one occasion 64 first-class nicroscopes being sent there by order of the gent of the Japanese Government. If, therefore, he people there were well acquainted with microcopes made by Mr. Beck and others here, it would e useless for anyone there to produce such a one s that upon the table, as they would be quite ertain that no one would purchase it.

Dr. Maddox's paper "On the Different Tissues ound in the Muscles of a Mummy" was read by Ir. Crisp, Dr. Maddox being unfortunately still nable to attend the meetings of the society.

Prof. Bell said it was exceedingly interesting to ind that a people who were so despised at the present time had succeeded in preserving the tissues f the body in this very remarkable way.

Prof. Bell gave an account of a recent visit which he had paid to M. Pasteur's laboratory in Paris.

The President felt sure that the Fellows were very much obliged to Prof. Bell for the very interesting account which he had given them, and for which their thanks were due.

Mr. Deby called attention to a series of double-stained sections of the rare parasitical plant, *Brugmansia Löwii*, one of the Rafflesiæ, but differing in its being hermaphrodite. It grows on the overground roots of a species of *Cissus*, and was collected by him in 1884 in the Raritan range of mountains in central West Sumatra. The sections show the development of the plant from the time it begins to raise the bark of its host as a minute tubercle up to the complete maturity of the ovules. The double-staining allows of distinguishing the limits between the tissues of the parasite and of its host, which on unstained sections cannot be determined. The formation of the locula of the ovary is very remarkable, and partakes more of a fungoid growth than phanerogamic.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday, the 18th inst., at the Institution of Civil Engineers, 25, Great George-street, Mr. W. Ellis, F.R.A.S., president, in the chair.

Mr. A. S. Marriott and Capt. Paul Mordovin were balloted for, and duly elected Fellows of the society. The following papers were read:—

(1) "Brocken Spectres and the Bows that often Accompany Them," by Mr. H. Sharpe. The author has collected all the original descriptions of the Brocken Spectre, which is really the shadow of the observer cast by the sun upon clouds. In some cases the shadow is surrounded by a bow, which the author shows is like the rainbow in colour and in the order of colours. The head of a shadow is sometimes surrounded by another sort of phenomenon touching the head, and which the author names the "glory."

(2) "Results of Thermometrical Observations made at 4ft., 170ft., and 260ft. above the ground at Boston, Lincolnshire, 1882-86," by Mr. W. Marriott, F.R.Met.Soc. These observations were made on Boston Church Tower, which rises quite free from any obstructions, in a very flat country, to the height of 273ft. A Stevenson screen, with a full set of thermometers, was placed 4ft. above the ground in the churchyard, a similar screen and thermometers was fixed above the belfry at 170ft. above the ground, while a Siemens electrical thermometer was placed near the top of the tower. the cable being brought down inside and attached to a galvanometer on the floor of the church, where the indications were read off. The results showed that the mean maximum temperature at 4ft. exceeds that at 170ft. in every month of the year, the difference in the summer months amounting to 3°, while the mean minimum temperature at 4ft. differs but little from that at 170ft., the tendency, however, being for the former to be slightly higher in the winter and lower in the summer than the latter. As the electrical thermometer was read usually in the day-time, the results naturally showed that the temperature at 4ft. during the day hours was considerably warmer than at 260ft. The author, however, detailed several sets of readings which had been made during the night as well as the day, the results of which were of a very interesting character.

(3) "Snowstorm of March 14th and 15th, 1887, at Shirenewton Hall, near Chepstow," by Mr. C. J. Lowe, F.R.S.

During the evening the president made a presentation to Dr. J. W. Tripe of a silver tea and coffee service, which had been subscribed for by the Fellows in acknowledgment of the many services which he had rendered to the society during a period of over 30 years.

USEFUL AND SCIENTIFIC NOTES.

Chilian Nitrate of Soda Beds. — The total area of the province of Tarapaca (Chili) is 16,789½ square miles, and it is divided naturally into five distinct and well-defined zones. The first of these zones commences on the shores of the Pacific, and has an average width, west to east, of eighteen miles. It is formed, in the first place, of the beach; and, in the second, of the coast range, which attains an altitude varying from 1,125 to 5,800 feet above the sea level. This zone may be denominated the guano and mining zone. The fertiliser is found all along the coast, while the rich mineral fields of Huantajaya and Santa Rosa, and the less important ones of Carmen, Rosario, Huantaca, Paiquina Chanavaya, and Loa, are situated in the coast sierra. This belt has an average width of eighteen miles, and as it advances eastward it becomes more and more depressed, and finally terminates in a series of pampas (open plains) having an elevation of 3,500 to 3,800 feet above the sea level. Nearly all these pampas contain vast beds of salts, sulphate of soda, and sulphate of lime. They are known locally by the name of salares. In some parts of the desert of Atacama the beds of nitrate of soda are found under these salares deposits, but in Tarapaca the caliche (nitrate earth) is found only under a bed of conglomerate known as costra. It was believed, at one period, that all the pampas in this zone contained caliche, but explorations have demonstration that they only contain traces of nitrate of soda. The true nitrate beds commence on the eastern boundary of the first zone. The second zone of the province is the nitrate region. It commences on the edge of the Camarones gully and extends southwards to the desert of Atacama. Up to 1858 it was believed that the nitrate beds extended northwards beyond the Camarones gully, and even as far as the Azapa valley, in the province of Arica. The nitrate zone does not run geometrically paralled to the Tamarugal pampa, which is its eastern limit. In some places the grounds run out one or two miles further to the east, and in some places they bend in that distance from the westward. The quantity and quality of the caliche varies very considerably, but the dimensions of the nitrate zone may be set down at 120 geographical miles in width, east to west. It is estimated that the nitrate beds contain the enormous quantity of 1,908,630,502 quintals, and it is stated that, with the present export duty, which is equal to $27\frac{68}{1000}$ pence per quintal, the deposits will yield a revenue of £230,809,447.—*Chilian Times.*

THE flea, grasshopper, and locust jump 200 times their own length, equal to a quarter of a mile for a man.

SCIENTIFIC NEWS.

THE Dun Echt Circular, No. 145, announces that a code telegram has been received from Cambridge, Mass., giving the following elements of Barnard's new comet. The computations were made by Prof. Boss, of Albany, from observations taken on May 12, 13, and 15. T = 1887, June 26·67, G.M.T.; π — ☊ 27° 43′ ☊ 244° 41′; i 17° 2′; log. q 0·10216. The place for Greenwich midnight, May 30, is R.A. 15h. 46m. 28s. S. Dec. 17° 29′. The brightness is increasing.

Dr. Palisa, of Vienna, has discovered another minor planet, which will be No. 266. It is of the 12th magnitude.

Dr. Doberck, of Hong Kong, concludes from observations of Jupiter recorded there during 1879-1886 that the equatorial and polar diameters at the mean distance of the planet are respectively 38·207″ and 35·942″. Measures of Saturn made during the same period give external diameter of ring 40·28″; diameter of Cassini's division, 34·42″; internal diameter, 26·82″; and the equatorial and polar diameter of the disc, 17·22″ and 16·53″. The latter is larger than the measure of Bessel, Struve, or Main.

The death is announced of M. Edme Felix Alfred Vulpian, the eminent physiologist, at the age of 61. Born in 1826, the son of a distinguished lawyer, he took his degree of M.D. in 1854, and soon afterwards was attached to the Museum of Natural History. In 1867 he was appointed professor of pathology to the Faculty of Medicine; and though attacked under the Empire as a materialist, he was called in when the Comte de Chambord was dying at Frohsdorf. He was an ardent champion of the Pasteur treatment. M. Vulpian was the author of many medical works, among them being his treatises "Des Pneumonies sécondaires" (1860), "Leçons sur la Physiologie générale et comparée du Système nerveux," "Leçons sur l'Appareil vasomoteur," "Clinique médicale de l'Hôpital de la Charité," and "Maladies du Système nerveux."

Those who received their first lessons in photography years ago will hear with regret of the death of Colonel Russell. Colonel Russell's family name was Branfill; but, under the provisions of a will, he assumed the name by which he is known. It is to him that photographers owe a practical method of alkaline development, and many valuable papers in connection with photography proceeded from his pen. For the last fifteen years, however, Col. Russell had devoted himself to country pursuits on his estate in Essex. He was born in 1820.

The well-known geologist, Dr. Studer, of Berne, is dead, at the ripe age of ninety-three; and the equally distinguished botanist, Johan Edvard Areschoug, formerly professor of botany at Upsala. He was born in 1811.

Mention of Upsala reminds us that a Linnean herbarium has been presented to the university by Prof. P. Sötherstrand. It is a duplicate of that possessed by the Linnean Society of London.

The Natural History branch of the British Museum, in Cromwell-road, has just received a valuable donation from Lord Walsingham, consisting chiefly of a collection of British butterflies and moths, with their larvæ or caterpillars in various stages of development; also a fine series of Indian species collected and preserved in the Punjab by the Rev. J. H. Hocking, and specimens of the various exotic silk-producing moths. With very few exceptions the British larvæ, which retain a most life-like appearance, and are placed upon models of the plants on which they feed, have been prepared and mounted by Lord Walsingham himself. The whole collection consists of 2,540 specimens of larvæ belonging to 776 species, together with a series of perfect insects of each species. As continued exposure to light is unfortunately very injurious to specimens of this kind they cannot be exhibited permanently; but for the advantage of those who would like to study the collection without any restriction, it will be placed in the entrance hall of the museum for a period of five weeks from the present time.

The first annual meeting and soirée of t

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structors of locomotives.—*Maste*

SOLDERING LEAD

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* By JAMES F. HOBART, in the .

County of Middlesex Natural History and Science Society was held on Monday last. The council succeeded in making an interesting gathering of exhibits, amongst them being a fine collection of beetles belonging to the hon. sec., Mr. Sydney T. Klein. After a short introductory speech by the president, the Earl of Strafford, the hon. sec. read the report, and it was subsequently determined that the subscription payable by ladies should be the same as that paid by other members, in order that the income might be sufficient to cover the expenses.

The anniversary meeting of the Royal Geographical Society was held last Monday. General R. Strachey, F.R.S., vice-president, in the chair. In the report it was stated that the total number of Fellows on the list on May 1 was 3,332. The total net income for the financial year ending December 31, 1886 (exclusive of the balance in hand and a donation of £1,000 from Miss Gill) was £7,938, over £200 more than in the previous year, but less than in 1884. The net expenditure for the past year was £7,768, less than in either of the two previous years. The total investments of the society amount to £19,658, and the total assets to £40,533, exclusive of the map collections and the library, insured for £10,000. The medals and other awards of the society were presented to the recipients by General Strachey. The founder's medal was presented to Colonel Holdich, R.E., in consideration of the services he has rendered to geographical science by the zeal and devotion with which he has carried out the surveys of Afghanistan. The patron's medal was presented to the Rev. George Grenfell, for the extensive explorations made by him during his thirteen years residence in West Africa, especially in the region of the Congo. General Strachey then delivered the annual address, in the course of which he referred to the position taken by the universities of Oxford and Cambridge with regard to the appointment of lecturers in geography, and to the ready manner in which the proposals of the council have been assented to by the Education Department. General Strachey then reviewed the question of education in geography as a scientific subject, and subsequently gave a brief account of the exploring work done during the past year. The ballot for the new council and officers was then taken, and General Strachey was elected president.

In a paper read by Mr. Wynter Blyth before the Chemical Society, he mentioned that he had had the opportunity of examining portions of the bodies of two out of five persons who had died suddenly from the effects of lead-poisoning. In one case he separated about a third of a grain of sulphate of lead from the liver, and about a thirteenth of a grain from one kidney, besides finding lead qualitatively in the brain. In the other he was able to examine the brain with more minuteness, and estimated that here the cerebrum contained about a grain and a half, and the cerebellum about a quarter of a grain of sulphate of lead. Mr. Blyth suggests that the symptoms are produced, not by poisoning in the ordinary acceptation of the term, but by a destruction of important nerve-centres. The paper is a valuable contribution to plumbism.

The Foreign Office has sent to the Department of Science and Art a copy of a note from the Russian Ambassador, announcing that a Scientific and Industrial Exhibition of the products of Siberia and the Oural will be held at Ekaterineburg, in the province of Perm, in the course of the ensuing summer, and requesting that the Lords of the Committee of Council on Education will cause publicity to be given to the object of the proposed exhibition, which is to call attention to the valuable natural productions of that region. The Russian Government will welcome the presence of British travellers, specialists, and men of science at this exhibition.

The Dutch Government are about to construct a railway in Sumatra in order to bring coal to the coast from the rich fields near the River Umbili. It is estimated that there are about two hundred million tons of excellent coal, which would be readily purchased by steam vessels trading to Singapore and China.

The site for the Pasteur Institute in Paris has been definitely chosen in the Vaugirard

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ΓO THE EDITOR.

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ould be addressed to the EDITOR *of*
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BOOTIS—B 71—B 31.

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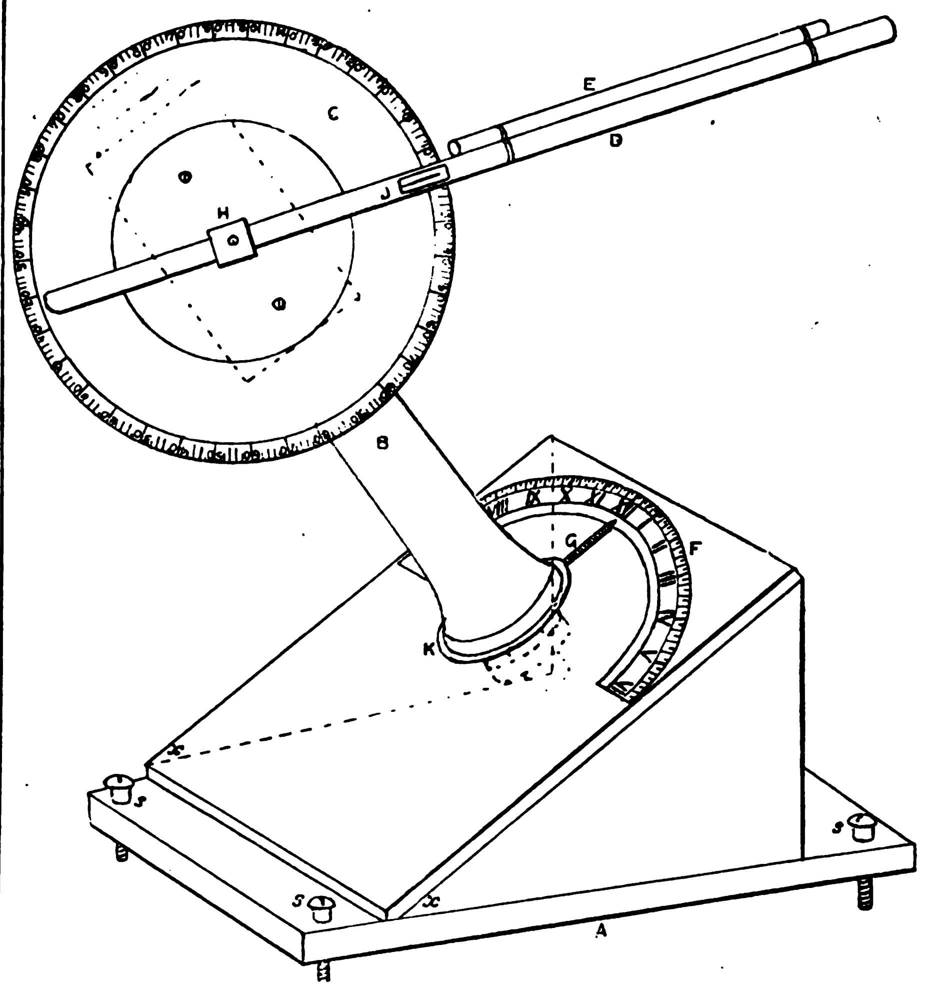
r there 34 = 6 mag. and



26 = 6 mag., so that the stars are made equal; and while the mag. of 26 is made similar to what it is elsewhere, the mag. of 34 is a mag. below what it is elsewhere (except in D.M.), and it is made *equal* to a star than which it is generally made *brighter*, and than which in the exception referred to it is made *fainter*. These circumstances point, especially when taken together with what is pointed out above, to the possibility of irregular variation, although, these circumstances concerning Argelander's mags. apart, I have come upon nothing indicating variation in either 34 or 26 Boötis.

When observing Camelopardus on January 17th last, I obtained an observation of B 71, and entered it as "Fine orange." On the 19th of the same month I observed it again, and made the same entry. This star is in Webb as O Σ 67, but the circumstance that this pair is B 71 is not noted.

On the second of these evenings I also observed B 31. This is a very fine star. I entered it "7½. Fine red, yellowish tinge." The mags. in B vary from 7 to 8, and the colours from "pale" to "very" red.

S. Maitland Baird Gemmill.

Glasgow, May 20th.

STAR-FINDER.

[27308.]—About eighteen months ago I designed and made for my boys a very simple equatoreal, which I dubbed "Our Boys' Star-finder." Thinking it might interest some of the younger readers of the "E.M.," I send a sketch of it. Being all of wood, it is easily made by anyone who can use a few tools, the only bit of lathe work necessary being the turned shoulder K of polar axis. A is the baseboard, 9in. by 5in., near each corner of which is inserted an ordinary wood screw S S for the purpose of levelling the base, to which two sidepieces are nailed, having the angle x equal to the co-latitude of the place. On to these sidepieces is fastened another board, on which is marked the hour circle F. Through this board passes the lower end of the polar axis, having a shoulder turned up on it at K, and is secured by a wooden collar and pin underneath. On to the upper part of the polar axis is fastened the declination circle C, 5½in. diameter, made of ½in. baywood, having the outer rim of a thin compass card divided into degrees pasted on to it. The hour circle F is half of a similar card, with the hours painted underneath, and divided to 20 minutes. G is the hour index. D is a straight wooden pointer, 12in. long, having a piece of brass tube E attached, and a small opening at J, into which is fixed the point of a common pin by which to set the pointer in declination. H is a nut to clamp pointer in position. By this simple toy affair I have often picked up the planet Venus at midday when visible to the naked eye.

Austwick, Lancaster. **T. B. Clapham.**

STARS SEEN FROM THE BOTTOM OF A WELL.

[27309.]—It is useless to keep discussing a matter of this kind in the absence of precise and reliable evidence; but as the question seems to haunt the pages of the "E.M." like an unquiet spirit, I beg to offer the following suggestions to lay the ghost once for all. It is patent to anyone that is conversant with the merest elements of astronomy, that it can be of no use to look up a chimney-shaft or a coal-pit anywhere and at any time of the day and expect to see stars in a general way. The probability is, that if stars have been seen, they are the few conspicuous stars that pass the zenith in this country. I submit that there are only four that are likely to have been observed under the circumstances indicated. They are—

1	α Cassiopeiæ	N. Dec.	55	36	
2	ζ Ursæ Maj. (Mizar)	"	55	55	11
3	β Draconis	"	52	23	6
4	γ Draconis	"	51	30	8

Star No. 1 should be looked for in some of the coal pits near Glasgow; No. 2, the most northern pits in Northumberland, or those just over the Scottish Border; No. 3, the Warwickshire pits, near Birmingham; No. 4, the Welsh pits, near Cardiff. This last star also passes the zenith of London, so a chimney-shaft in the metropolis, not too far from the 51·30 parallel of latitude, might suffice. In any case, the exact time of transit must be calculated (a matter of very little difficulty), and if the sky be clear and the star be then looked for, it *must* be seen, if stars ever were seen in like circumstances. With regard to the time of the year, the star first mentioned is available now, Mizar in June, and the two stars in Draco in September. If any of our friends living in the neighbourhoods referred to will give a list of the coal-pits and describe their exact locality, the calculations can soon be made, and at a suitable moment the vexed question can be definitely and conclusively settled.

W. J. B.

[27310.]—In the "British Encyclopædia," Vol. V., published in 1809, it is mentioned that in the Observatory of Paris there is a pit 170ft. deep, used formerly for experments on the fall of bodies, through which the stars are seen at midday.

W. C. Cole.

ON THE LAWS, REACTIONS, AND CONSTRUCTION OF SOME FORMS OF PRIMARY BATTERIES.

[27311.]—TWO parts of hydrogen require 16 parts of oxygen, and not 17, as the printer made me say last week, to form water.

The H_2 given off by decomposition of zinc is capable of wrenching oxygen from nitric acid, forming nitrous acid, three parts of which reform one of nitric, giving off nitrous fumes at the same time. Now, 63 parts nitric acid oxidise two of water, and the nitrous acid formed by every three parts of nitric reforms one of nitric, so that 63 × 3, or 189 parts by weight oxidise 10 of hydrogen, and are equivalent to the consumption of 64·9 × 5, or 324·5 parts of zinc.

Taking commercial acid (strongest), we find that 9lb. of nitric acid should neutralise the hydrogen evolved by the consumption of 13lb. of zinc. As 1lb. of zinc is equivalent to 375 ampère-hours at, in the case of a Grove's cell, 1·91 volt, we should, in a theoretically perfect cell, obtain 716·25 watts, or close on 1H.P. (electric).

In practice, we find that we are fortunate if we get 40 per cent of this, so that we may take the average commercial efficiency of this form of cell as from 35 to 40 per cent. for a thoroughly well-constructed and carefully-attended cell. For lighting purposes, where $R = 3r$, we may obtain better results; but we find that we have to throw away the nitric acid when only about 80 per cent. of its power is consumed, as the E.M.F. rapidly falls at about that point. If we take nitric acid at 8d. per lb., sulphuric acid at 1d., zinc at 4d., we get the cost in theory of this form of cell as zinc 4·04d., sulphuric acid 1·33, nitric acid 5·53; total, 10·90 pence.

In practice, of course it is quite 60 per cent. dearer. The causes for this are that the nitric acid and the impurities contained in it attack the zinc, especially when the cell stands idle; that the internal resistance of the cell is high, as dense porous cells are imperative; that a great part of the acid is wasted, and that the internal resistance rises steadily from the commencement of discharge, so that we find the effective E.M.F. about 1·6 volt. This makes the cost about 1·3 penny per lamp of 20 candles. Other sources of waste tend to raise this still higher, so that the man who can obtain a lamp of 20 candles by the Grove's battery under 1·5 penny per hour, may think himself very fortunate.

We now come to the next stage of the subject, in which I propose to describe as carefully as the particulars supplied me will permit, the construction of the different forms of batteries, together with the uses for which they are best suited.

I propose to divide batteries into two classes, single fluid and double fluid.

Single Fluid Batteries.—The simplest form of single-fluid battery is the Smee. This cell has no depolariser, the hydrogen being removed by mechanical action. Its construction is as follows:—A thin sheet of silver is first treated with a solution of platinum chloride on both its sides, then exposed to the fumes of sublimed ammonic chloride, which forms the double salt 2AmCl, PtCl, on the plate. It is now heated until the AmCl and the chlorine combined with the platinum are both set free, leaving a film of spongy platinum adhering to the silver plate. This silver plate, or rather sheet, being usually rather thin, is fixed in a wooden or other suitable frame, which insulates the silver from the two zincs which are suspended one on each side of it.

These zincs are well amalgamated, and are clipped one on each side of the insulating frame holding the silver plate by a brass clamp, which forms one of the poles of the battery. The other (positive) pole is formed by a suitable binding screw in metallic connection with the silver plate. The solution is dilute sulphuric acid from 1 to 7 to 1 to 10. In this cell the hydrogen set free is given off at the platinised plate by the innumerable small points formed by the rough surface of the spongy platinum. The initial E.M.F. of this form of cell is about 1·45 volt; but the E.M.F. obtained during working varies with the quantity of current given off, as a denser film of hydrogen is formed as more current is generated, which causes partial polarisation, more or less marked according to circumstances. This cell is largely used for electro-plating and typing, for which it is most admirably suited, as, although the E.M.F. is low (about ·5 volt), so is the internal resistance; and, therefore, the current is large for the size of the cell, and very constant.

Another form of battery in which depolarisation is effected by mechanical means is one in which the negative plates are formed of carbon discs, partly dipping in dilute acid which contains the zincs.

These discs are fixed on an insulating spindle, and are revolved more or less slowly by clockwork or other means, so that the air effects depolarisation. I have never seen this form of battery; but should think it too complicated even if it were efficient. If I remember rightly, this cell is called the "Bazin" rotative battery.

There are two forms of single fluid-battery in which the depolariser is in contact with the zinc as well as the carbon. The first is the "bichromate." This, in its simplest form, consists of a plate of carbon and one of amalgamated zinc immersed in the following solution:—Bichromate of potash (or soda), 2½oz.; sulphuric acid, 1oz.; water, 20oz. This cell gives an E.M.F. of two volts with a very low internal resistance. It runs well for from 1½ to two hours, and then needs to have the solution changed. Since, however, the zinc is in contact with the oxidant, both these are wasted, and, according to my experience, this form of cell is quite four times as dear as the two-fluid bichromate to be presently described. This cell is, however, very handy where great power is needed for a short time, as for surgical work, or for running motors for short periods where expense is no object. It is cleanly and portable; but it is necessary that the zinc should be removed from the solution, as the local action, no matter how well the zinc may be amalgamated, is, owing to the contact with the bichromate, very violent and rapid. In this battery the hydrogen abstracts oxygen from the chromic acid contained in the bichromate, which becomes reduced, and forms, with the sulphuric acid, potassium (or sodium) chrome alum. The other cell alluded to above is the Schanschieff. This cell is infinitely superior to the last. It consists of a zinc plate between two carbons, and the solution is a saturated solution of sulphate of mercury in water, to which is added as much sulphuric acid as it is possible to do without re-depositing any of the sulphate of mercury. This cell has a remarkably low internal resistance, and its effective E.M.F. is 1·5 volt. In this cell the hydrogen attacks the sulphate of mercury, forming with it sulphuric acid, and depositing the mercury on the carbon plate. This mercury can be collected and used over again. This cell has only two faults: the cost is high, being about 4s. 6d. per H.P. per hour; and the local action is so great that if the zinc be immersed when the cell is not in action, the mercury becomes reduced on it at its expense, so that it quickly disappears, leaving simply a pool of mercury beneath where it formerly hung. Arrangements are, however, made for suspending all the plates out of the solution.

Electrician.

MECHANICAL MATTERS.

[27312.]—THE letters of "our" old friend, "Eos" are very interesting. I hope he will continue to give us particulars of his long experience in foreign affairs— mechanical, botanical, medical, and otherwise.

I think I remember, many years ago, some of his letters on snakes and snake-poison in Africa, India, and other places.

With regard to the work of foreign artisans, have they any method of case-hardening iron similar to what is used in this country? "Eos" will, doubtless, have met with many kinds of gums and minerals of which we know little in England. Has he met with any mineral of a similar nature to emery, which would fulfil the place of the finer emeries used in optical work—that is, is there any which would smooth glass in a similar way to what a lump of Tripoli de Venise will polish it?

"Copeaux" has given us a very interesting letter on "Hook Tools as used at King's Cliffe." Will he tell us what is the angle of the bevel of the cutting edge of these hooks? Is the end of the curve sharpened as well as the bend? And, with regard to Fig. 4, page 271, does this represent a straight tool with the end turned up square across, or is it turned up slantwise? Which part forms the cutting edge?

Orderic Vital.

THE SEXTANT AND ITS USES.

[27313.]—JAMES ADAMS (27305, p. 276) in his remarks on my letter, which appeared under the heading of "The Sextant and Its Uses" (p. 424), displays such an absence of anything like a practical knowledge of the subject that it is not without hesitation that I have decided to reply to his strictures.

He first disagrees with what I say about the distance of the sun, and, to quote his words, "It (the sun's distance) might be ten times, or only one quarter as great as it is without in any way affecting the matter." Indeed! Does he not know that the farther any heavenly body is away, the more accurately can its angle of altitude be determined, and that, for this very reason, stars are always preferred? If he does not (which apparently is the case), it would be well for him to make himself acquainted with this and other elementary facts before assuming the position of critic. The accuracy of an observation of altitude depends—*to a great extent*—upon the distance of the body observed, for when this is not infinite, a correction for parallax must be made (which increases as the distance of the heavenly body decreases), introducing complications at once. Then, again, if the body is comparatively near, it appears as a disc instead of a point. For these reasons *practical men* always endeavour to avoid using the moon for sextant observations for latitude, &c., as the possibility of error in the altitude is greatly increased.

That no correction need be applied to the catalogued declination of stars is perfectly true, *but not for Mr. Adam's reasons*, which are simply absurd, the real reason being that the fixed stars are so distant that their apparent position is unaffected by the motion of the earth in its orbit, the major axis of which *practically* bears no proportion to the infinite distance of the nearest star.

Referring to my diagrams, he says that "they prove nothing save that were the earth less in diameter, then would a degree of latitude be less in length." Now, if our learned friend will take the trouble to look at them, and think a little, he will see that he is mistaken.

What I have shown there is that the accuracy with which an agle of altitude of a heavenly body could be measured, would *in practice* be found to depend in great measure upon the size of the earth. To make this clear, suppose the meridian altitude of a star to be 50°. Now, let the observer travel along the meridian (northward) till he finds that the altitude has decreased 1°, or is 49°, it is evident that he has travelled over 1° of the earth's circumference, or 69½ English statute miles. Now, suppose him to be placed upon an earth of much greater dimensions, he will still have to pass over 1° of its circumference to decrease the altitude of a star 1°; but in this case he will have travelled a much greater distance than 69½ statute miles. This being the case, a little thought will make it evident that it would be easier to fix the exact position in latitude of a place on the small earth than the large, for 1° reading on the sextant will, in the first case, mean 69½ statute miles; while on the second, *it may mean double*, in which case any error in the graduation of the arc, or in reading off the angle, will be *twice as great*.

Again, in his remarks on what is said in my letter about the cause of the difference in temperature between the Torrid zone and the Frigid he displays an astounding amount of ignorance of anything approaching even an elementary knowledge of the subject. Let it be granted that what he says is approximately correct *in theory*; but what about *the real facts of the case* as they affect the temperature? Near the Polar regions the sun is below the horizon for months together, and consequently these regions pass through a long night, when, owing to the absence of the sun, everything becomes frozen; and when the sun is above the horizon, it can never attain any great altitude, and is frequently partially obscured by fogs and mist; consequently, it has very little effect on the temperature of those regions.

There are several other things that I should like to notice; but fear to trespass further upon your space.

May 23. **Edward A. B.**

WORKSHOP SCRAPS.

[27314.]—*Dyeing Couleur de Rose with "Safflower" or "Bastard Saffron."*—This product consists of the dried flowerets of *Carthamus tinctorius*, a staple crop in Egypt, India, and Southern Europe. I never could fix this beautiful dye, the most popular colour for summer wear among the millions of Indian women. When faded, the muslin, or other cotton fabric, is washed and redyed, as the process is very cheap and simple—a penny or two. Take a quantity of safflower, put it in a clean washing-basin of cold, soft water, stir it with a stick till the water is of a deep orange yellow; do this repeatedly till the water comes off clear, throwing it away every time; squeeze out all water from the mass with a piece of flat wood, draining the mass. Now take a solution of carbonate of soda, pour it on the safflower, stirring well up; then steep the muslin or cotton fabric in this mixture, rubbing well into it with very clean hands; when thoroughly soaked, pour in a quantity of fresh lemon-juice, turning the cloth over as rapidly as you can, squeezing and pressing every part of it in the liquor. In half an hour rinse it in cold rainwater, washing off all the petals of safflower cleanly, and then stretch over lines in the open air to dry; after that the fabric can be got up like other linen. I have frequently performed this process for ladies on fine muslin and thin calico, much to their astonishment. I am told white silk will take it.

Toilet Rouge.—The whole of the above process is carried out, excepting the immersion of cloth; the carthamic acid is precipitated, washed, and dried at a gentle heat, and finally mixed intimately with finely-powdered talc. This is the French cosmetic.

aucers.—These are made for giving a flesh ilk stockings and other articles of dress; etals, prepared as before; 2oz. carbonate gallons rain water, and the colour pre- by first adding 4lb. prepared chalk; when ell mixed, citric or tartaric acid, finely d and stirred in, or used in solution.

in Varnishes.—I was lately looking over ion of small home-made lathe-fittings, ars old, when I noticed that the only ithout a spot of rust was a tool-rest (I socket and base); its coating of burnt-in brown was nearly as good as when I tried eriments from the pages of our "E.M." lve years back. Here they are for the of present readers. No. 1. Clean your or cast-iron article, and make it quite hen coat it with a uniform film of some e oil (I used cold linseed-oil). This done, sed in a sheet-metal oven to the action of mperature, not strong enough to carbonise In this way the iron absorbs oxygen at ent the oil is decomposed, and there is t the surface a thin coat of brown oxide, lheres very strongly to the metal, and will a high polish, giving it quite the appear- he finest bronze. Note.—I made a kind ircular muffle of an old tin box, over a stove, the work raised up on a wire sup- he centre to avoid burning the article.

Take oil of turpentine, add to it drop by d while stirring, strong sulphuric acid, rupy precipitate is quite formed, and no roduced on the addition of a drop of acid. id is now repeatedly washed with soft water, ne refreshed after a good stirring, until the es not exhibit any more acid reaction tested with litmus paper.

recipitate is next brought upon a cloth et all the water run off, and the syrupy it for use. This thickish magma is painted iron with a brush; if it should happen to iff, dilute it with a little oil of turpentine. tely after the iron has been so painted, t is to be burnt in by a gentle heat, and ling the black surface is rubbed over with a rag dipped in linseed oil. According to or (?) this varnish is not a simple covering rface, but it is chemically combined with l, and does not, therefore, wear off or peel her varnishes do from iron. NOTE.—I member I succeeded perfectly with both nts; but at this distance of time, added stances of travel, I am not sure which of epresented in the tool-rest holder. Surely ls could be so treated. **Eos.**

S OF DAYLIGHT PER ANNUM.

.]—I HAD noted the strange errors of d A. R.," p. 242 (let. 27237), and specially making the duration of sunlight longer orrid zone than it is in the Frigid"; but of Mr. Adams's notion (p. 276) that of all latitudes" had equal annual dura- d but half the 8,766 hours of the year, I nagined that refraction gave every place more than 4,383 hours of day, and fewer and twilight; and that the excess of sun was least in the Torrid zone, and greatest pole. This would be so were the earth's rcular, or as little eccentric as that of But I find the effect of its eccentricity e South Pole at present have fewer hours han the Equator, or, I presume, any other ne hours of day per annum decreasing for ep from the North Pole along a whole to the South Pole, but quicker before the Line than afterwards.

inition of daylight can make it less than me that a ray from any part of the sun's ceivable by a calm sea. This is the case s his zenith distance is less than 90° 50′ in r, or 90° 49′ in June—namely, 90° + his eter + 33′ for refraction, or rather 34′. kes the year's daylight at the Equator 3 hours, or 80 hours more than those of d twilight. But by this year's *Nautical* we find the North Pole is now enjoying lump") view of the sun (or part of him) March 18th, 8 p.m., till September 25 at 4,576 hours; and by this and next year's, Pole will be so favoured only from Sep- 0th, 18 p.m. (or 6 a.m. of the 21st), till an wo later a.m. of March 21st, 1888, or 4,394 ly 11 more than half a year.

Equinox, there are about 102 hours that s have simultaneous view of the sun or im; and for 34 of these hours both see e disc of him; just as, in the evening of gust 3rd, places in Wales and western Eng- see (doubtless to the triumph of Mr. n) the sun and the eclipsed moon at once.

E. L. G.

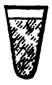
USPENDED FISH JOINTS.

.]—IN reply to Mr. Lanchester's letter I beg to say that there have been numerous attempts made to solve the question he has been proposing. Numerous patents have been taken respecting this joint; but none seem to have had such a success as would justify their general adoption. One of the most common is certainly that which consists in the use of fish-plates extending over the lower head of the rail, which they embrace, and under which they are bolted together. Practice has not proved that this complication was very advantageous. I think, for my part, that the use of a metallic permanent way, with the use of Vignoles rails, on longitudinal sleepers, would be one of the best solutions of the question.

Longsight, Manchester. **E. Gobert.**

HOOK TOOLS FOR TURNING AND CARVING WOOD.

[27317.]—"COPEAUX" refers to me as having many years ago described in the "E.M." my practice of using hook tools for hollow wood-turning. I had forgotten that I had done so. I do not use the T-rest as an abutment for the tool, but merely lower it down below the centre to serve as a support, then, by grasping the rest and stem of the tool together, draw the hook tool into the work near the bottom. By this method of holding, the tool will not catch, as the rotation of the work has a constant tendency to thrust it away. These hook tools, slightly modified, make splendid carving tools. For this purpose the end of the piece of steel should be drawn out into a thin blade, and bent round a pin into the form of an eye or ferrule having an inclination of about 10° with the stem; the end is then filed up to a cutting edge both at the top and bottom of the ferrule like a gouge, and then hardened and tempered, sharpened with the grindstone and oilstone, and the edge kept clean by using a round oilstone-clip inside. These tools may be made from 1in. down to ⅛in. in diameter. They cut best with the lower incline downwards; but the upper edge is useful for undercut work. The larger sizes should be driven into big, strong handles about 18in. long and 1½in. diameter. A person with strong arms and wrists will be able to cut most kinds of wood away with these tools at a surprising rate, scoring it off in great, substantial strips, and if having an eye for figure, and supplemented by smaller tools of different patterns, such as V-shaped, will speedily carve out a figure, as these tools cut equally well across the grain. I have always had a liking for pattern making, and one of my favourite tools for curved work has been a kind of riffler made according to this section.



It consists of a bar of steel about 10in. long, hardened and blue-tempered, with the top cut into teeth. The sides and round back are smooth. For roughing out, the toothed side is used as a rasp or saw; but for trimming off to form and working round projections, the tool is laid on either side, which serves as a guide, enabling incurved work to be sliced off, more or less in thickness, with much facility. **F. H. Wenham.**

HOOK TOOLS—INDIAN TOYS.

[27318.]—IN my letter last week (27286) the printer has made me say "wet the tool on the back"; the advice was, of course, to "whet" the tool.

The blade of No. 4 is only ⅜in. broad, not 1⅜in., as given in the drawing. The blade of No. 3 is about $\frac{1}{16}$in. thick at the back.

Long ago, when folks came from India by the Cape, I, and several other small people, were made happy by a present of wooden toys of Indian workmanship, mostly turned, the outsides of which were covered with a brilliant green and red lacquer or varnish. I have often wondered since what this varnish was, and where, and how, these toys were made. The hollow ones are evidently done by some sort of hook tools. Can "Eos" enlighten us? I was interested to see specimens of such toys in the Exhibition last year. It might have been fancy, but it struck me these were not so well finished as my old playthings.

Copeaux.

NIBLETT'S SCREWING APPARATUS AND SCREWOLOGY.

[27319.]—THE novel arrangement of screw-gear invented by Mr. Niblett is, I am sure, a very clever, useful appliance, and one which does infinite credit to the ingenious and persevering inventor. Still, I am not able to satisfy myself that a slight error is not caused by tilting the swash-plate; but, within the limits likely to be required, it must be, practically, very trifling indeed. The apparatus is not intended to cut screws with mathematical accuracy; but for common use, where a screw thread is needed quickly and without much trouble, I think it will prove a very efficient tool. I should imagine that the incipient error to which I have alluded, would show itself in an almost imperceptible change of thread-pitch, rather than in a distortion of thread, as the limits of traverse were reached; but the nature of this error, and, indeed, the question whether an error does or does not exist, can only be decided by practice.

I have read through the descriptive articles, and also the various letters, and do not think that "O. J. L." has said a word too much in favour of this novel contrivance. I also read with equal interest the letters of Mr. Wenham and "J. M. G.," and at first I could see little in the invention, but further perusal showed me that it was a thoroughly novel idea, and one which will bear further development. I have ventured to pen down a few matters which may, perhaps, not be altogether valueless in screwology. Let us begin with some very elementary principles.

What is a screw? An inclined plane wrapped round a cylinder. Suppose our flexible inclined plane to represent the section of a staircase—that is, formed of a number of equal horizontal steps and a number of equal vertical or rising steps. If this be wrapped round a cylinder, we may consider it as a spiral staircase, on which it is obvious that, say, three steps forward or backward take you three steps up or down, and it is immaterial in what part of the stair these steps are taken; an equal forward motion always causes an equal rise. *This is the essence of screw motion*, and if we consider the steps to diminish so that eventually the zigzag line merges into an even curve, this curve is a screw spiral. Its property is evidently this—uniform rotary motion of the foundation cylinder causes uniform traverse motion in a direction parallel to the axis; or expressed in a form more convenient for our present purpose, uniform equal traverse motion accompanies equal angular motion.

A cylinder is bounded by a closed curve—the circle—hence a continuous inclined plane wrapped on such a solid must return over itself at equal distances apart, and thus forms a uniform, continuous spiral. Let us now leave the cylinder and consider a solid, or part of a solid, not bounded by a closed curve. Hitherto the inclined plane and solid have been used to develop the spiral; let us now use the inclined plane and spiral to develop the solid. For this purpose we are not confined to the use of the identical *screw* spiral; it is possible to develop a spiral curve which, while not being a screw spiral, shall yet have precisely similar properties, and may therefore be used as a *base* to develop a screw. We have said that the essence of screw motion is—uniformly equal traverse motion accompanying equal angular motion—that is, it is compounded of two uniform motions: a rotary one about a fixed axis, and a linear one parallel to that axis. Now, in the ordinary cylindrical spiral these motions take place in planes *square* to each other, the rotary one *about* the axis, the linear one *along* the axis. Let us next compound them both in *one* plane.

First, with regard to angular motion. Two bodies have equal angular motion when their radius vectors sweep through equal angles in equal times. We are, therefore, not limited to a fixed length of radius: this may be variable without affecting the angular motion. On any line E A D draw a circle A B C with centre D. Divide this by radii into any convenient number of equal parts, say, 36, the radii D 1, D 2, &c., being drawn at 10° apart. At E, draw E F square to E D, and on it mark off a number of equal spaces E *a*, *a b*, *b c*, &c., the length of each being (merely for convenience of illustration) equal to the arc A 1 or 1-2. Suppose that a body is revolving uniformly in the circle A B C, at such a rate that it would describe the path A 1 in a certain definite time. At A suppose it to become acted on by another constant force, which alone would carry it from E to *a* in the direction E F in the same definite time. Then under the influence of the combined constant forces the body will describe a spiral path A G, which is found in the following way: Through each of the points *a b c*, &c., draw lines parallel to E A D, and prolong the corresponding radii D 1, D 2, D 3, &c., till they intersect these lines at 1′, 2′, 3′, &c.; these are points on the curve A G. Let $Ea = a$, radius vector $D1' = r$, and angle $AD1 = \theta$, then the equation of the curve is evidently

$$r = \frac{n\,a}{\sin. n\,\theta}$$

It may be traced on each side of the initial line A D, and also on the right side of the circle. As the result of two combined uniform motions, it may be used as a base to develop a screw; but we are evidently not confined to this one curve: it is merely one of a family of curves all possessing similar properties. For instance, take a lesser distance for each of the parts E *a*, &c., say, half the original E *a*—that is, bisect E *a*, *a b*, &c., and number the division points from E—1, 2, 3, &c. From each in order, draw a series of parallels to intersect correspondingly numbered radii, and join by a curve the various points of intersection. We

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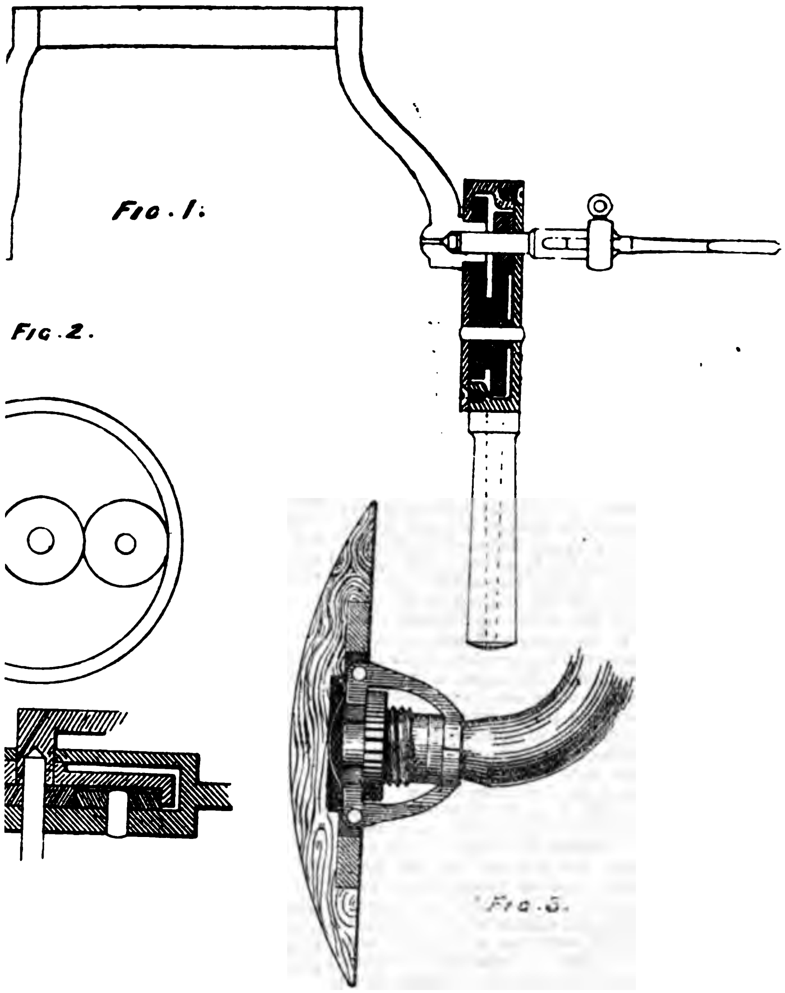


Fig. 1.

Fig. 2.

Fig. 3.

ɜ *revolving handle* of a brace always
fascination for me; but I never
king use of it in drilling till I had
ımine the merits of different forms
I soon decided that the ordinary
.r better than any other contrivance;
peed for small drills. I then made
; of brace with gearing similar to
of a lathe (as in Fig. 1). This in-
thed wheels. To simplify it, I pro-
annular wheel on the brace, giving
l spindle through two small wheels
ɔut I could nowhere get this annular
r carried out the idea. At last my
dle" came to my aid, and I rigged
ı pulley on drill-spindle, and a larger
ıe handle. With an open band, the
lower than the brace, I believe, and
band, much faster; but the slipping
ıde the contrivance useless as a tool.
ıted two bottle-jack wheels for the
as delighted to get an admirable
heels being same diameter, the drill
as fast as the brace. Up to this
ıware of the existence of a sun-and-
and I now think Watt probably got
similar way seeing a handle, though
ʼing on the pin carrying it. After-
larger drills with different speeds,
.he form of which I gave the sketch,
ɔeed of 4 to 1 (from wheels, 3 to 1)
.um practicable. The drill is a sort
of screwdriver and crank, and for
he best mechanical principle I have
pplied, as the power goes the same
drill—round the same axis—and
ıpeed at the same time. I wish Mr.
ıuccess (commercially) than I have
thing. I think he will find such a
ɜd by sculptors in marble, in which
g portion of the drill-spindle should
ʾin. at least. The drill-holder I con-
ƴ own drill is somewhat different to
ʼe seen in use. It is a split hollow
one size of drill-shank only, the
in easily. At the end a ring with
ced to one jaw, so that by a quarter
screw both jaws are closed upon
ʾhis (where the slight projection
no obstacle) is much more of a tool
ican chucks. I find, with the latter,
od grip on a small drill it is almost
t the spindle in the vice and apply
ıere is an enormous amount of rubbing surface from a large screw, and cone upon cone. The least rust makes a dead lock. The only small advantage I can see in their use is that they take various odds and ends of drills. Of course, I am not speaking of lathe chucks. With the holder I have sketched, the tightening power is applied in a plane at right-angles to the plane of the revolving spindle, so that the position of the spindle assists the action of tightening. It is centring in effect, and a drill is fixed and removed with the minimum of trouble possible. I hope some of your readers may be induced to try it.

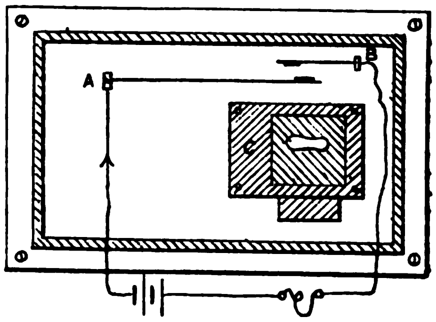
Fig. 3 represents a removable handle I designed, for a brace to be used under pillar as well as in the hand. Turning nut releases the jaws.

I hope, Sir, that you will pardon the length of this, as I write in hopes that some may benefit by it.

Silke.

A HANDY SWITCH.

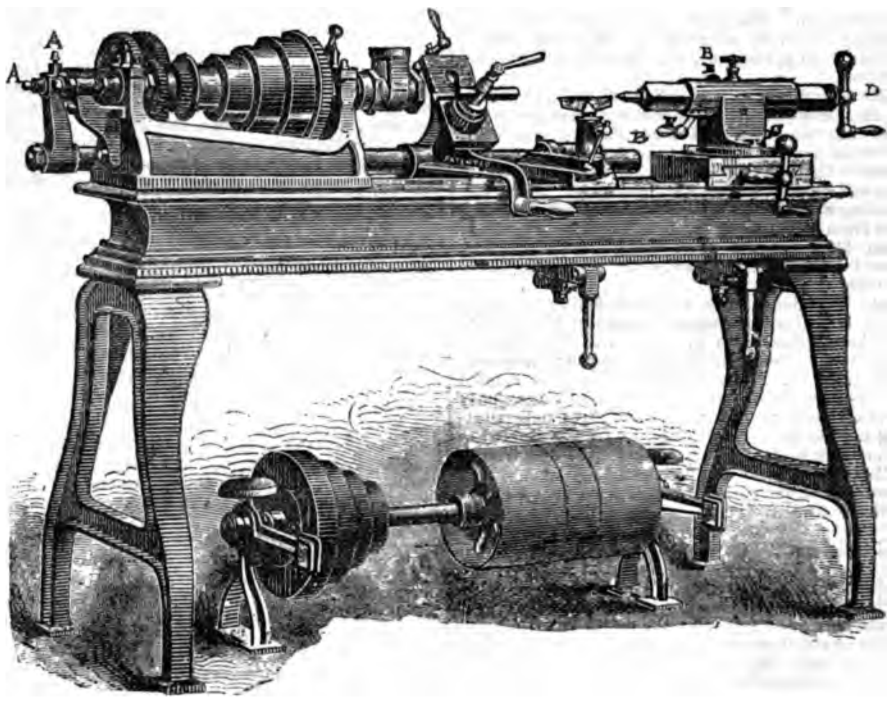
[27822.]—HAVING been greatly bothered at one time by unauthorised people making use of an electric light battery of mine, I devised a switch which could only be moved by a key, thus putting a stop to their little games. I have found it so extremely useful myself that I inclose sketch and description for the benefit of others in a like plight. It consists of a baseboard about 6in. by 5in., on which is fixed a lock C. Directly in front of the bolt of the lock are placed two springs A B, about ⅛in. in front of the lock; they are not, of course, touching. The one is connected to one pole of the battery, the other to the lamp, or whatever it may be. When the lock is locked, as it were, the bolt shoots forward and presses the two springs together, thus completing the circuit. When it is unlocked they again separate. The whole is covered by a case about 5in. by 4in. by 1in., leaving a 1in. margin of baseboard.



Londiniensis.

LATHE MATTERS, &c.

[27828.]—I SEND a woodcut which will, I think, prove of interest to many. The cut represents an American-made lathe for brass chuck work—that is, work turned without the use of the back-centre, though it has a back-centre which can be used in the ordinary way in connection with the hand-rest. Some time ago, while the front-slide controversy was raging, it was pointed out that there was a difficulty about removing the saddle when plain turning by hand was required, and several ways were shown of meeting the difficulty. Here we have another way—namely, by fusing the poppet and slide-rest into one! Thus the poppet gains the power of "setting over" and of swivelling round. It can bore as usual; but as the barrel is square the drills require no slotted T to keep them



from turning. When used as a slide-rest, the tools are fixed into the coned hole which takes the centres, and this is apparently all that is required for face-work. Cylindrical work on brass can probably be quite sufficiently well done by hand, no slide-rest or saddle being in the way. The square "cylinder" (!) is moved forwards by a screw D, and also by a rack and pinion, the handle of which is seen at E E. The handle at C locks the pinion in or out. The mandrel is very properly made of great length to give steadiness in overhung work. At the back will be seen a traversing bar for screw cutting, somewhat similar to Mr. Wenham's; but in this case the depth of cut is regulated by a slide-rest fixed upon the bar. I do not know whether a spring is required at A A′ to hold up the guiding die to the hob or guide-screw, or whether the cut is gradually deepened by the slide-rest; but evidently the die and hob must close when the first scratch is made as well as when it is brought to its full depth. One feels this would be all right for brass, but for iron and steel the bar would, I think, require to be much stronger and very tightly fitted. Instead of fitting the guiding screws on the mandrel, the makers have preferred to fit them on to a short shaft driven by gearing, which is sometimes of equal and sometimes of a 2 to 1 ratio. This shortens the arm which carries the die; but I think it a mistake to introduce back-lash instead of allowing the tool to run back in cut.

Will someone say whether Fox was not the original inventor of this class of lathe, and, if possible, give us a cut of a Fox lathe?

I am obliged to "R. R. N." for noticing the query about the Essex chuck. I have two mandrels coned out to take the same centres and bored up 3in. with ½in. holes. I wish to fit either the American split-wire chuck or an Essex chuck into them; and, to avoid all overhang, should like, if possible, to use only the spring part of the Essex, fitting it directly inside the mandrel. Will "Britannia" kindly say whether such a plan can be recommended (see sketch last week).

I was surprised to find from "O. J. L.'s" letter that there is an exhibition at Bradford. I understand there is also one at Manchester, also containing lathes and other tools. I have seen no notices or advertisements of either of them, nor even heard when they open and close, and think some account of them would be acceptable to many of us.

F. A. M.

LATHE MATTERS.

[27824.]—THE split jaw chucks mentioned by "F. A. M." letter 27250, are used in this country on light drilling-machines, and are fitted to the spindle in the manner shown in his sketch. In a lathe I recently designed, I am thinking of using similar split jaws for holding drills; but with this difference, i.e., that the pressure of drilling causes the chuck to grip the drill, all screwing being dispensed with. The chucks will be prevented from turning round by means of a temporary feather, which I think, however, will be a superfluous precaution.

My objection to the adoption of so large a nose as Mr. Gray proposes, is that it excludes the use of 2in. and 3in. vice and other chucks, which are mounted on face-plates; there being no room behind the holding screws. I would not use a screwed nose on a 2in. or a 2·5in. lathe. From 3in. to 4in. a 1in. nose would be a very suitable size; but from 4½in. to 5½in., I would not have more than 1¼in. for the nose, though even this size would cause some trouble in mounting small chucks.

My experience with the cone fitting coincides with Mr. Gray's remarks in letter 27255. The chucks supplied with the lathe will fit perfectly; but those subsequently made at home are very difficult to fit. Notwithstanding the most careful setting of the slide-rest, the chuck will often only bear on the cone in certain places, thus necessitating a great deal of scraping. I do not think the cone alone is altogether trustworthy. I have seen lathes made with the cone fitting; but it has always been in combination with the flange or the cylinder fit.

A. F. Shakespear.

Lüttichaustr. 14, Dresden, May 20.

[27825.]—IN considering the shape of a lathe-spindle-nose there are three points from which it must be viewed; the desired result is that a face-plate or chuck should be held firmly, its surface truly at right angles to, and concentric with, the axis of the spindle. The first point of view is the mental conception of an ideally perfect spindle-nose and chuck-boss; I mean "perfect" in "fit." This "perfect fit" is one of those things which are easy to imagine, but somewhat difficult to carry out; it is, however, from this point of view only, or, at any rate, mainly that several correspondents seem to look at the question. From it either a cylinder and shoulder fit or a cone fit will equally well give the desired result.

The second point of view is the maker's point. After all, the surface of a cone is produced by a straight line revolved in a true circle. The accuracy of that straight line depends on the truth of the slide-rest, and the accuracy of the circle on the truth of the originating lathe-spindle, exactly the same as in the case of a cylinder; therefore, the production of a true cone is no more difficult than the production of a true cylinder. But whereas when the true cone is finished, the true bedding-surface of a cone-nosed mandrel is finished; when a true cylinder is finished, only half of the bedding surface of a cylinder and shoulder fitting is done. The shoulder has yet to be formed, and unless this is truly at right angles to the cylinder it is useless. Now, I think that no one would wish to contend that it is easier to get two settings to exact correspondence with two other settings than it is to get one setting to one other setting. But even yet the maker has something to look at; the fitting surfaces on the spindle-nose ought to be ground true with an emery wheel after the spindle has been hardened and trued on its bearings. And here again I think everybody will admit that it is easier to grind one straight line than two at right angles including a corner. As a matter of fact, the latter is a very awkward job indeed; the former is a very simple one. That the cones should be trued by grinding spindle nose and chuck together (with a little sand, I suppose!) is, firstly, impossible, and next, even if possible, would not give the desired result. The spindle-nose should and easily can be made a perfect cone, perfect in straightness of face, perfect in roundness, and perfect in concentricity quite independently of the chuck. Moreover, as it has no sharp corner the surface of the cone may be left dead hard, and so preserve its truth almost indefinitely. But, after all, the making of spindles is manufacturers' work, and the ease or difficulty of producing a particular design does not affect lathe users, except in so far as it may influence the cost. The making of a true seat in a chuck, however, is of more immediate interest to the lathe user, as he often makes new chucks for himself. To gain full advantage from the cylinder fit, the *whole* length of such fitting part on spindle and chuck should bear alike—that is, they must be exactly parallel, and fit to within a limit of $\frac{1}{2000}$ of an inch. I don't wish to imply that this is impossible, or even exceptionally difficult; but it *does* require considerable skill and experience. If, after much care and time, the least bit too much of a cut be taken at last, the cylinder fit is no fit, and the job is spoiled. Whereas, if in boring a cone seat, the angle of cone be not quite correct, another cut can be taken to true it, and the only result will be that the chuck will go a *little* further on the spindle; the fit, and the centring will be as perfect as before.

As for the face of the chuck boss, I don't think I can remember one leaving the lathe a perfect fit for the spindle shoulder; they almost always require scraping to bear equally all round. The third point of view is as to what the result of wear will be. Now, everything must wear, sooner or later, more or less. When the cylinder-fit of a lathe spindle-nose is worn small, its value as a concentric setting is gone. But when a cone-fit wears, and it has worn equally all over, the chucks will only screw a bit further on; its power to centre will be as perfect as at first; while, if it has worn unequally, it can be trued up very easily, and *its old chucks will still fit it.*

I have written somewhat fully on the merits of cone-fitting, because experience has taught me that it is the only perfect practical method of making interchangeable fits. My own impression is that the centring of a lathe chuck as usually made is practically a cone-setting. The chuck boss cannot be made a perfect fit on the screw, because if that were done, it would be too hard to put on and off. Also, everyone must have noticed that if a very loose-fitting chuck be screwed up firmly, it generally runs true after it has once been trued in its place. The chuck is really held between the shoulder on mandrel and the backs of the threads. They are conical as regards the axis of spindle; they centre the chuck (more or less perfectly), and the shoulder sets it square.

I like Mr. Rawlins's suggestion of putting the screw behind the cone, and shall try it the first time I have an opportunity.

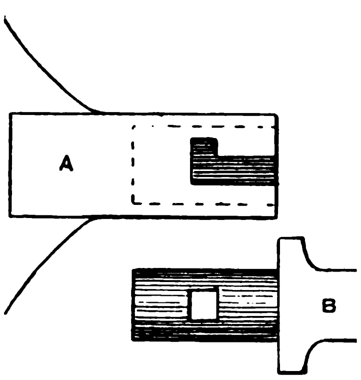
Of course, in making chucks with a coned seat, the worker would have a plug gauge the exact duplicate of the cone part of the spindle-nose. This he would try into the chuck, so as to be sure he had got the exact taper before removing the chuck from the working lathe.

Jno. W. Newall.

Arnold-road, Bow, E., London, May 21.

LATHE ATTACHMENT.

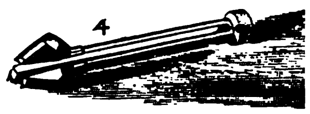
[27826.]—HAS anybody tried the bayonet-socket joint? I have been doing so lately, and I think for small lathes under certain conditions it will do well. The greatest accuracy of fitting in stem and cylinder, and impregnable hardness of metal are im Corundum powder and good case-harden



accomplish both. When I have more ti tend to make further experiments in this Which portion will best suit mandrel or ch to be proven; at present, the latter seems t suitable for socket—brass chucks would nee steel collars. A, chuck; B, mandrel.

THE ESSEX CHUCK.

[27327.]—IN reply to "F. A. M.," the of lathe can be drilled so as to form the s the Essex chuck, and the cap of the chucl be tapped to fit on the nose of mandrel. T



must be drilled so as to be a good fit a countersunk to fit the inner cone 4. T when screwed on, would contract the jaw usual way. The illustration will show.

T.

SUPERNATURAL DARKNES

[27328.]—I HAVE no desire to enter argument with a correspondent who is so o (?) as the writer of letter 27287, page 272; order to prevent readers being misled by letter, wish to say that the passage in Jos given up by Lardner, Gibbon, Warburt others, and that the "quack" who is my auth the statement that no trace of the allege natural occurrences can be found in any of the period, is the author of the "Decl Fall of the Roman Empire."

Wm. John Grey,

Newcastle-upon-Tyne.

RAILWAY BRAKES.

[27329.]—POSSIBLY Mr. Samuel Davie himself one of the "fair-minded persons" to in his letter (27289) of last week; but only shows how one may be both fair and at the same time. How can the Crook against the Westinghouse brake when, Government Inspector shows, the collisi caused by one driver undoing what the ot doing? It was as though air had been let i vacuum pipe and the ejector opened at t time. The brakes would go on and come o When properly worked, the Government In found the "brake acted well, and the tr under perfect control," and what more is re Mr. Davies seems to think, however, that the driver of the first engine says he appl released his brake several times in runnin the 4½ miles, he is justified in concludi "each time the driver wished to alter th of the brake he had to release it, and so le hold on the train," thereby suggesting t driver could do nothing else, and obviously ing your readers to infer that the train was run away at any time.

Now, is this the reasoning of a fair-person? One might suppose that railw panies have had to wait for the advent tinuous brakes before they could work thei at all down gradients; but the fact is, trai been worked without continuous brakes clines for many a year, and goods trains worked still. Moreover, these trains hav worked from Tow Law to Crook by the aid Westinghouse brake for some years bef collision, and ever since, under the "perf trol" found to exist by Major Marind shows it was entirely due to the faulty sy working when two engines were attached exception to the rule took place. There has been so much nonsense talked about this working of gradients by the aid of continuous brakes, that it may be well to state that since these appliances have been introduced the conditions are altogether different from what they were under the old system. Formerly it was not safe on certain gradients for a driver to "let go his hold on the train," because the speed would so accelerate as to render it very difficult, if not impossible, to regain control of it; but there are no gradients on which a train cannot be controlled, when every vehicle is fitted with a trustworthy brake. Whereas previously the gradient might overcome the train, now the brake can overcome the gradient; and on such gradients as that at Crook—about 1 in 50—most drivers are satisfied to check the speed occasionally in preference to allowing the brakes to remain on ever so lightly all the way down. They are thus not only able to run down at good speed and save time, but they save brake-blocks and tires, and also make things pleasanter for the passengers. No driver cares to keep the blocks on his engine-wheels longer than he can help at a time, since both blocks and tires become hot, and it is only on very steep and long inclines that anything like a constant pressure is necessary. People like Mr. Davies seem to forget that the gradient enables the train to be run without steam in the first place, and that drivers have now the power of taking all the advantage that this can give them, knowing that they have full control of the train, and the power of checking it promptly at sharp curves or facing points.

I, too, have read Mr. Marshall's paper, and he evidently knows as little about the practical working of railways as Mr. Davies. No driver of an express train in this country having climbed ten miles up-hill at 25 or 30 miles an hour is content to run down on the other side at the same speed. The fact is, 70 miles an hour and over is run daily in this country on down gradients; but the driver does not feel that he has ever let go his hold of the train any more than if he were running on a level road. I am quite aware that there are gradients so steep and so long that it is necessary to keep the brakes on continuously; but there was no necessity for this in the case mentioned, or the driver would have done so. That the driver should have voluntarily applied and released the brakes several times is, therefore, no argument against the brake—at all events, to any "fair-minded man." In another paper I noticed last week a letter, in which some facts on this subject come opportunely to hand. It is therein mentioned that in Hungary the trains are controlled down inclines of 1 in 37 and 1 in 40 for 25 miles by the Westinghouse automatic brake at a speed not exceeding that of the ascent.

S. and D.

[27330.]—SAMUEL DAVIES (27289) seems to have fallen on a mare's nest in finding the return of the Crook accident in the Board of Trade Blue Books; but I am at a loss to know what he proves by bringing the case forward. Surely he won't dare to say that the brake was to blame for the neglect of the driver of the second engine, or if he does, I don't know at what state of imbecility we shall arrive next. The return goes on to prove that the driver of the second engine was in the wrong—he ought to have kept his handle at the "dead point," or have put his brake "on" when he found the other driver did not do so. I am at a loss to know why, when at 300 or 400 yards from the Crook West distant signal, as soon as he found his brake not acting, he did not whistle for the hand brakes or draw the second driver's attention somehow. It would look a great deal better on the part of vacuum advocates if they would confine themselves to the hard, solid truth, instead of bringing forward defects that have no existence at all, except in their own imagination. Samuel Davies appears to forget that the Government inspector made a trial down the Consett and Crook bank, and in his report said: "The brake acted well, and the train was under perfect control." Mr. Davies tries to get rid of this by a mere quibble. Let him and his friends apply themselves to answering the seven questions put to them by "Loco" (27290), and instead of wasting paper writing what Westinghouse cannot, and what vacuum can, do, get a train, and go and do it.

I am rather surprised at Mr. Kiernan quoting Mr. Stretton in support of his vacuum brake. In "Safe Railway Working," Mr. Stretton says: "Vacuum *appears* to fulfil Board of Trade conditions, and so it is returned by them; but Westinghouse brake does fulfil the conditions, and no *appearing* about it." One does fulfil their conditions, the other *appears* to do so;—that's a difference with a vengeance, and a nice little difference, too, or I know nothing about it.

Rover.

[27331.]—YOUR correspondent, Mr. Samuel Davies, page 272, in his opening sentence, makes an incorrect assertion to the effect that the action of the Westinghouse brake cannot be graduated. He then proceeds to refer to a case which occurred upon the North-Eastern Railway on the 24th June, 1884, which is perfectly irrelevant to the subject; and further, he makes quotations from *certain parts* of the Board of Trade report, and does not state the whole truth.

I examined the brake upon the train in question, and have the official report and my own notes now before me.

It will be remembered that in 1884 brake pipes at the leading ends of engines were comparatively new, and the giving control to the leading driver when two engines are employed was also new. In the Crook case, the driver of the second engine did not place the brake handle in the neutral position, but left it in the running position; therefore when one driver tried to put on the brake, the second driver's valve tended to release it. Major Marindin reported that the explanation was simple enough, and that when trying an experiment with the second handle in the "neutral" position, "the brake acted well and the train was under perfect control." An air-pump is capable of supplying sufficient air for working a train of any length, and the Crook case was not in any way due to the pump, but solely to the second driver placing his handle in the wrong position; and certainly it furnishes no facts against the principle of the Westinghouse brake.

Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.
General Office A.S.R.S., 306, City-road, E.C.
May 20.

[27332.]—ON the 12th of this month there was a collision between a goods and cattle train on the North-Eastern at Prudhoe station, blocking both roads. A passenger train was coming along at the moment; the driver put on the Westinghouse brake, and pulled up just a yard or two short of the *débris*. Now, Sir, no other brake in the world could have done that; time lost getting "on" would have meant a bad accident.

Loco.

[27333.]—I HAVE never before troubled you with my views on the brake question, not being a railway man; but I don't see that your correspondent, Mr. Davies (letter 27289), has proved anything except that the air leaked away; so it does with the renowned 2-minute brake (vacuum); if the second engine-valve caused the leakage, why put it in that position? The fact of the driver saying he "released" the brake proves nothing to my mind. I have ridden some hundreds of miles on the N.E.R. and also others; but I have never met with the violent jerk that I should imagine would be the inevitable result of taking the brake off and then putting on a heavier pressure. My idea of the Westinghouse system is that the train-pipe pressure is simply equivalent to a variable spring on a reducing valve (the triple valve); if the load is decreased, easing train-pipe air-pressure, then the valve rises, admitting air to brake cylinder; the air is, of course, let out of reservoir until so much has been withdrawn that the two pressures (train-pipe and reservoir) on opposite sides of valve are equal, when, of course, the valve closes by gravity. After this, any further diminution of train-pipe pressure causes the valve to again rise till equilibrium is again established. This being correct, I fail to see how the brake cannot be regulated. You might just as well say that a marine-boiler safety-valve cannot be set to blow-off at a lower pressure by means of easing-gear (reducing load).

Some of your correspondents don't see that the air entering at the van and engine-valves makes any difference to the vacuum brake. I do. Assuming an equal stroke in vacuing and press. system brakes (not so in practice), the quantity of air is simply proportional to the areas of cylinders *i.e.*, over six times more in the vacuum than in the press. I have often seen 120lb. on van gauges N.E.R. We can get over this, of course, by reducing stroke of vacuum brake cyl., but then we also reduce play of brake blocks, which require adjusting oftener in consequence; and supposing we do make the actual quantity of air equal to press. system, it still has to travel through all the resistance of train pipes, whilst in the pressure system it is only the air in the *train pipes and triple valves* that has to be moved any distance, as the brake cylinders are supplied through the triple valve from reservoir under carriage—a negligible distance,—and it is as well to remember that the *pressure* of a gas does not affect its resistance through pipes, whilst the quantity does. In the vacuum system we cannot have a reserve of power *in a small space*; in the pressure we can. I am quite ready to admit that there are several advantages in the vacuum system, but at present I am with Mr. Stretton in defence of the pressure brake as the only one that is fairly reliable. Some may say it is only the details of the vacuum brake that give trouble; just so, but it is the details that make all the difference between a horrible smash and safety.

G. T. Pardoe.

CONTINUOUS BRAKES.

[27334.]—THE statement (in letter 27289) that the Westinghouse brake cannot be graduated in its application is absurd, and can only be made by one unacquainted with its action and unaccustomed to ride over it. I have travelled on the Brighton railway almost every day of my life since 1878, when it was first begun to be fitted, and am exceedingly used to its application with every possible degree of power.

Owing to the crowded state of the lines near London signal-stops are only too frequent, while the signal is as often taken off again before the train has come to a standstill; in such cases, the release of the brakes is instantaneous. As to graduation, Brighton drivers are used to make very gentle stops (except in a few cases, when running banks), by means of, perhaps, half a dozen slight reductions of pressure: the puffs of released air are perfectly audible to me sitting at an open window, and I am very well acquainted with the stronger bite of the blocks instantly following each successive puff from the driver's valve. I think, therefore, I may say, after ten years' continuous experience on one line, in continually stopping local trains of from 10 to 16 coaches to fast expresses of, perhaps, 24 coaches, that the Westinghouse brake gives perfect control of a train under all circumstances, and that it is equally available for seven or eight successive increases of pressure on the blocks, as for instantaneous application with full force, and as instantaneous release and reapplication.

As for Mr. S. Davies's example of June 24, 1884, it simply shows that the drivers were unused to the brake with double-engine running. Had the main reservoir of the train-engine been shut off from the main pipe, and the brake worked from the pilot, there would most certainly have been no difficulty with the brake.

The following note from the last available brakes' return may be of interest in the present connection:—On June 22 last, 8,302 booked stops and 11,865 signal-stops (20,167 in all) were made with the brake on the Brighton railway. There were no mishaps whatever with the brake that day, while the total mishaps of all kinds for the half-year were 24 on a mileage of 2,967,796 miles. Five serious mischances were also averted by the instantaneous action of the brake during the same period.

136, Strand. **H. C. Sotheran.**

[27335.]—MR. SAM DAVIES, in a letter (27289) which was inserted in your issue for May 20, thinks he has made a case against the Westinghouse brake; but he is greatly mistaken, for he has proved absolutely nothing. After having gone at some length over the report of the Government Inspector, he comes to the conclusion that the driver had to release the brake when he wished to alter the power. There is nothing new in that. However perfect a continuous brake might be, this manipulation is necessary, more or less, according to the skill of the driver. It seems to me that the one concerned in that incident had not got the necessary dexterity; but altogether there is nothing in the whole affair that is against the Westinghouse brake.

On running down long inclines, the only danger there could exist is that the boiler-pressure should get so low that the pump could not compress the air at the required pressure. Drivers should not allow the boiler-pressure to fall below 80lb. when going down an incline, and the piston of the air-cylinder should be always somewhat smaller than that of the steam cylinder.

Had the vacuum automatic brake been used on the train in question, and under the same circumstances, the result would have been the same. With proper management it can never occur that brake-power should completely disappear.

E. Gobert.
7, Dame-street, Longsight, Manchester.

THE ACCIDENT NEAR HARRINGAY PARK.

[27336.]—IT would be, as Mr. Stretton says (p. 273), a waste of space to discuss cases which are perfectly clear; but it is not clear whether he means that the above accident is one of those cases, or that it was so remarkable that it is not worth discussing. The circumstances are, he thinks, "almost incredible," and perhaps he will offer some explanation of them, or give some hints as to means of preventing them in future. Various railway accidents may have been fully and fairly discussed in these columns; but that at King's Cross has not been, and as to Mr. Stretton's remark that he does not see why I should suppose the above accident will not be, I would refer him to my letter on p. 243. I spoke of "explanation," not of "discussion." Incredible, remarkable, or anything else, as this accident may be, there is obviously nothing at present to prevent its repetition, and as business increases at the Tufnell Park yard there will be all the more risk of its being repeated. Most people acquainted with railway work are aware that the element of human fallibility will

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Lüttichaustr

[27825.]—I
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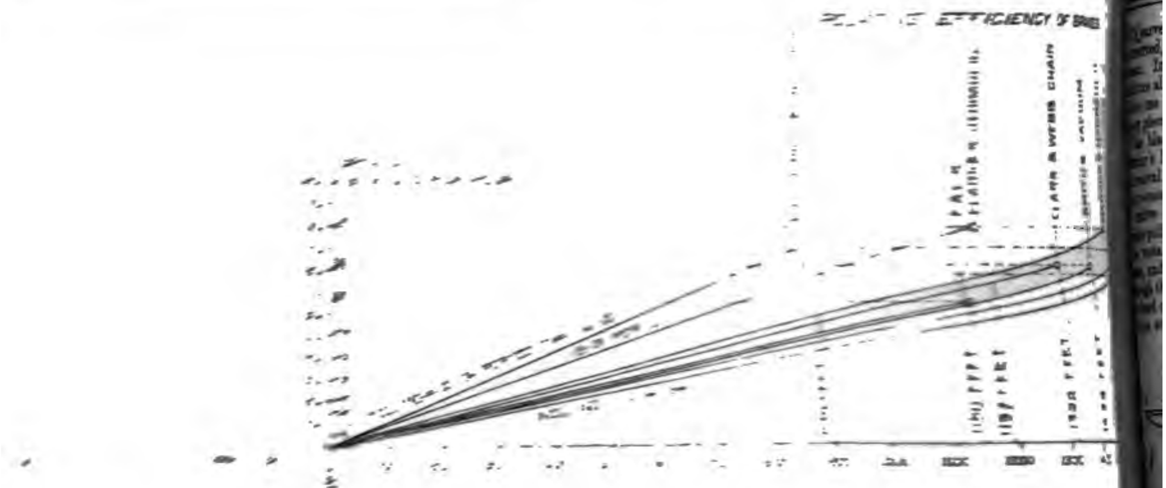

[illegible] Hugh Low.

RAILWAY SIGNALS.

[illegible] railway readers may like to [illegible] G. H. B.

DIAGRAM OF BRAKE STOPS.

[27[illegible]]—[illegible], page 731, No. [illegible], having asked me to furnish an illustration of the brake diagram to which I referred in my reply, page 1[illegible], I now forward one of the diagrams which I constructed upon my return from the Newark brake trials, June, 1875.

It relates to experiments made under Series I, Section [illegible], and 12, in which all available brake power was used. Engines unprovided with brakes were reversed, but sand was not used.

[illegible]	Newark Trials. Name of Brake.	[illegible]	[illegible]	[illegible]
Midland	Westinghouse automatic	52	898	10·01
"	Clarke's hydraulic	64½	1197	8·31
	Barker's hydraulic	64½	1611	6·47
L & N W	Clark and Webb chain	49½	1322	6·21
L and Y	Fay	44½	1160	5·75
G N	Smith's vacuum N.E. engine	49½	1483	5·72
L B & S C	Westinghouse vacuum	52	1713	5·26
Mid	Steel McInnes	48½	1588	4·91

The results having been obtained, the diagram serves to determine the mean retarding force which has been applied in each case.

A train starts from the direction of "A." to get up speed, and the brakes are applied at the zero point "B." The vertical line at the zero point on the one side shows the speed of the train, and on the other the foot tons of energy per ton due to each speed, or in other words, it denotes the height it [illegible] that a body would have to fall through to gain the velocity shown on the other side of the scale.

The efficiency of the brake is therefore demonstrated by the direction of the line drawn from the zero point to the point corresponding to speed and distance. In the diagram it is shown that the action of the Westinghouse automatic brake was [illegible] per cent. of [illegible] in bringing the train up at [illegible]. The [illegible] brake it will be observed only gave a retarding force of [illegible] per cent. or a gradient of [illegible].

It will thus be seen that although trains are running at various speeds, the relative efficiency is readily demonstrated upon the diagram.

Clement E. Stretton.

Consulting Engineer Amalgamated Society of Railway Servants.

[illegible] May [illegible].

FUSIBLE SOLDER.

[27339.]—The addition of more or less bismuth to the ordinary tinman's solder renders a less heat necessary in the operation with the bit—in fact, so low a melting temperature is required, that I only use a wax taper or spirit-lamp, employing a strip of copper as soldering bit and [illegible] resin as the flux. Baker's fluid sometimes too. Anybody who tries the common solder on their sheet zinc, or tea lead, or a white metal teapot, will learn a useful lesson in metallurgy—a spreading jagged hole will follow the bit instead of a joint. The Chinese have known this fusible solder for centuries, and our tea-growers have had to copy their recipe; the foreman, being usually a Chinaman, did the right thing when planting commenced. Eos.

SOLDERING.

[27340.]—In "Sike's" able letter about soldering he does not mention a good old-fashioned way of keeping the bit clean after it has been tinned. On removing the bit from the fire, dip the point very quickly into a gallipot containing sal-ammoniac and water—a cubic inch or more dissolved in boiling water will last a long time. The efficacy of this dip is marvellous, and does not injure the bright face, whereas simply rubbing it on a piece of sal-ammoniac sometimes forms a thick film, which must be wiped off before working, besides taking so much longer. It is a common practice to dip in the chloride of zinc solution: but this should never be done except when re-tinning, as it causes a hard amalgam to form, and makes quick work difficult. In working tinplate, most beginners experience a great difficulty in knowing when the bit is hot enough. In taking it from the fire, if the bright part has turned a light brown, it is "Just right." Even a dull red is not too hot. Epsom.

LENTIL DISHES.

[27341.] — According to Liebig, all leguminous food is muscle-feeding, containing a large quantity of vegetable caseine, proved by my long observation of the high-caste wrestlers and athletes of India, to whom the flesh of all living creatures is prohibited. Milk, hearth cakes of wheaten flour, and lentils in quantity constitute their daily food, and they have tasted no other, except fruit and vegetables, since they came into the world. A sculptor or painter would rejoice in such living representations of the Farnese Hercules. These men play with the clubs, weighing each 40lb. or more, like feathers, and carry enormous weights round their thick necks, besides pulling a bulky bow, its strings of metal-rod, lenses with tinking
same until the bow le
Again, as a diet
kitchen. constipation,
a great reputation.
ings I have had to li
wheaten cakes and
water to drink.
lived in the East, lik
breakfast two or
the most palatable
Dhal, or Eastern Dal-
saive lentils. Take
as often found in the
put the lentils in a
night. Next morning
large, or two small,
thin, put an ounce of
a clear red fire, add
about till they
skimmer, carefully
into a saucer, and
teaspoonful of the
about with a spoon
has reached a rich
and put aside to coo
on the fire with
lentils an inch or two,
trivet close to the re
only simmer, no
wooden spoon, breaking
When they begin to
fried onions, curry
saucepan, stirring it
you do not burn
tinually. When ready
whole lentil
rice in a separate
squeeze the juice of a
plateful. For cheape
dripping instead of
not eat such rank grease
fuel for all such dishes
add sour fruit while
Mulligatawny Dal.—
or fowl is boiled down
head or neck preferabl
onion or butter. A
some mushrooms are
are boiled in this
salt to taste. I always
persons dislike it, and
cake or slices of toast
I have used split pea
lentils for making
very good substitutes.
Lentil Flour.—You
you have Revalenta Ara
its cost as a patent
suit tourists well
savoury spoon diet

THE "MANDA

[27342.]—This
peculiar to the Dyaks
name, a terribly
obtainer." The
session, rather large
about 2¼lb. The blade
on the left side, and
surfaces, on the right
right, forming a segment
using the mandau grea
the concave side alway
shown, as forgetful
cause the blade to
sults to its wielder's
deer horn, sometimes

:ang or spill of the blade
y crude guttapercha or
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r getting loose, and that
nade by myself from a
inned fast. The temper
about that of a good
is absolutely necessary
re the hard woods and
ch merely dull the edge
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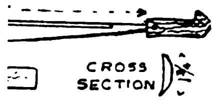
ower of the mandau in
t be seen to be believed.
a hard wood tree 4½in.



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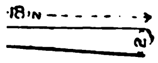

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e same man decapitated
The "parang," the uni-
alays, is, in its simplest
l, hammered out into a
Fig. 2. When I was an
bacco plantation, we im-
from Birmingham, but
were too hard and brittle,
on those made by the
pore and Penang. The
i, but use a peculiar tool
nife, wedging the blade
idly scraping it down to
temper at a low red heat.
of working up old files
cellent tools; but it is a
month is often spent in
I should much like to
et the peculiar temper of
is hardly to be touched
quite soft, and the blade
h contract bayonet.

Tukang Besi.

ARMATURES.

iced several queries in
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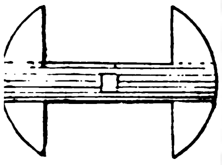
armatures, Siemens H
g patent rights, I have
a view of producing an
l work, without heating,
that I send you full par-
of my fellow-readers.
eet-iron, punchings or
as Fig. 1. When built

F I G 2.



chings form a solid core
2, the projecting portions

s with brown paper in

y 2½in. long, it is an easy
l by shunting a portion of
ld light an 11-volt 10c.p.
y. Field magnets were
ong, wound with 4lb. 16
armature, about ¾lb. 18

machine were submitted
his opinion thus: "Your
success. I admire the
ery much."
l the machine, and the
to Mr. Bottone for his
ill consider this descrip-

W. Tilley.

AN OLD ESCAPEMENT.

[27344.]—There is a drawing of an escapement almost exactly similar to this (letter 27236) on plate XXVII., Fig. 3, of Moinet's "Nouv. Traité Génl. d'Horlogerie" (in the Patent Office Library) invented by Thiout L'Ainé, and taken from plate XLIV. of his "Treatise on Horology," published in Paris, 1741. Thiout gives three other arrangements of this escapement, improvements thereon, which I think Mr. Marson will care to investigate.

May 18. **Horloger.**

LEGAL REPLIES—BILLS OF SALE.

[27345.]—Taxes (62410).—Prior to the Bill of Sale Act, 1882, a bill of sale did protect goods from seizure for rates, if not for taxes; but that Act by Section 14 expressly provides that no bill of sale made thereunder shall protect goods and chattels which would otherwise have been liable to distress under a warrant for the recovery of taxes and poor and parochial rates, so that the date of this bill of sale is the *real* point. The rest of the question turns upon facts which would need consideration.

Re-registration (62444).—By the periods named this bill of sale must have been made prior to the Act of 1882. It is, therefore, not wholly void for want of being re-registered; but it thereby becomes under the Act of 1878 invalid as against execution creditors and in bankruptcy. In other words, it is good in the hands of the holder against the granter, and can be enforced upon default; but not as against creditors who have issued execution or a trustee in bankruptcy.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall, E.C.

DIATOMS IN COCKLES.

[27346.]—In a letter published on the 20th inst., Mr. Shrubsole invites correspondence on the occurrence of the diatom *Coscinodiscus concinnus*, which, as he tells us, has lately appeared in great abundance in the estuary of the Thames. For some months past I have been greatly interested in the microscopical examination of the sea-water inclosed within the shells of the common cockle (*Cardium edule*), taken from sandbanks off Southport, near the estuary of the Ribble. As a rule, several species of diatoms, chiefly boat-shaped, were found in each drop of water examined under a ¼in. objective; but of late the beautiful discoid form of *Coscinodiscus* has appeared, though I am not prepared to say that the species is identical with that of the diatoms referred to by Mr. Shrubsole, *concinnus* being a variety of which I have no example in my collection, and with which I am not familiar. The coincidence, however, rather seems to favour the view that similar forms have appeared about the same time in the two localities. Whilst writing on this subject, it occurs to me that it may be of interest to some of the many workers with the microscope who are readers of the English Mechanic to know what an interesting field of research is afforded by the contents of the cockle. Amongst the numerous objects from this source which have come under my own observation may be enumerated the following:—

Infusoria, of many minute species, in great abundance; occasional examples of the radiolaria; rotifers, of unfamiliar forms; lively little crustaceans, of the order Copepoda; spicules of sponge, fragments of algæ, &c. The manipulation is simple enough for the merest tiro with the microscope:—Open a cockle (freshly gathered specimens preferable), receiving the contents in a watch-glass; then with a camel-hair pencil transfer to a glass slip a drop of the liquid, together with a little of the fine deposit of sandy particles which will be found within the shells. Cover carefully with a disc of thin glass, and examine with a power of two or three hundred diameters; the result will often prove a pleasant surprise.

50, Park-road, Southport. **John Ford.**

A new process of annealing wire consists in coiling the wire upon a hollow metallic core or drum, embedding the wire and core in sand or its equivalent, surrounding a central open space, subjecting the whole to heat with the wire thus embedded, and then allowing the whole to cool before removing the wire from the embedding material. While cooling, the vessel is dipped intermittently into cooling liquid.

A very good way to anneal a small piece of tool steel is to heat it up in a forge as slowly as possible, and then take two fireboards and lay the hot steel between them and screw them up in a vice. As the steel is hot, it sinks into the pieces of wood, and is firmly imbedded in an almost air-tight charcoal bed, and, when taken out cold, will be found to be nice and soft. To repeat this will make it as soft as could be wished.

A half-pint of Croton (New York) water has been demonstrated by a physician to contain 58,000 bacteria.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61908.] — **Harmonium.** — To G. Fryer.—Better late than never; I "expected" your opinion. I am convinced that the pan is all right, because I "borrowed" reeds of a narrower and shorter scale from a Hillier I have in my possession. I fixed them in place of the broad reeds; the result was, what I term a good pipe-like tone, equal to the reeds even "at home." I think this also proves the wind right, but I have not the means to tell what the pressure is per inch, or I should do so. The reeds are well screwed to veneer, pallets rise ⅛in. parallel when "tipped." I don't see that the "price" can be any detriment in my case, for I have bought the best of everything; at least, what I understand to be the best after reading "Ours" for years. I also think that "Ours" will solve the mystery without calling in any talent. You are quite right; I have set the reeds right according to my own judgment. I believe that to be the seat of the "mystery." I now ask again (query 61908, page 42, with rider), that instrument gives a good tone and vibration with narrow reeds "borrowed" from another instrument.—Queen.

[62122.]—**Caen Stone.**—I have not recommended any "courses"; but I suggested what might be done by way of prevention or cure. What I "recommended" was to leave it alone and let it get dirty. I remember the attempt to clean St. Paul's in 1868, when "Alexandra, the sea-kings' daughter," came over. The result was not satisfactory, nor are recent experiments. As a matter of fact, I put the question to a F.R.I.B.A. and he said the only safe method for carved work was a jet of steam; but if the dirt is on plain parts, possibly some of it might be rubbed off, and the parts protected by enamel or something of the kind in future. Is it worth while? The dirt is natural; but if it can't be removed it might be covered up, if it is desirable to keep the font in a "spic and span" condition. Will it not be more natural to allow it to take whatever appearance it will?—Saml. Ray.

[62124.] — **Sluice Gate.** — As the parts are always wet, cements of any kind will be out of place; but would it be possible to put in new frames? That is going beyond the question, which is, as I understand it, some remedy which can be cheaply applied. "F. C." has used tarred canvas without success, but how would it do to line the contact parts with rubber tubing? That adapts itself readily to any kind of surface, and would be secured to the gate by screws, I suppose. It answers capitally where it is required to make anything wind-tight, provided sufficient compression is brought to bear, and it might serve in this case—especially as water preserves it—provided there is not much rubbing friction. The tubing is, I think, better than strips of rubber, as it "beds in" beautifully.—Nun. Dor.

[62128.]—**Rear-Driving Safety Bicycles.**—(1) Curving the front fork seems to be more for appearance than for utility. On some machines it brings the handles nearer the saddle. (2) Non-vibrating forks make the machine more comfortable on rough roads. (3) Bringing the wheels closer together would make the machine run less smoothly; to get the handles nearer the saddle, the front fork might be made to lean backwards more, or the handles could be differently arranged. (4) I consider the gear used in the "Merlin" and "Omnicycle" to be very inferior to the crank and chain. I have some doubts if the gear could be fitted to a bicycle; in a tricycle there is plenty of room between the wheels to allow of any gearing. The levers, &c., would certainly add considerably to the weight. (5) Morgan's chain is now considered inferior to the self-lubricating. Most makers will fit any chain to order.—A. F. Shakespear, Lüttichaustr. 14, Dresden.

[62153.]—**Long Train Runs in the U.S.**—Since writing the reply on p. 251 I find that the longest run in the United States is with the Chicago limited express, on the line from New York to Albany, 142 miles, and that probably by this time the "Saratoga limited" has been put on, which will run from New York to Troy without a stop—148 miles. It is a special and exclusive train; but as it is to be regularly worked, it will form the answer to the query. The train consists of drawing-room, buffet, and smoking cars, and will leave the central depot, New York, about 3 p.m. on Saturday, arriving at Saratoga at 7.30, returning on Monday morning, so as to reach New York at about 12.30 p.m. That will include the longest run without a stop in the United States.—Nun. Dor.

[62183.]—**Wooden Pendulum.**—A rod saturated with paraffin wax ought not to be affected by damp. "SM." appears to have adopted a good plan to saturate the wood; but its efficacy depends upon the relative size of the tube and pendulum-rod. I found the paraffin wax expanded considerably upon melting, and unless the containing vessel is large enough to allow for this expansion, there is not sufficient paraffin to keep the rod covered when cooling, and the uncovered portion is not completely filled, and, therefore, is subject to change from damp.—A. W.

[62195.]—**Colliery Grease.**—I beg to thank "Nun. Dor." for his reply to my inquiry; the recipes he gives, however, are too expensive for my purpose. I want a grease for waggon wheels and other rough work in and about a colliery. The ingredients are rosin oil, heavy coal oil, water, and lime; but I cannot get at the proportions.—R. MURRAY.

[62196.]—**Post Office Batteries.**—May I be allowed to supplement "Nun. Dor.'s" information by saying that according to Preece and Sivewright the battery which is largely used in France is the Leclanché, which has supplanted, to a great extent, the Marié-Davy. In Germany, the batteries mainly in use are Meidinger's, and Siemens', and Halske's, both modifications of the Daniell. In America, Groves, the Calland, the Lockwood, the Baltimore, and Eagle batteries are at work; and in India, the Minotto.—WM. ROWLAND HART.

[62216.]—**Laundry.**—There are no books on the subject; but "Steam" could surely obtain permission to visit some existing steam laundries, and possibly hear the opinions of the proprietors. Failing that, any of the makers of the machines will give him information.—T. J. M.

[62219.]—**Sugar Solutions.**—I think "W. M." will find some of the information he requires in Soames's "Treatise on the Manufacture of Sugar from the Sugar Cane," Spons, 125, Strand; and possibly the rest of it in Weatherly's "Art of Boiling Sugar, Crystallising," &c., published by Baird.—NUN. DOR.

[62222.]—**Tempering Cast-steel Jumpers.**—For jumpers the bar should retain its toughness while the edge is made hard without being brittle. To do this, heat several inches up to a dull red, and dip in the forge water, moving up and down a little so that not much more than an inch enters. As soon as a blue can be seen, dip the whole of the part that was heated, withdraw and allow to cool slowly. I suppose it is ordinary steel you use. There are some useful remarks on pp. 168, 248 in recent numbers of this paper.—TEE SMITH.

[62226.]—**Glaze for Bricks.**—If "An Old Subscriber" will turn to page 544, Vol. XXXIX., he will find that the information he requires is regarded very much as a trade secret; but there is a good deal of information in back volumes. It is doubtful whether a glaze or flux can be used with a blowpipe to repair the enamelled earthenware sinks; but the querist might easily try some of the enamel frits he can buy.—NUN. DOR.

[62264.]—**Duodecimals.**—In the abstract a system of duodecimals is better than one of decimals, and if we were a new people without a system of notation, we should choose 12 as a radix rather than 10; but should probably prefer 8 to either. In brief, 12 is better than 10 as a radix, because it can be divided by 2 and 4 without fractions; and 8 is better still, because it can be divided into halves, quarters, and eighths without fractions. The factors 3 and 6 in 12 are little used in practice. Our present system of decimal notation could not be easily converted into duodecimals or octonals, as such a conversion would not only mean that all the works on astronomy and logarithms ever written in the world would have to be rewritten and translated into the new notation, but it would mean the rewriting of all chronology and all history. Every mathematical work, with the exception of a few on geometry, would have to be entirely reconstructed. Moreover, a great deal of the poetry of the world would break down on a duodecimal system. Tennyson's "Charge of the Light Brigade" would be known as the "Exploits of the Gallant 420," and Byron's description of the ball on the eve of Quatre Bras would contain the exquisitely poetical expression, "Six hundred and phity-four (6 ϕ 4) hearts beat happily." I think these difficulties are enormous and insuperable; but added to these is the objection that the expressions of every-day speech would have to be altered. A baker's dozen would contain eleven, a fortnight would contain twelve days, and a young man would come of age at nineteen. Any attempt to alter our radix at this late period in our history cannot be entertained for a moment. The introduction of the decimal system into this country as a general standard would be an immense advantage, and would do away with our present clumsy and antiquated systems of weights, measures, and coinage. So retentive, however, are the people of this country of old customs, that even practical and already tried systems find little favour here. But to attempt to *introduce here so stupendous* a revolution in our numerals, the advantage of which is still doubtful, seems to be to be utterly absurd.—W. B. LEIGH.

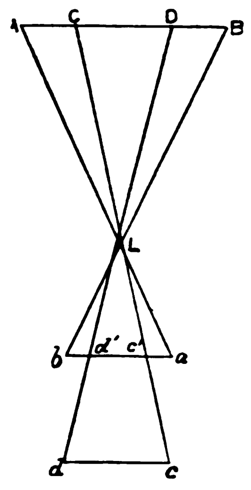
[62334.]—**Hose Pipe.**—If you paint it, it will become soft and sticky, and probably rotten. Do not keep it full of water, but keep a little always running through, to prevent it becoming hard and dry. Burying it in the soil will not do.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[62346.]—**Dead Dipping.**—Immerse the articles in a mixture of nitric acid 200 parts; sulp. acid, sp.gr. 1·845, 100 parts; common salt, 1 part; sulphate zinc, 2 parts; rinse thoroughly. Olive-green bronze for brass: Dissolve 1 part permuriate iron in 2 parts water.—ENGINEER, St. Mary Ch., Torquay.

[62350.]—**Dead Black on Brass.**—Make the brass quite clean, and apply the following preparation with a camel's-hair pencil:—Bichloride of platinum, 4 drachms; nitrate of silver, 1 grain; water, 6oz. When the right depth is obtained wash with clean water, dry, and finish with plumbago.—ENGINEER, St. Mary Church, Torquay.

[62366.]—**Spiral Wheels.**—I made an error in my former reply, for which I apologise. To overcome a resistance of 1,500 produces a pressure acting at right angles to surface of tooth of 1,500 $\sqrt{2}$ = 2,115lb. The friction being ·08 of this, or 169·2lb. (say 170lb.) requires an additional force of that amount acting in direction of tooth, which is increased to 170 $\sqrt{2}$ in direction of driver = 240lb., so that a total force of 1,740lb. is required at circumference of driver.—T. C., Bristol.

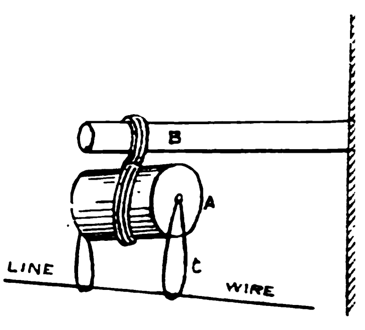
[62373.]—**Photo.**—The focal distance of Ross's rapid rectilinear $\frac{1}{4}$-plate lens is $4\frac{1}{4}$in. If only one of the lenses is used, this distance is exactly doubled. Hence, the view embraced by the RRR is twice as broad and twice as high as that embraced by the single lens. In other words, a quarter of the view delineated on the plate by the RRR is spread over the same sized plate by the single lens. Consequently, every object taken by the single lens appears four times as large as when taken by the double arrangement, both views being taken from the same spot. Of course, in using the single lens the advantage as regards architectural subjects is sacrificed. Perhaps the accompanying diagram may make the subject quite clear. L is the lens, *a b* the focussing screen when the RRR is used, and *d c* the same when the single lens is employed; from which it is clear, without going into the geometrical proof, that, in the first case, while the two extreme points A and B (vertical or horizontal) of any distant view are taken in, in the latter only C and D = $\frac{1}{2}$ A B are included. In fact, the picture on *c′ d′* is spread over *c d.*—G. G. B.



[62380.]—**Achromatic Condenser.**—As I have just had an achromatic condenser of large angle fitted to my own microscope, I shall be pleased to give "F. R. B." a description of the same, and results so far as I am able. Like him, I had a condenser of about 90 degrees angle, and felt that I could not work up to the level of my objectives; but Messrs. Swift and Son, of Tottenham Court-road, London, have just fitted up an optical combination for me of 180 degrees angle that answers my purpose both for central and oblique light. The achromatic combination is composed of three sets of lenses, at the back of which is a revolving diaphragm, with seven holes, ranging from $\frac{3}{8}$in. in the largest to $\frac{1}{16}$in. diameter in the smallest. There is a centring cap for the front lens, and five stops to give dark ground and oblique illumination for the largest aperture of the diaphragm. With the new condenser I can get a narrow streak of intense light when using the $\frac{1}{12}$in. objective, and without shifting either lamp or mirror, can, with the stops, get all the oblique light I want for resolving diatoms. I have only had the condenser
and have no skill whatever in resolving d
I nearly always work with central light
night, for the purpose of answering this
inserted one of the stops for oblique
without any trouble whatever resolved *R*
and then *Frustulia Saxonica.* Hith
"F. R. B.," I have been only able to do
much shifting about with the lamp and
produce oblique light; but now I find tha
position of the lamp and mirror would
purposes. The price of the condenser in
is £4 4s., and Messrs. Swift and Son tel
by placing a little glycerine between the
of the condenser and the glass slide, I
for an oil-immersion condenser; but of
will upset the correction for colour
T. F. S.

[62380.]—**Achromatic Condensers.**
had some experience in the use of achron
densers, and would wish to warn "F
against expecting too much from this kin
ratus. The best achromatic condenser
not enable an imperfect object-glass t
tests for which it is inadequate. N. Rh
is very variable. I have here six slid
diatom, mounted by various artists. Of
only can be properly solved by a 1-10 obj
The others require a 1-20. With thi
great attention must be paid to the perfe
tion of O.G. for thickness of cover-glass.
denser also must be carefully centred and
I use three different condensers, viz., th
ster," Abbe's, and Messrs. R. and J. Bec
form. The "Webster" gives good resul
is quite possible to resolve N. Rhomboi
its aid. A stop must be used which onl
light by part of the outer zone of c
Abbe's condenser is made by Zeiss, an
nished me some years back with a patte
fits into the substage of my "Crouch"
The angle of aperture is large (N.A.
gives really splendid results, but requi
practice before one is able to use it to it
vantage. This instrument costs £3 5s
new achromatic condenser, with its diap
very efficient, and I believe it will do
that can be reasonably expected from a c
The Iris diaphragm is decidedly a great
ment, and admits of great delicacy in t
ment of light. This instrument seems
designed for use with high powers.
lens is removable, and the condenser gi
very good light for low power object-glass
is a wheel of diaphragms with central
dark ground and oblique illumination.
disc contains blue glasses of different tin
I have found most useful as light modifie
ally for drawing with the camera lucid
£5 5s. I would recommend "F. R.
"Nachet's" prism for oblique light. I
this little instrument a few days ago fro
Beck, and found it will enable an obje
resolve difficult test diatoms with muc
facility of manipulation than the variou
sers. The only thing requisite is to rac
till one gets the greatest amount of l
rotating it in its fitting, the pencil of lig
made to fall in any direction on the obj
light is sufficient even with a No. 3 e
COPPER.

[62379.]—**Acoustic Telephone.**—I c
that anything is wrong with the arrange
the diaphragm properly made? The pull
be dispensed with, and an indiarubber
stituted, as sketch. A is the rubber secu



iron holdfast B, which is driven in the w
a wire stirrup which runs through the
the line wire is carried by this, and is,
perfectly insulated. A stranded wire, say
No. 24 would be better than a single
W. A. W.

[62379.]—**Acoustic Telephones.**—I
Rogers would be good enough to adv
address, I would be happy to send him
the post the information he desires. The
tions and illustrations I wish to send hi
take up too much space in the "E.M."—

]—**Turbine.**—The height of water is ıt to 28lb. pressure per square inch, and arge about 25gals. per minute. The actual ɔf available power depends on the condi- ipe, and whether free from bends, &c., so water may flow with the least possible l friction. Why not test for yourself the by gauge and discharge by measure and here is a very good motor, named the notor," which I think would give you der the above conditions. If you like to a newspaper wrap, I will forward parti- hich cannot be inserted here, for obvious -ENGINEER, St. Mary Church, Torquay.

.]—**Drawing.**—A very good work on is published by Cassell, Petter, and Galpin, "Drawing for Machinists and Engineers," A. Davidson, containing forty double and e-page plates, having above 200 illustra- ıpted for drawing copies, and containing plain instructions for drawing, colouring, hints on the use, &c., of drawing instru- I have some papers by Peter William "On the Speed of Engines for Driving s, &c., and the Electrical Regulation of date 1885). If this is the kind of thing wants, they are published in pamphlet the Institution of Civil Engineers, 25, Gt. treet, Westminster, W.—E., St. Mary Ch.,

.]—**Safety Saddle.**—In reply to your about fixing the stirrup-leathers to King's ıddle, I have used one of the saddles, and following particulars, which will show that its name of "safety": The stirrup-leathers by four loops on four studs attached to the

FIG. 1.

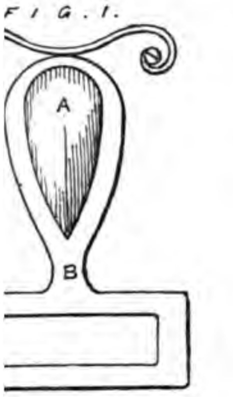


FIG 2

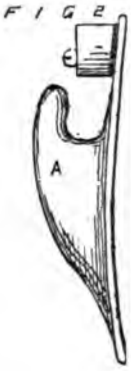
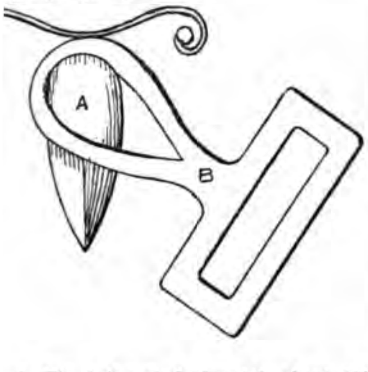


FIG 3.



A, Fig. 1, is a stud of metal, about 1½in. l ⅝in. wide at its widest part. In the top ıtud is a recess to hold the metal loop B. ɔops are fixed one to each of the top ends tirrup leathers. A cover-spring keeps the the recess, and this recess and cover-spring wn edgewise, Fig. 2. When the loop is ɔbliquely, and considerably out of perpen- to its natural hanging position, and then d suddenly, as if a rider were thrown with hitched in the stirrup, the loop on either the saddle comes away. Of this peculiar there is not a doubt, for I have tested it dably sometimes) in more ways than one. hows the stirrup latch being released by an snatch.—STEEPLECHASER.

6.]—**Mercury.**—Mercury is usually freed aces of other metals by prolonged contact trong sulphuric acid. In order that the ɔould always be ready for use, it is a good keep it in a strong spherical glass vessel, a tap at the bottom and a stoppered orifice ɔp. The mercury is covered with a layer of ic acid; the clean metal is drawn off by the use, and afterwards returned through the the top. The only objection to this method pense of the glass vessel. When mercury is highly contaminated, it is quicker to distil, keeping the orifice of the retort under water to insure thorough condensation. It is not safe to use a glass retort. An iron bottle or earthenware retort is the best to use. A high temperature is also necessary, as mercury boils at 400°. The presence of other metals may raise the boiling point. Mercury should not be allowed to come into contact with such metals as zinc, brass, and copper, and then filtration is amply sufficient to free it from dirt. A separate quantity should be kept apart for use in making electrical contacts, and it is unnecessary to purify it for such purposes. The only case in which pure mercury is necessary is in experiments on the rotation of currents round magnets, &c., and then the mercury should be poured into the cups just before performing the experiment, and removed immediately afterwards, so that it has very little time in which to act upon the metal of the cups and wires. Such slight contamination is easily removed by sulphuric acid. Nitric acid will dissolve some mercury and cause waste.—SM.

[62390.]—**Trigonometry.**—Since the sum of the angles of a triangle = 180°, angle A C B = 57° 25′, and angle A B D = 54° 38′. Also, angle C A D = B A C − B A D = 32° 20′, and, therefore, cos. C A D = ·8448. Now, $AC = AB\,\frac{\sin. ABC}{\sin. ACB}$ and $AD = AB\,\frac{\sin. ABD}{\sin. ADB}$. Hence, we have the formulæ—

$$\log. AC = \log. AB + \log. \sin. ABC - \log. \sin. ACB \quad \ldots\ldots\ldots\ldots(1)$$

$$\log. AD = \log. AB + \log. \sin. ABD - \log. \sin. ADB \quad \ldots\ldots\ldots\ldots(2)$$

Substitute for the terms in (1) and (2) their numerical values, as given in tables of logarithms and we find that

$$AC = 855, \text{ and } AD = 1212.$$

But—

$$CD = \sqrt{AC^2 + AD^2 - 2\,AC \,.\, AD \cos. CAD} \quad \ldots\ldots\ldots\ldots(3)$$

Putting for A C, A D and cos. C A D the values already obtained, we have from (3), C D = 670yds. very nearly.—J. R. C., Charing.

[62406.]—**Pulleys.**—The slip of the belt is on the small pulley, and is owing to the small amount of grip obtained by the belt, this also being lessened, as you suggest, by the disproportion between the pulleys. If you could employ a larger pulley in the place of the small one (as you say you could drive faster), it would greatly improve matters, and a wider belt, if pulleys will admit, would also be of assistance. Crossing the belt would increase the grip on the pulleys, if the reversal of the motion didn't matter.—E., St. Mary Ch., Torquay.

[62406.] — **Pulleys Slipping — Speeding Laval Cream Separator.** — Assuming that "Doctor Medicinæ" is speeding the counter-shaft of his cream separator, I shall be pleased if I can assist him, as I also use this machine. I have a 16in. pulley on the main shaft, which is driven at about 200 revs. per minute. The distance of centres is 7ft. 6in. only, and horizontal distance 3f. 9in. This position is less advantageous than "M.D.'s"; but I am not troubled with slipping. I think it would be desirable to use a smaller pulley than 36in. I formerly considered that resin or tar was necessary on belt; but, thanks to a hint from "ours," I applied linseed oil varnish, quant. suff., which has made the belt very pliable, and tenacious as indiarubber. Another hint: Watching some dynamos at work at the "Healtheries," I saw the importance of using a somewhat slack and pliable belt in a position as nearly horizontal as possible, with the slack side upward, when driving a small pulley. I observed that, under these circumstances, about ¾ of the circumference of the pulley was in contact with belt. If "M.D." is driving in the other direction, I would recommend him to change the direction of motion if practicable. Slip being a variable quantity, depending on the condition of all the belts, I constantly use a pitch-pipe or tuning-fork as a standard for maintaining speed of separator. When the machine gives out the tone of G sharp I am satisfied, and this appears to be the highest speed obtainable in my practice, when the small V-shaped leather band used has become oily. The slip at the high-speed pulley is more important than that at the intermediate one.—W. G. BULL, Martock, Somerset.

[62410.] — **Income - Tax and Inhabited House Duty (Distraint for).**—Queen's taxes are preferable to bills of sale and to other distraints, so are the "expenses." (2) In the circumstances mentioned of favouritism (in remitting expenses) shown by the tax collector, "Victim" has no redress.—B.SC., Plymouth.

[62410.]—**Income-Tax upon Property, &c.**—If any person charged to income-tax refuses to pay the duty on demand made, the collector must distrain upon the premises charged with the duty, or must distrain the person charged by his goods and chattels. Every distress levied by a collector must be kept by him for five days, at the cost of the person refusing to pay, and if the duty is not paid within five days, the distress must be appraised—that is, a value must be set upon it by two inhabitants of the parish, or other sufficient persons, and then sold by public auction by the collector or his deputy. If anything remains of the proceeds of the sale after deducting the duty and the cost of taking, keeping, and selling the distress, it is restored to the owner. If at the time any duty of Income-tax becomes in arrear, any goods or chattels belonging to the person charged are taken in execution, or are seized by virtue of any other process, except at the suit of a landlord for rent, or by virtue of any assignment, such as a bill of sale, the person by whom the goods, &c., are so taken or seized must pay to the collector all arrears of duty due at the time of execution or seizure, or payable for the year in which the same is levied or made, not exceeding one year's duty; and if payment is not made by him, the collector must distrain and sell the goods, &c., as if no execution or seizure had been levied or made. If the person on whom the distress is levied pays the duty which is levied on him, but refuses to pay the expenses of such distress, a further distress may be levied on his goods and chattels to the amount necessary for the payment of such expenses. If the collector in the case of one person does not demand the payment of the expenses, such action does not excuse another person who may be liable for similar expenses from their just payment. The collector has to act on his own responsibility, and he may be aware that in two cases of persons who may be called upon to pay the expenses of a distress and have refused so to do, the one person may have money to meet such a demand and the other may not. I do not think that it is at all likely to be a matter of favouritism on the part of the collector. If the public, who are so frequently aggrieved by the assessment and payment of Income-tax duties, would appeal to the commissioners, they would, I am sure, meet with substantial justice, and many points in the management of the duty, and in the carrying out of the Income-tax Acts, which are now but little understood, would be made more intelligible.—COMMISSIONER.

[62415.]—**Secondary Battery.**—There should be lugs on the tops of the lead plates, and these should be placed alternately to the left and the right of the top end of the cell. All three left-hand lugs must be connected together to make one electrode, while all the three right-hand ones are connected to form the other. To prevent short-circuiting, separate the sheets by flannel, or, better, by a little asbestos cloth. The current in ampères will vary with the resistance you insert. You may profitably allow six ampères to flow through the outer circuit.—S. BOTTONE.

[62415.]—**Secondary Battery.**—The best separators I know of are gratings, such as used in the Elwell-Parker, made of vulcanite. Slips of wood well soaked in paraffin are also much used. It is convenient to arrange the plates and separators outside of the cell; then secure them with two or three stout rubber rings, so that the whole set of plates can be moved about without derangement, and then place them in the cell. I suppose the plates are made with lugs; if so, all the lugs of + plates should be on one side, and all of − plates on the other. Unless in exceptional cases (as the one I replied to last week, 62316), the surface advisable to allow for each ampère-hour capacity is 20sq.in. of peroxide surface. You may, therefore, expect from 7 to 8 ampère-hours capacity, although you can eventually quadruple this by continued forming.—ELECTRICIAN.

[62416.]—**Screw-cutting.**—If you have two 20's which are also usually supplied, you can cut 23; thus $\frac{20 \times 20}{23 \times 100}$ and 46 by $\frac{20 \times 20}{46 \times 100}$; also 33 by $\frac{20 \times 20}{55 \times 60}$; but the other numbers being prime, you cannot cut by wheels alone, unless you have those numbers in wheels also.—T. C., Bristol.

[62416.]—**Screw-cutting.**—"Jack Cade" can cut some of the screw rates he mentions, but not all. The whole subject of which screws can be cut with change wheels, and which cannot be cut is thoroughly threshed out in a little book on "Screw-cutting," published by Messrs. Lockwood (post free 1s.). Taking Jack Cade's" examples—

$$\frac{33}{4} = \frac{3 \times 11}{2 \times 2} = \frac{90 \times 55}{20 \times 30}$$

Also—

$$\frac{39}{4} = \frac{3 \times 13}{2 \times 2} = \frac{90 \times 65}{20 \times 30}.$$

Get the above book if you want to understand all about screw-cutting.—LATHE.

[62417.]—**Photographic.**—Pyro. ammonia and sodic sulphite developers are equally good. For an amateur who is apt to over-expose, the latter is best. To get greater density, double the quantity of pyro., and develop for a longer time.—B.SC., Plymouth.

[62417.]—**Photographic Developers Compared.**—No absolute statement can be made on this subject. With some brands of plates the sodic sulphite gives the best results; with others, the pyro and ammonia. This latter seems to suit the greatest number of English operators; but my preference (as also many other Continentals) is certainly in favour of ferrous oxalate, as being so thoroughly under control and producing such excellent results.—S. BOTTONE.

[62418.]—**Wood Boring.**—For years past I have bored long, straight, smooth holes as tubes for model pump and other hollow works with the American-twisted augers—the smaller sizes in a chuck, the larger by back feed against the centre head. The new lipped twist drills are made expressly for this operation; but a short trial has convinced me that the Norwegian gimlet (so easy to make) can do the same job up to any calibre quite as well. Flatten $\frac{1}{3}$rd of a bar tough steel, file out a taper, heat in a muffle, wrap a spiral to gauge, finish off with round and flat files, temper to brown colour. I mean this as a lathe drill, of course, in a chuck.—EOS.

[62419.]—**Photographic.**—(1) An over-exposed plate will always develop quickly, and more than likely the "image" will not come out at all; (2) Derwent plates are suitable for instantaneous work under suitable conditions; (3) Get "Platt's Exposure Book" (1s.), and you will find that four tables are necessary to answer this query of "What exposure is required with the optimus," &c.—B.SC., Plymouth.

[62419.]—**Photographic Exposures.**—Yes, it is possible to expose so long as to set up what is known as the "reverse" action. I have not tried the "Derwents" plates, so I cannot say. But most of the plates found in commerce will take an "instantaneous" picture. The exact time of exposure will depend largely on the nature of the light and the subject; but $\frac{1}{50}$th of a second would be sufficient in ordinary cases.—S. BOTTONE.

[62420.]—**Oval Turning.**—The ordinary lathe-head is used for this, and carries an oval chuck. This consists of a chuck which has a slide working in dovetails, and which slide carries a duplicate of the nose of lathe mandrel for attachment of other chucks. Two pins project from slide through slots in base of chuck, and engage with outside of a ring which is attached to front of headstock, and is adjustable sideways to alter relative movement of slide by means of screws.—T. C., Bristol.

[62421.]—**Printing.**—Chloride of lime gives black tones with two grains chloride of gold per sheet. Use two to four drops saturated solution of lime.—B.SC., Plymouth.

[62421.]—**Printing (Photographic).**—Velvety black tones may be obtained on silver paper by the use of platinum chloride instead of gold chloride in the toning bath. The essentials for obtaining rich black tones with good contrasts are—First, a plucky negative. (No pure black and white tones can be obtained on pictures printed from feeble negatives.) Second, the prints must be bronzed in the shadows. The prints having been well washed to remove excess of silver nitrate, place them in the following toning bath:—Water, 1 quart; platinum chloride, 2 grains; sodium acetate, 100 grains. To be made up several hours before using. Fix as usual.—S. BOTTONE.

[62422.]—**Mechanics.**—Thirty miles an hour = 44ft. per second, and as the acceleration is assumed uniform, and train acquired this velocity in 300 seconds, the accelerating force is $\frac{44}{300}$ft. per second. If the pull equalled 150 tons, the acceleration would be 32ft. per second; consequently, the pull must have been directly as the accelerating force divided by 32 and multiplied by weight of train, thus $\frac{44}{300} \times \frac{150}{32} = 2240 = 1540$lb. To this must be added resistance of train = 150 × 10 = 1,500. Total mean pull = 1,500 + 1,540 = 3,040lb. —T. C., Bristol.

[62424.]—**Painting Designs on Cloth, &c.**—For painting designs on cloth and for needle-work use Chinese white, mixed in a bottle with some good strong gum (if too thick to work pretty freely, add a little water), and trace the design with a drawing-pen, and there will be no difficulty. I have drawn designs for ladies' needlework for seven or eight years, and have had but one or two complaints of their coming off. It is best, after tracing the material, to dab it with a soft cloth, as it seems to fix the pattern more. If tracing is required on a light surface, use powder blue with the Chinese white, &c.—ARTIST.

[62425.]—**Electrical Tricycle.**—I am under the impression that an electrical tricycle may not be used on the public roads unless preceded by a man with a red flag, and proceeding at a rate not exceeding five miles an hour. You would probably want about 2cwt. of accumulators, and then you would most likely be very sorry you had invested. —S. BOTTONE.

[62426.]—**Valve Gearing.**—The link rocks backwards and forwards owing to motion of eccentrics, and it, therefore, makes an angle each side of the vertical. The block is constrained to move in a straight line at right angles to the vertical, and it is only when the surface of link is vertical that the block would not tend to slip if it had no guides. This can only happen for a moment in each vibration. At all other times it simply presents an inclined plane to the block, up which the block tends to slide or link to move in opposite direction, and the shorter the link for same stroke, the greater the angle and *vice versâ*. This tendency to motion is restrained by suspension links, connected through cranked lever to reversing handle, and by stop in catch-plate, and this tendency may be such as to be a question as to whether you shall pull the lever or the lever pull you. It is overcome in some cases by screw applied to lever. It is this angularity which is such a nuisance in some forms of automatic cut-off gear as applied to stationary engines.—T. C., Bristol.

[62428.]—**Wood Turner's Hand-Planer.**—Brass plate D in mine is secured by flat-headed bolts sunk in the plate, thus leaving the bottom of tool smooth to lean on the T-rest. The gap E for escape of dust and chips is a blank space left between the cutter and wedge, about $\frac{1}{8}$in. or so. This is, of course, left in mounting, and is not cut afterwards. D is the bottom plate, with bolt-heads visible. The double line is the bent base of cutting iron, fitting accurately into the wooden head of this tool. Everything is held together by the two bolts. Choose the toughest wood you can get for the purpose.—EOS.

[62430.]—**Faulty Coil.**—The fault is most likely in your arms, and not in the coil. As the right arm is the stronger, *id est* has the most developed muscle, more resistance is encountered by the current, hence it is more felt in the right arm. —S. BOTTONE.

[62430.]—**Faulty Coil.**—This is a fault inherent in all coils of same make. Ferguson's method of winding partly obviates this. By reversing the connections with the battery, you will find that the opposite pole of secondary coil becomes strongest. In all coils the negative secondary pole is weaker than the positive; but in coils of Dyer's pattern this difference is much greater than it should be, owing to faulty construction.—ELECTRICIAN.

[62433.]—**Radius of Lens.**—1. If of crown glass, double the radius is very nearly the focal length of a plano-convex. A lens equi-convex on both faces has its focus very nearly equal to the radius. 2. The focus of the plano-concave will be negative; but practically the same length as the corresponding plano-convex. 3. Let R be radius of convex surface, r that of concave. F = principal focus; then $\frac{1}{R} - \frac{1}{r} = - \frac{1}{F}$ or $\frac{1}{R} = \frac{1}{r} - \frac{1}{F}$ from which $R = \frac{r\,F}{F - r}$. Thus, example: A diverging meniscus whose concave radius is 3, has a negative focus of 5, what is the convex radius?

$$R = \frac{5 \times 3}{5 - 3} = \frac{15}{2} = 7\tfrac{1}{2}.$$

The above is the common rule for meniscus lenses, and evidently the sign of F depends on the relation of R and r. So long as $\frac{1}{R}$ is less than $\frac{1}{r}$, or R greater than r, F must be negative. 4. I should think no better information can be found than in the back volumes of the "E. M." If any better books exist, we shall all be glad to know of them. I have often wished that Mr. Wenham's admirable articles in Vol. XVIII. could be reprinted; it would help many inquirers.—O. V.

[62436.]—**To Metallurgists.**—I have often met with the defect alluded to by "J. Hy. T." It occurs as well in finished bar iron as in puddle bar. I believe it to be mainly due to the presence of cinder in the iron. It is worthy of notice that tin bar iron, made by the Welsh "Finery" process, is almost always quite free from blisters. This finery process is used in the making of iron for charcoal tin-plates, precisely because it gives very clean iron—in fact, much superior in that respect to puddled iron. Some years ago, when I was employed as analytical chemist in the Swansea district, the manager of a mill newly started consulted me with reference to the continual blistering of his tin bars. On drilling holes through the centre of blisters, we found that they were always hollow, and that the iron was not welded wherever a blister had taken place. In my opinion, bad welding is often, if not always, due to cinder, at least in mill work. When the iron comes from the balling furnace it retains in its pores a quantity of oxide of carbon. This gas not being able to escape because of the rapid chilling of the surface of iron by the water, which is kept flowing on the rolls, the oxide of carbon would have a tendency to force apart the walls of any cavity caused by an
weld. Whether this theory is true or
not prepared to say. At all events, on
the supply of water to the rolls, we foun
blisters were much less frequent. We the
our attention to the mixture of pig-iron
endeavoured to produce a more fluid cin
iron became much cleaner, and the bli
scarce.—COPPER.

[62437.]—**Photographic.**—Intensifi
fulfil the querist's conditions, should be
mercuric bichloride. See, first, that th
thoroughly fixed, then washed, steeped
solution, and thoroughly washed again
let the plate stay too long in the saturate
solution, or it will be reduced, not intensif
it out before it is "bleached," wash th
and steep in a solution containing one
ammonia (hydrosulphuret of ammonia
be better) until the negative darkens
again; wash thoroughly and dry.
Plymouth.

[62438.]—**Pipeclay.**—Yes, provided
clay be perfectly dry previous to puttin
fire, it can be baked. This is how ord
pipes are actually made. French chall
drated silicate of magnesia.—S. BOTTON

[62439.]—**Electrical Business.**—Pr
wires were kept perfectly insulated
another, galvanised wire would do. A
some kind is absolutely necessary. You
full accounts of the photophone and Grah
experiments in back numbers.—S. BOTT

[62439.]—**Electrical Business.**—
wire would have to be insulated by some
other, and a return could be made by w
gas pipes; but for such a short dist
better to use properly-covered wire,
have a return wire, as it saves
bother and trouble in the end. There
remember rightly, an article in Cassell's
for All," on the photophone, and unless
of the query is answered by other corres
I will look it up, and do my best to an
questions.—WM. ROWLAND HART.

[62441.]—**Luminous Paint.**—Tak
sheet of glass, and give it three or fou
Balmain's luminous paint, laying them on
as you can, and letting each coat thoro
before applying the next; and then gi
coats of a neutral base to preserve it.
painted-glass is usually baked afterwar
why not buy the glass already painted?
cheaper than doing it yourself, or if you
a small piece for spectrum experiments,
a luminous match-box do? If you live a
London, or have any difficulty in proc
glass, I will send you a small slip, if
advertise your address.—WM. ROWLAN

[62442.]—**Arc Light Dynamo.**—
BOTTONE.—Using an armature about 5in
you may wind it with about 3½lb. of N
balance the resistance with an equivalen
of No. 14, say 6lb., on the fields, which
about 8in. high by 3in. in diam. If
shunt for incandescent lighting, then, the
being wound as above, the fields may b
with 8lb. or 10lb. of No. 20.—S. BOTTON

[62443.]—**Acute Spasmodic Asthm**
first thing to do in this case, so as to b
practical benefit, would be to place the
ferer in the hands of a competent dentist
the mouth was put in proper order, and t
cating power restored, a medical man w
have some chance of doing good, shoul
vices be required, as a very great deal of
asthma is really impaired digestive pow
worse by drugs and inhalations.—DENS.

[62443.]—**Acute Spasmodic Asth**
would appear from "Cosmopolitan's" d
that the first thing to do is to improve the
digestion. She must get false teeth, an
rule to masticate her food thoroughly; t
attention must be paid to diet, and, ab
change of air is most beneficial. As to
the most useful are arsenic-iodide of
and inhalations of pyridine; but they sh
be taken on the advice of a medical pr
who knows the case.—B.SC., Plymouth.

[62443.]—**Acute Spasmodic Asth**
not let the lady play with her health by re
quacks or attempting to doctor herself;
be visited by a really good medical man
made asthma a special study. In the me
let her procure a set of teeth, for unle
masticate her food, she cannot digest it,
she can digest it, she cannot be well. Th
avoid *tea*, for that is sure to affect her
As a palliative, during the paroxysm
smoke cigarettes of *Datura tatula*.
things, let her avoid wine, beer, and s
BOTTONE.

[62443.]—**Acute Spasmodic As**
"Cosmopolitan," I observe, seeks medi

pecting the case of a chronic sufferer, who may, may not, have some hereditary tendency to that cial form of malady. One regrets no hint atever is given thereon, since it is often an portant consideration. Asthma, moreover, is properly termed spasmodic, except when quite omplicated. In this lady's condition, for ance, it may, or may not, be symptomatic, anic, of pulmonary congestion, emphysema, ertrophy of the heart, &c. Of course, in smodic asthma of various kinds, admission of is lessened, the bronchial tubes are blocked up h frothy mucus, and their muscular fibres are tracted; but even these results are by no means most grave or serious. "Cosmopolitan's" eemed client appears to me—an old doctor—to e considerable wasting from defective gastric e physiologically. Hence, perfect digestion l ultimate assimilation are simply impossible, ause the natural process of dissolving aliment the stomach, and preparing it for bodily rishment, is not adequately accomplished in the gs. Distension of the stomach, excessive flatu- ce, prolonged coughing, and the rest duly follow consequence of irritation of the pneumo-gastric ve. Nutritive solids, with cayenne, are prefer- e to much liquid nourishment of any sort. nced beef, for example, a good mashed potato, h bread and butter, light puddings; and for rning and evening meals, black tea, with cream, gar, and dry toast, with horse-radish, is whole- ne and refreshing. If supper be wanted, one lespoonful of fine cognac in a small basin of e gruel ("Robinson's Groats") is very suitable. t mustard foot-baths, alternated with hot salt t-baths, should be often resorted to. Wine of psine, a solution of the powder in sherry, should given after each meal in the dose of a dessert oonful, and at 11 a.m. and 3 p.m. one teaspoonful ammoniated tincture of quinia in water. garettes of stramonium frequently give relief. "Cosmopolitan's" patient resides in some remote t-of-the-way place, he may possibly get of the llage herbalist a very useful mixture as follows: Tincture of lobelia two fluid drachms, chloric her three fluid drachms, tincture (or juice) of nium three fluid drachms, in half a pint of cilage of almonds. A tablespoonful thrice ily. Homœopathic arsenicum and belladonna d dosimetric strychnia and atropine, have like- se their remedial place and power.—WILLIAM ITCHMAN, M.D.

[62444.]—**Bills of Sale.**—The holder does not his hold upon the property if the re-registration omitted; but it is void against execution, ditors, or assignments for benefit of creditors a trustee in bankruptcy, unless the party is in ssession under it. Take possession, sell, or force ew one.—B.Sc., Plymouth.

[62445.]—**Stoppage of Drain.**—I was much oubled with the soil-pipe and drain from my pe-stone getting stopped up with fat, until I nd a perfect cure by emptying a kettle of boil- g water into it once a week.—X. [An occasional shing with a hot solution of potash is still better. ED.]

[62445.]—**Stoppage of Drains.**—You had tter fix one of the many grease traps made, as ar the sink as possible, but outside the wall d connected to sink by a short piece of lead pe, the fat will accumulate in the trap instead your drains, and is readily got at for cleansing rposes. This should effectually cure; but you st get the drain thoroughly cleansed of all fat, d the only way is to take them up and relay, as would take an enormous amount of chemical lvent to thoroughly cleanse them.—A. E. B.

[62446.]—**Equations to Curves.**—The ques- n of "Architectural Student" does not seem to a very appropriate one in the way it is given, r it is really too indefinite to receive a definite ply in these columns. The method of fully vestigating the figure of curves by means of their uations, constitutes in itself a great part of the ence of analytical geometry, and moreover ters largely into the domain of the differential lculus. The method of finding the equations to rves can, however, be explained here, as it admits a succinct explanation. Geometrical propositions y be divided into two classes—those which con- n *magnitude* or quantity, and those which con- n *figure* or position. Algebra is naturally apted to the former kind; but not so apparently the latter, for it does not appear at first sight w it can be applied to investigate the form of rves. Accordingly, though algebra soon after introduction into Europe was applied to ques- ons relating to magnitude, it was not till the year 37 that it was applied to investigate the figure curves by the celebrated Des Cartes, who first troduced the method of co-ordinates and of uations to curves, and thereby laid the founda- n of analytical geometry. Finding the equations curves may be exemplified by finding that of e ellipse, where the sum of the two focal radii always the same and is equal to the major axis. aking the centre of the curve for the origin, and its axes for the axes of co-ordinates, let a and b denote respectively the major and minor axes, and x the abscissa. In order now to determine the ordinate y, it is evident that three independent data are necessary, because considering the major and minor axes as given quantities, we would still require to have the abscissa x or some other third quantity also given before the length of y could be fixed. The method, then, of finding the equation to the ellipse, as an explicit function, is to find the value of y in terms of a, b, and x, or, in other words, to find y as a function of x and the constants a, b. Doing this we obtain $y = \frac{b}{a}\sqrt{a^2 - x^2}$ for the required equation. Now, this equation must be extremely expressive and characteristic of the curve itself; because, considering the quantities a, b, and x, as given, we must necessarily perceive that it is the geometrical condition for describing the curve—the condition that the sum of the two focal radii be constant—which has enabled us to find the value of y, and on which this value entirely depends. Therefore, this equation is the algebraical equivalent for the law by which the ellipse is described geometrically, and all the properties of the ellipse are implicitly contained in the equation, and are capable of being derived from it by the fixed and general rules of analytical geometry. Indeed, we can often deduce the more apparent geometrical properties of a curve by merely inspecting the algebraic equation which represents it. Thus, in the present instance, it is at once evident that the ordinate of an ellipse bears to the corresponding ordinate of a concentric circle whose radius is a, the constant ratio of b to a, and again, since the equation may be at once resolved into the proportion $y^2 : (a + x)\ (a - x) :: b^2 : a^2$, it shows that the square of any ordinate is to the rectangle contained by the two segments which that ordinate makes on the major axis in the constant proportion of the square of the minor axis to that of the major axis. Instead, however, of the explicit or resolved form of the equation, we may take the rational form $a^2 y^2 + b^2 x^2 = a^2 b^2$, and as this equation is only another form of the preceding one, it is just as expressive of the ellipse, and is the one most commonly employed. Having now shown the reason why equations to curves are so specially characteristic of them, it may be well to consider next the readiest means of finding those equations. In the first place, in order to distinguish the constants from the variable quantities, we are to inspect the geometrical figure and observe what magnitudes vary and what do not vary, according as the variable point which describes the locus changes its position. Those magnitudes which do not vary with the changes of the variable point are to be considered as constants, and those magnitudes which do vary are to be considered as variables. No variable must be allowed to remain in the equation to the curve except the two co-ordinates, x and y, though it will generally be necessary in the first instance to introduce other variable quantities and afterwards to eliminate them. As a practical illustration of the foregoing explanations, let us find the equation to the ellipse involving its eccentricity, and here we may regard the ellipse as the locus of the vertex of a triangle whose base $= 2C$ and sum of its two sides $= 2a$ are given quantities. Let r and s be the two focal radii, then we have the equation $r + s = 2a$, and the axes of co-ordinates being rectangular we have also the equations $r^2 = y^2 + (c + x)^2$ and $s^2 = y^2 + (c - x)^2$. Now, we may see that r and s are each variable quantities because each of them varies in length according as the vertex of the triangle changes its position, and therefore they require to be eliminated; but as we have got three equations we have got sufficient to eliminate these two quantities, and thus to find the equation to the curve. Similarly, in general, it follows from the nature of a system of equations that in order to find the equation to any curve from its geometrical definition, the number of equations to be taken from the corresponding geometrical figure is one more than the number of variable quantities that are to be eliminated. Every line, whether straight or curved, may be considered as being the locus of a variable point moving according to some fixed law or condition, and may be considered as resulting from an indeterminate geometrical problem. If the problem were a determinate instead of an indeterminate one, it would only designate a point instead of a line. The circumference of a circle may be regarded as resulting from the indeterminate problem of finding a point situate at a given distance from a fixed point. In such problems an indefinite number of points can evidently be found which will satisfy the required condition, though, however, they must all succeed each other in a regular order of position depending upon the nature of the proposed problem. In all cases, however, the figure or shape of the line which forms the locus is completely determined, for the indeterminateness extends no further than as regards a point, and not as regards a line; and thus, in the problem just cited, no other curve but the circle could satisfy the required condition, so that, though an infinity of points are allowable as solutions, yet they are so far restricted in position that they must all be situate in a line which is the circumference of a circle whose centre is the fixed point, and whose radius is the given distance. What we are to observe here in particular is the fact that the figure of the locus or curve depends entirely on the condition contained in the proposed geometrical problem. Now a very remarkable analogy exists between indeterminate geometrical problems of this kind and equations in which there are two unknown quantities. If an indeterminate geometrical problem be expressed by an algebraic equation, that equation will contain two unknown quantities; and conversely, if an equation with two unknown quantities be represented geometrically, the result will be an indeterminate problem which will generate a line for its locus. Now, in equations to curves, the two variables are treated exactly as two unknown quantities mutually depending upon one another, and receiving all possible values, —and thus it is that they generate a locus—while the constants are considered as being known or as literal coefficients. The indeterminateness which exists algebraically in one equation, with two unknown quantities by which it admits of an infinite number of solutions is represented geometrically by the fact that instead of referring to a point, it refers to a whole line. Since an equation with two unknown quantities can thus be represented by an indeterminate geometrical problem from which a locus may be deduced, and since the figure or shape of that locus depends entirely, as we have seen, upon the conditions of the problem, it must also depend equally as much upon the algebraic or transcendental equation from which that problem results; and, therefore, any equation with two unknown quantities may be conceived to represent the figure of a line. It is by this means that figure as well as magnitude is expressed algebraically in equations to curves. Not only do equations to curves enable us to investigate the peculiarities of their course to an extent surpassing the powers of the descriptive geometer; but they also supply the means of discovering curves in infinite variety, since every equation we can take with two unknown quantities has in general a corresponding curve for a locus; and hence we may perceive the immense increase in the range of geometry that ensued from the discovery of Des Cartes. As the position of a point in a plane is determined by its co-ordinates, we are thus able to trace the form of a curve from its equation, for, by giving arbitrary values to the abscissa, we can deduce corresponding values of the ordinates by means of the equation, and thus any number of points can be determined, and the curve traced out accordingly. It is evident, therefore, that in order for the equation to be fully ascertained, the constants must all be known, as otherwise the curve could not be traced out in such a manner, and would have no fixed position. From the form in which equations with Cartesian co-ordinates appear, it might at first be supposed that they are not homogeneous in themselves; but this irregularity is only apparent and not real, because the constant coefficients must always be supposed to represent such quantities as render the entire equation homogeneous. Thus, in such an equation as $Ay^2 + Bx + c = 0$, if c be supposed to be a quantity of two linear factors, and therefore to represent a surface, all the other terms must also represent surfaces; therefore, B must represent a line, and A numbers. In some works on conic sections the equations to the curves are obtained from some geometrical definition for each curve; while in other works the general equation of the second degree is taken, and the equation for each curve is deduced as a particular case of the general equation. Theoretically, one course is as proper as the other; but, no doubt, the former course, though less general, is much simpler, and more suitable for beginners; and such was the opinion of Todhunter, who adopted it. In solving geometrical propositions algebraically, in order to know to what extent algebra has been of advantage to us, a good idea can be formed by observing, after the conditions of the problem are expressed into algebra, to what extent the operations of algebra have been employed, in order to obtain the final results. The more lengthy and intricate these operations are, the more advantageous will be the algebraic method over the geometrical method; because then the more has the aid of algebra been called into requisition, and, as a matter of course, the algebraic operations are more easy and uniform than the corresponding geometrical operations. Judging according to this criterion, the examples of its application, which I gave on "Algebraic Geometry," p. 252, the case where algebra is of most advantage is in the theorem regarding the circle (Fig. 3); the next in order is that to which Fig. 1 refers; while in the theorem on the intersection of three lines, its application is of no use except by way of illustration.—VLADIMIR.

[62447.]—**The Bansoolah.**—I recommend 1½lb. weight of finished metal, good tough steel, the solid part about 2in. square at each angle of the widest part, the hole through 1½in. increasing to obovoid, so that the handle cannot shake or turn round when in use. This handle of tough, hard wood, seasoned holly, or ash, length of blade 2½in. from square head (exclusive of it), 2½in. broad. This blade is a wedge of gradual taper. One-third of blade from edge should be of chisel temper, the head being left rather soft. The Indian carpenter uses the latter as a hammer to drive heavy nails, and as an anvil for straightening his primitive drills and soft wire rivets. The edge at angle 45° from handle.—EOS.

[62448.]—**Governors.**—I have not made a drawing, but I think the following will suit your query:—1, 1½lb., or 2¼in. diam.; 2, 2in.; 3, 7¾in.; 4, 15in.; 5, ½ steel; 6, 5in.; 7, 3in.; 8, 2in. Connect with equal bell crank to suit yourself. I do not however, advise you to put on this form, which would only run at about 80 revs. per minute. I should slot the balls and connect rods to their centres direct, and reduce balls to 1½in. diam., and put a spiral spring on *c* (see page 237), so as to keep *b* and *d* apart. You must have means to adjust spring to suit your requirements, and run at same speed as engine at least.—T. C., Bristol.

[62450.]—**Boiler.**—If 10in. diam. and of ¼ plate, double riveted and ends stayed; if flat, this should be safe at 150lb. You do not sufficiently describe boiler to say what it would drive. Is it simply a plain shell?—T. C., Bristol.

[62452.]—**Liquid Gelatine.**—By repeatedly boiling, and more especially in the presence of an acid (say vinegar, nitric acid, or citric acid, &c.), gelatine loses its power of setting when cold, and becomes converted into metazelatine.—S. BOTTONE.

[62455.]—**Spots on Sensitised Paper.**—The cause of small black specks is matter in the wrong place—otherwise dirt. Every time "S. B." sensitises paper he must filter the silver solution, and also brush over the paper with a camel-hair flattener.—B.SC., Plymouth.

[62456.]—**Heating Small Hall.**—For heating the largest amount of cubic space at a minimum of cost and consumption of fuel, I have found nothing equal to the "Tortoise" (or slow-combustion stove). Coke broken small burns well; but clean cinders do best. I know of only one fault—the smoke-pipe requires to be shielded at its outlet by some kind of cowl or wind-guard. I have had one in use to warm a large-sized workshop about seven years. In mid-winter 65° to 70° temperature is insured for hours, and when made up at night I have found hot coals the next morning—about 12 hours' heat for a few pounds of fine stuff. The great iron pipes from boiler apparatus are a great disfigurement to the walls in my house, and cannot be removed in summer, like the "Tortoise" and its piping.—EOS.

[62457.]—**Leverage.**—Although not addressed to me, I would point out to querist that he must give distance between guides and between wheels, and size of wheels. It is quite possible to arrange them so close as to jam the whole concern; but if put 6in. apart between, guides 2½in. apart, and wheels 2in. diam., it would run freely.—T. C., Bristol.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

61953. Loco. Engines, Narrow Gauge, p. 67.
61858. Photographic, 67.
61978. Perambulator Wheels, 68.
61995. Casts, 68.
61998. Reversions, 68.
62005. Battery with Non-Conducting Elements, 68.
62007. Plaster Trusses, 68.

62206. Sprague's Universal Galvanometer, p. 160.
62224. To "Fiddler," 161.

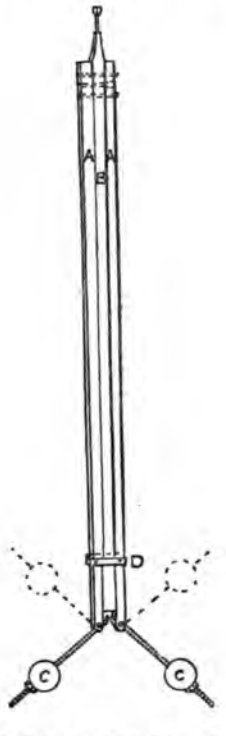
Harness Varnish or "Reviver."—Dissolve, in about half a pint of methylated spirit, 2oz. of shellac, ½oz. of Venice turpentine, and 1oz. of gum benzoin. Stir in a sufficiency of a mixture of four parts drop-black, and one of indigo blue, to form a deeply-coloured varnish, then make up with spirit to the measure of one pint. Apply with a sponge or soft brush.

Etching Liquid for Steel.—Mix 1oz. sulphate of copper, ½oz. alum, and half teaspoonful of salt, reduce to powder, with 1 gill of vinegar and 20 drops of nitric acid. This liquid may be used for either eating deeply into the metal or for imparting a beautiful frosted appearance to the surface, according to the time it is allowed to act. Cover the parts you wish to protect from its influence with beeswax or tallow.

QUERIES.

[62458.]—**Air Propeller.**—I want to press as much air as possible per hour through a 6in. by 3in. tube; the air tube supplied through a feeding tube, and passed into a delivery tube. The instrument must not be open at the sides like an ordinary fan. Will some kind reader, well up in the matter, suggest any existing form of air propeller (must not be bulky), and, if possible, state the rate of delivery in cubic feet per hour, and the power required to work it.—R. A.

[62459.]—**Clock Pendulum.**—Can any reader counsel me? I intend making a clock pendulum which I think will supersede the quicksilver bob. I shall fasten at the upper end three strips of metal A B A; such that B shall expand and contract more than AA. By this arrangement, the holes C C will rise and fall with the temperature, thereby counteracting the lengthening and shortening of the whole pendulum. D is a clip to keep A A from springing apart. What are the best varying metals for the job? How would B iron, and A A brass do?—P. W. BALDWIN.



[62460.]—**A Wonderful Clock.**—I saw at the Exhibition of 1851, a clock that used to be exhibited at Exeter, by those to whom it had come down from the maker—if I remember rightly, one John Lovelace. It was made about the end of the 15th century, after 30 years' labour. I will not pretend, after such a lapse of time, to enumerate what it was designed to perform; but having seen it, will venture to say that if ever it was in going order it might well be called the wonderful clock. It passed out of the hands of the Exeter people under the hammer of the celebrated Robins, many years ago, I believe, before it was exhibited in 1851. It may be that some of your readers know something about this clock; if so, I am sure many would be pleased besides myself to hear of it.—MANN.

[62461.]—**Sour Yeast.**—Would any reader kindly inform me whether yeast that has been boiled will keep longer in summer than when it is merely scalded?—BAKER.

[62462.]—**Bookbinding.**—Will some friend give a poor bookbinder a wrinkle how to use Dutch metal, in place of gold leaf for common labelling?—A POOR BOOKBINDER.

[62463.]—**Registration.**—I am anxious to register an association (not intended for profit) merely for the sake of protection against infringement. How must I proceed, and where shall I apply? How are societies similar to the Cyclist Touring Club registered and where? What is a deed of constitution?—TILLETT.

[62464.]—**L.Y.R. Vacuum Brake.**—Could any correspondent furnish a sketch of the ejecting apparatus used in the above? I know the general principle, but should like to see a drawing. Also does the wire on the carriages for shunting purposes, release the ball-valve or what?—C. C. W.

[62465.]—**Solidified Oil.**—In reply to Mr. Hardy's inquiry, will be pleased to have particulars of above suitable for land and marine engines.—M. B. BAIRD.

[62466.]—**Tin Alloy.**—In melting gold I cannot succeed in getting out the tin alloy to my satisfaction, although I can get the copper out. Will any of your correspondents kindly inform me the best way to do this?—J. E.

[62467.]—**Essex Chuck.**—As I see that "B. R. N." (27298) has had some experience of this chuck, perhaps he can tell me the probable reason of the breakage of the small jaws. I have had two sets, and each time I find them broken after being used two or three times, that is to say that when I went to fix a small drill, the next time I found one of the jaws broken off. I use them carefully, and I am certain no one else touched them.—WM. ROWLAND HART.

[62468.]—**Compensated Pendulum fo day Clock.**—Theoretically a glass rod pend in diameter, with a 1in. cylindrical bulb, blo end, and containing some 4in. in weight of merc give perfect compensation. The bulb woul stoppered mouth for increasing or decreasing t of mercury, and the regulating arrangement fixed to the top of the glass rod. Has this pend tried, and with what success? I should be gl results, as also how the attachment of brass t made. Can a cap of brass be cemented to the H. P. SLADE.

[62469.]—**Telegraph Lines**—Will someo give me the following information? The n miles in work, at the end of 1885 or 1886 of, 1. office land telegraphs? 2. The railway telegr 3. The submarine cables? What has become of Atlantic cable—when was it taken up? I do among the eight cables crossing the Atlantic as the map.—WM. ROWLAND HART.

[62470.]—**Wheels Without Flanges.**— locomotives being sent to New South Wale flanges upon the middle pairs of wheels. I getting off the rails, is this as safe as with flange —INQUIRER.

[62471.]—**Railway Query.**—A train of c standing upon a level line, an engine setting ba strikes them too hard and they run back. W say per ton, must the engine have struck the v cause them to run back?—LOCO.

[62472.]—**Brakes.**—What is the cubical con Westinghouse and automatic vacuum brak tending over a train of 400ft.? A lecture wa Manchester lately, in which it was said that a 2i pipe has less contents than a 1in. air pipe, pe Kiernan or other vacuum advocate will explai GINEER.

[62473.]—**Engine Query.**—Will any friend me the horse-power of the compound engi following dimensions: Diameter of cylind pressure, 40in.; low pressure cylinder, 70in.; str and 40 revolutions per minute; initial pressure 60lb. per inch; steam cut off in small cylind What is the pressure at end of stroke of smal and the average pressure on small cylinder, pressure on small cylinder, and the initial press cylinder, and the terminal pressure in larg also the average pressure in large cyl compound engines has the valve in large cylind so as to cut off steam at any particular part of is it allowed to enter for the full stroke. When cut-off valve is used behind the slide valv pressure cylinder, has the slide valve any la steam enter for full length of stroke? In t back pressure is 2lb. per square inch. What is horse-power? The real power I suppose woul by a diagram.—ENGINE DRIVER.

[62474.]—**Foul Zincs.**—Can any of "our why the zincs of bichromate cells become co hard red deposit? It adheres so closely, and i that it is difficult to scrub them clean. I use composed of potassium bichromate 4oz., sul 4oz. (fluid), and water 40oz. The zincs are amalgamated.—PRINCIPIA.

[62475.]—**Stearine Refining.**—Can any give me information as to how stearine is r what appliances are requisite, or tell me o dealing with the subject?—ARNOLD WARBUR

[62476.]—**Microscopic.**—Looking through volumes the other day, I came across an engr piece of apparatus for making microcope slide rings, and doubtless intended to supersede th turntable. Owing to an accident my hand is and I cannot make the rings properly, so can say if this invention is worth anything, and if t sees this, can he tell me what would be the pro It is illustrated in No. 1,086, p. 487.—SLIDE-MA

[62477.]—**Wimshurst Machine.**—W S. Bottone or other electrical reader kindly giv details for making a Wimshurst machine with plates (prepared as described last week in lett Sketches would be appreciated.—M. ISADOR, Le

[62478.]—**G. W. Goods Engine.**—I have a G. W. goods train worked by a goods engine, 4 coupled wheels apparently about 5ft., outsi built at Swindon, Aug. 1885. Any further par to how many there are of this class, and also the dimensions, will oblige—W. ROWCLIFFE, Oriel ford.

[62479.]—**Dynamo, 100c.p.**—To MR. B Many thanks for the reply to my query, No. 62 trouble you to make clear the following? F each with "F.M.'s" having a tunnel 5½in. d forming a square of 6½in. Does this mean each to be a block of 6½in. square (with recess for A.) combined? Will you please say how many lay 20, s.c., to put an A.? About what thickness t A. ought to be, if the winding is round the tw (over and under the A.), or inside and outside th in the Gramme ring? Will the shunt winding 2, 3 or 4 lamps being switched out, or must it be wound? A sketch would be a great help.—M. C.

[62480.]—**Dynamo Design.**—I have fit workshop for the purpose of making some small I fully understand the practical part of the wor quite at a loss to know how much wire, and wh put on to get the following results. I only mak from one set of patterns; but I want to wind shunt wound to give about about 80 volts, some an arc lamp, and some for electro-plating. Cou your correspondents give me an easy formula b could work out the sizes of the wire for myself understand high mathematics, and get quite Fricker's articles in the *Electrician*.—LIBERATO

[62481.]—**Measuring Round Taper** Can any of our readers kindly inform me how the above, so that I can place marks for eac gallon from 1 to 18, without having to fill water every time. The tanks will be 18in. bottom 12in. at top, and 22in. deep, with (36).

Driving Mill Stones. — To "T. C., In Vol. XLV. p. 160, I gave a rough sketch drive a pair of stones, 4ft. 2in., and on p. 184 plied ; but having bought a portable engine, o flywheels, one is 5ft. 10in. dia., the other dia., which wheel would be most suitable ? e size of pulley I shall have to put on lay stones about 100 per minute. I am sorry to o much. Would you also give me power of ler, 10½in. dia., 14in. stroke, pressure 60lb. ? old to get the nominal horse-power can be aring dia. of cylinder, and cut off the units— t ?—DUSTY MILLER.

Medical Coil.—To S. R. BOTTONE.—Pre- ling wire on paper tube, I fastened one end to w, leaving 6in. for connecting with steel of ter laying on ½lb. No. 24, s. covered c.w., I end to second binding screw and then to the w on base board. I then connected platinum r binding screw, with short piece of wire and connections. I described battery and its y 6th. I did not mention I had a piece of or a clamp on end of carbon block, painted arnish, not being quite dry when I had the awn out to work the coil.—ONE IN A FIX.

Coil Core.—Will some reader inform me e of wires is used to form the core of a coil solid piece of iron, and if it is at all detri- coil to have the iron wires incased in a piece iron tube ? I have a coil thus made, and want would strengthen it to use iron wires alone ?—M. A. B. P.

Tinman's Prices.—Can some practical by informing me if there is any means of present prices for making general tinware in London and Birmingham ?—TINPLATE

Dynamo Design.—To MR. BOTTONE.— e good enough to give me a simple rule by ich the diameter and depth of an armature o the dimensions of the field magnets of a aine may be calculated, when the size and re for the given E.M.F. and current have ed ? How many yards of wire per volt must e armature conductor, its speed being about ions per minute ?—AN AMATEUR ELECTRI-

Action from Dry Plates.—Would any t, perhaps Mr. Bottone or "Electrician," n me if I can get a feeble action from two y small copper and zinc plates of about one connected by copper wire ? For the purpose y want a very feeble action. How could I there is any electrical action goes on from tes ? I need not mention for what use I I don't want to use any liquid. I shall be ul for a reply from any of "ours." I am a in electricity.—ARMOURER.

Fixing Glass Cloth to Wooden ill any reader kindly inform me the best xing glass cloth or paper to wooden drum, —WOODWORKER.

Rock Crystal Spheres.—(Letter 27204). e trespassing on good nature to ask "Pris- o has contributed so much practical informa- columns, if he will describe the process of l spheres in crystal and also in glass optically . W.

Mirror.—Will "O. V." kindly give me the surfaces for mirror, similar to those used for where the silver is on the back of mirror, so arallel rays to a focus ? Also a formula to proportion of radii, if we use spheric curves, example, say the focus for parallel rays to be e thickness of glass at the centre to be 2-10in. ?

Boiler Query.—Having made a 'dome for r, I wish to put on an angle iron at bottom. get the right bevel, so that the angle fits the t it be made before shut or drawn after drawn after shut, how and with what tools ? HY.

Hot-Air Engine.—I read with interest J. ption of a ½-man engine which I think would ndy motor for an amateur to possess. I have in. by 7in. stroke, which I could utilise in f these motors. Would Mr. Seal or "F.A.M." the extra 2in. stroke would add anything to the engine ? Also the dia. and length of placer ? How could a governor be attached of this type ?—ONE OF OURS.

Boiler.—I have a rolled iron pipe, 3ft. 6in. n. in diameter inside, and 3-16in. thick, which ake into a boiler. What pressure would it square inch ? Will it do to drive a small hat rivets would be best, and what distance at size cylinders shall I require ?—PADDOCK

Speed and Feed of Saws.—Will any ne what is the best speed for horizontal saw, rate the timber should be fed ? Also the ed of cir. and log frame saws, and difference ard wood speeds ?—YOUNGSTER.

Photography, Vague Formulæ, &c. kind friend explain ? I constantly meet læ, of which the following is an example : per cent. solution of chrome alum." Does oz. alum in 100oz. water, or 10 dr. in 100dr., in 100 grains ? I have been told to use o 1oz. water, which is not 10 per cent. of any easure. I can understand 10 per cent. when ents are weighed, but not when one is the other measured. Is there a rule about using a lens of 4in. focus, which takes es with 3 to 5 seconds exposure. How long pproximately) will a lens of 12in. focus re- h the same brand of plate, of course ?—K. G.

Induction Coil.—Will Mr. Bottone, Higgs, d electricians inform me if my coil is con- ht ? I have made a paper tube 7in. long, ⅜in. hogany check glued on to one end 4in. square ; this tube is wound with two layers of No. 18 c.c. B. W. G. The contact breaker is arranged on the square end of this tube. The second tube is also made of paper, with two square ends, 4in. square, which slides over the tube with the No. 18 c.c. on. I have wound a little over 2½lb. of No. 36 s.c. wire, each layer paraffin waxed. Also one layer of paraffin paper over each layer. Now what I cannot understand, when I have got the primary wires coupled to one quart Fuller, and the brass tube not drawn out, I get a violent shock, and the shock does not increase in power until the brass tube is little more than half-way out, and then you may expect to feel something that is like a shock.—FULHAMITE.

[62497.]—**Incandescent Lamps.**—I have charge of a Siemens dynamo, which used to run 30 incandescent lamps, of 42 volts, and 4 arc lamps. Lately I have done away with the arc lamps and connected up the armature to run all incandescent. I put 80 lamps in, 47 volts ; but even at an excessive speed, I could not get anything like a good light. I have since changed all my lamps, and put in 42 volt lamps and get splendid results, and a cool machine. Would any kind reader explain the reason ?—WALLER.

[62498.]—**Micro - gilding.**—Can anyone give the method by which such minute objects as diatoms have been gilt ? Wishing to gild some minute objects, such as ferns, &c., I should be greatly obliged if any of "ours" would give full particulars of the method of working. Having profited for years by reading the ENGLISH MECHANIC, I am aware that parts of the process have been given. Hitherto, however, I have seen no complete detail of the method given—preparation of the object, previous covering with copper or silver, battery to be used, connection with same, anode, brightening of surface, &c. Will some one, practically acquainted, help amongst others—A. W. S.

[62499.]—**Abyssinian Well.**—I want to sink a well at the smallest possible cost. I believe water is to be obtained at a depth of about 30ft. or less. The well would have to be sunk through some 4ft. or 5ft. of shale, and through some 4ft. of stone. Could an Abyssinian well be bored through this ? In this district the cost of sinking an ordinary well of that depth would probably be 15s. a yard.—COUNTRY VICAR.

[62500.]—**Lathe Bands.**—I want to substitute round for flat bands to my lathe ; gut of ½in. diameter is too expensive, and I am in doubt as to best way of joining round leather. I am told that splicing done by a saddler is proved useless, and I am afraid that hooks and eyes will not hold, as what little thread of the screw could be formed would soon strip.—T. G.

[62501.]—**Electrical Gas Lighter.**—I have a cell for an eletrical gas-lighter, and I do not know how to charge it, so I would be very glad if any person could help me. There is a stick of black stuff. I have been told "Chatterton's Compound" will do as well ; round that is wrapped a sheet of silver, round the silver is chloride of silver. I think then the lot goes into, or at least, I took it out of a cylinder of zinc. Ought there not to be a solution of something ?—'ARRY.

[62502.]—**High Speed Electro-Motor.**—What form of motor is best, and what is the practicable limit of speed ? Would a speed of 100 revs. per second, and developing about a half-horse-power, during a run of two or three hours, be possible without injurious heating, and could the machine be driven by accumulators ?—SCHNELLIGKEIT.

[62503.]—**Cutting Small Brass Wheels.**—Will any of our lathe friends say whether small brass wheels can be cut in the lathe with a fly-cutter in the slide-rest ? If so how should the wheels be chucked ?—A. A. U. V.

[62504.]—**Glaziers' Diamonds.**—How should these be selected ? How are the sparks selected by makers ?—some seem to cut better than others.—ANN V.

[62505.]—**Pulley Blocks.**—Can any reader say which is considered the best pulley block, and give a description of it ?—N. S. A.

[62506.]—**Electric Battery.**—I wish to make a bichromate of potash cell of peculiar form. Can I use wood to contain the solution ? Is there any material for rendering a wood cell acid-proof ?—ELECTRIC.

[62507.]—**Perkins' Boiler.** — Where can I find a full description of this boiler ? What the tubes are made of, their arrangement, thickness, internal diameter, firebox and steam dome, if any ?—W. G. G.

[62508.]—**Balcomb Tunnel.**—Can any reader kindly give length of this tunnel, which is on the L. B. and S. C. —ZULU.

[62509.]—**Sextant Vernier.**—Can any of your readers inform me to what length, with reference to the limb graduation, the vernier of an 8in. sextant graduated to 10′ should be cut to read to 10″ ? Should it be the length of 19° 40′ or 19° 50′ on the limb ? I am alluding to a "long" vernier. A "short" vernier is the length of 9° 50′, and being divided into 60 equal parts, gives, of course, the reading to 10″, but I am uncertain whether the "long" vernier should be double this length (19° 40′) or $20° - 10' = 19° 50'$.—HUNDREDWEIGHT.

[62510.]—**Violin Repairing.**—I have got a very old violin which has seen so many changes in life that the glue has become rotten, and consequently the ribs are "bursting out," if I may so term it. About four years ago it had a magnificent tone so distinctly mellow, but now, alas! it is like a person singing with a husky voice, due to some vibration altogether exotic to its original tone. I imagine the bass bar is loose, and produces this huskiness ; the G string when played on is almost unbearable. What am I to do in this case ? The fiddle is at least 100 years old, but unfortunately of no eminent make. Supposing I had it repaired by an expert, could he reglue it entirely, and should I expect the same tone afterwards ? What would be the probable cost of same ? Any information will oblige.—SOLAR RADIANCE.

[62511.]—**Systematic Exposure.**—Will a user of Platt's tables in the systematic exposure book (Cartwright and Rattray) kindly explain the following ?—It tells me that if I prefer to number my stops according to the U.S. numbers, who have taken *f*/4 as the unit of aperture instead of *f*/10, the unit used in the tables, I have to substitute the U.S. numbers of the stops for the numbers given in Table III., and multiply the numbers in Table IV., representing the relative rapidities of the different makes of plates by 6¼, and the same result will be arrived at. I am using Wray's landscape lens. The stops are: No. 1, *f*/10 ; No. 2, *f*/11·314 ; No. 3, *f*/16 ; No. 4, *f*/22·627 ; No. 5, *f*/32. Should be glad of an example.—A. D. B.

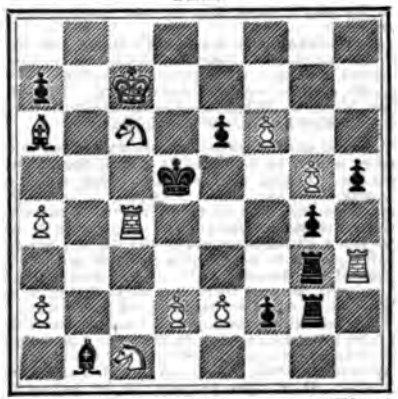
[62512.]—**Commanding the Sun to Stay Still.** —What other motion is there given to the mirror of a heliostat or siderostat than its revolution once in 24 hours ? Does the mirror follow the height of the sun from the horizon ? Then, if so, this secondary motion is an up-and-down motion (of the mirror). How is this motion governed ? Conceive the idea of a gnomon of a horizontal sundial revolving once in twenty-four hours, and a mirrror fixed to it, so that it (the mirror) would incline at an angle equal to the latitude of the place. Would this represent the working of a heliostat ? Perhaps our worthy friend "F.R.A.S." may suggest some solution of this (to me) enigma ?—SOLAR RADIANCE.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXLV.—BY I. M. BROWN.

Black.



White. [12 + 9

White to play and mate in three moves.

SOLUTION TO 1,043.

White.	*Black.*
1. Q-Kt 8.	1. Anywhere.
2. Q-R or Kt mates.	

(Five variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,043, by H. Hosey-Davis, Avon (tame and uninteresting, but two variations omitted) Hensing, Major (simplex munditiis), V. S. Pochin, Black Pawn (a pretty idea very neatly expressed : dual if 1, Kt-Q 5), G. A. A. Walker, James Palmer (two variations omitted), F. Krasser, W. Hewson-Kilbee (variations not given), T. H. Billington, Harry Norton, Lancaster, Snowdrop (dual), J. W. Hamill, A. Dean, E. C. M. (Ipswich), J. Mackenzie, A Beginner, J. J. Spence ; to 1,042, by A. Bolus, J. W. Hamill, J. J. Spence, Snowdrop, James Palmer, G. A. A. Walker, Country Boy, H. Hosey-Davis, Hensing, C. S. Bright, Genoa.

H. F. L. MEYER, J. Quigley, and G. J. Slater are thanked for problems.

V. S. POCHIN.—You will see you were duly credited with both solutions. Even clerical errors are liable to a deduction of marks.

A. BOHN.—The problem shall be reported on ; but if we remember right, check was threatened by black.

M. GOPAL.—For games we should recommend beginners to get "The Chess Manual," price 6d., published by Simpkin, Marshall, and Co., an admirable little book ; for advanced students, "Gossip's Manual," and "Cook's Synopsis" (Morgan), both 3s. 6d. we believe. For problems "The Problem Art," recently published by Mr. and Mrs. Rowland, would be useful to the tyro ; to the more advanced, "The Chess Problem Text Book," (Cassell), Mackenzie's "Chess," "English Chess Problems," and "Chess Gems."

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Advertisements must reach the office by 1 p.m. on Wednesday to ensure insertion in the following Friday's number.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 25, and unacknowledged elsewhere :—

SELIG SONNENTHAL AND CO.—J. W. Queen and Co.—E. P. Alexander.—Lt. Bassett.—Toodles.—A Fellow of the Royal Astronomical Society.—Eos.—Silke.—Dubitans.—W. Jackson.—A Reader of the E.M.—Ormond.—Arthur Mee.—W. Habgood.—Ponto.—Student.—Silver Grey.—Another Novice.—D. G.—Holland.

G. M. S. (The answer has been frequently given in our columns, and is to be found in any of the books on patent law. Briefly, the use of a patented article for the benefit of the user, either financially or for his personal convenience, is an infringement; but to construct a patented machine simply as an amusement or as a model, is not an infringement of the patent; nor is it an infringement to construct a patented machine for purposes of experiment. In the case given it would be infringement, because there is a decided user of the machine, and it could not be contended that it was only for experimental purposes. 2. We are not aware that they have been compared with the albo-carbon light, which is an addition made to the gas, and can be applied to any form of burner. They can be had of any of the dealers.)—L. O. F. (As you want it for use with a Fletcher foot blowpipe, why not procure his catalogue, in which you will find all particulars of the substitutes for coal-gas.)—BERT. (It was described so recently as p. 205, in the number for April 29; but full illustrated descriptions have recently appeared in the electrical serials. The paragraph forwarded by you contains statements which are certainly not accurate.)—A NEW READER. (Some are made by stitching thin pieces of magnetised steel in red flannel. Refer to answer to "Non-Electric," on p. 258.)—TRYING TO LEARN. (The difference between shunt and series winding has been described many times. It is useless to say "don't refer to back numbers" We cannot repeat every time a querist asks for information. See p. 507 last volume, and the indices for diagrams.) — PATTERN-MAKER. (Several cameras in back volumes. If you want information for making a bellows camera, see Nos. 946, 953. They are in print, and can be had from this office, post-free, for ten halfpenny stamps.)—W. R. (We do not think any practical work on the subject has been published; but you will find in back volumes all the information needed, though it is naturally "scattered.")—TURNER AND BORER. (Such rules as there are have been given in our columns, and the usual formula will be found in the textbooks. For works on the subject, consult Wilson's "Treatise on Steam Boilers," Crosby Lockwood and Co.; Courtney's "Boiler-maker's Ready Reckoner," same publishers; and Nicholls's "Theoretical and Practical Boiler-Maker," published by the author at Blackpool we believe.)—G. MITCHELL. (No doubt we shall have some information about the accidents referred to when the official reports are issued.)—W. S. (From the Captain of the Steam Reserve at any of the Government Dockyards.)—H. P. (Procure a catalogue from Crosby Lockwood and Co., Stationers' Hall-court, E.C., and look through back volumes for a great deal of information on the subject.)—WILLIE JACKSON. (We illustrated in No. 705, p. 57, Vol. XXVIII., a method of drilling square holes patented by Mr. J. Hall, of Chancery-lane. We believe such drills are sold, but we do not know who makes them. See Hints Nos. 4 and 5 above.) -P. J. H. (How can anyone answer such a question unless you give some idea of what you mean by a heating apparatus? You will find all sorts of arrangements in back volumes.)—A CONSTANT READER, A.H.S. (See Hint No. 4. We believe the company is selling them now, but we do not know the address. No doubt you will find it in the advertisements of the daily papers. See p. 446, No. 1139, for some details of methods of increasing the illuminating power of gas.)—DYSPEPTIC SUFFERER. (Depends entirely on circumstances. Quick beating, unless there is a special reason for it, is a sign of weakness; but you should not trouble yourself with such matters.) — J. G. (Try the following:— Melt carefully with a gentle heat 2lb. of yellow beeswax, and add 4½oz. of Venice turpentine, 2oz. of lard, and 1½lb. of elutriated bole. Mix thoroughly and pour into water, kneading it well with the hands. A common preparation is suet one part, beeswax two parts Another is wax five parts, olive-oil one; and still another, wax four parts, turpentine one part. With a little experiment on different proportions, you will no doubt produce an article that meets your requirements exactly.)—A PERPLEXED MOTHER. (It is a trade name, and we do not think an analysis has been published. As good a lotion as can be made is compounded of sulphuret of potassium one drachm, soft soap two drachms, water eight fluid ounces; dissolve together and shake. Or make an ointment of sulphuret of potassium 2½ drachms, lard and soft soap of each 1oz., olive oil ½oz.)—PUZZLED ONE. (The puzzle you inquire about was illustrated on p. 133, April 8 last, and was answered in the number for April 15.)—TYPO. (There are several recipes in back volumes: for instance, one in No. 1203, p. 232, Vol. XLIII. Possibly the simplest is to add tannin to good glue until the latter becomes sticky and "ropy." 2. Some of them are made of glue and glycerine with other ingredients, which are kept secret by the makers. As a rule, the composition can be thinned with water. Some makers do not use glue, but dissolve waste pieces of skin by soaking in water for a long time, and then boiling the crude glue or dissolved skins with glycerine under pressure.)—DANDELION. (Pour a little sulphuric acid or a strong solution of sulphate of iron into the crown after removing the growing shoot.)—S. H. (There are Murray's and Baedeker's guides; but if you inquire at one of the railway bookstalls, or at any of the large booksellers in your city, you will find some cheap guides which will give you much of the information you want. Several illustrated guides for trips have also been issued.)

A New Washable Truss.—An Important Invention.—Harness Xylonite Truss is the most perfect appliance ever invented. It gives complete comfort and support without irritation. It has a beautifully smooth, flesh-coloured surface, and is guaranteed to last a lifetime.—Address: MEDICAL BATTERY COMPANY (Limited), 52, OXFORD STREET, LONDON, W.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Second-hand Lathe wanted in exchange for **Bicycle** or Lock-stitch Sewing Machine.—Wellesley House, Colchester.

What exchange for Coventry Rotary pattern **Tricycle**, cost £15, only ridden a few miles.—As above.

Sociable **Tricycle**, Rudge's Coventry Convertible, splendid condition, lamps, bells, complete, cost over £29. Will exchange for good American Organ.—BUCHANAN, 110, Fenchurch-street, London.

Iron Safe wanted; send size. Will exchange Howe Tricycle or European Arm Sewing Machine, cost £5 10s., not used 3 months, or Model Engine and Boiler.—C. HANWOOD, 12, High-street, Wellington, Somerset.

"**English Mechanic**," Vol. XXXV. to No. 1,139, Vol. XLIV., first five bound, sell 20s., or offers Photographic Goods.—G. M., 12, Victoria-road, Twickenham.

Woodturner's 7in. centre **Headstock**, back centre, T-rest; one-horse Horizontal Boiler; 20in. Perambulator Wheels, Axles, Caps. Exchange, approval; stamp.—W. SMITH, Bilston-road, Wolverhampton.

Steam Gauge 2½in. single Lathe Wheel, crank and treadle, complete; Surface Plate 10½in. by 11in.; youth's Tricycle, part finished; offers, approval.—W. SMITH.

Salvo **Tricycle**, ball bearings throughout, lamp, gong, &c., good as new, cost £26. Exchange.—9, Wellington-place, Bowdon.

5in. stroke **Shaping Machine**, by Kendall and Gent, Manchester, self-acting circular motion, top driving, vice, &c. Exchange.—9, Wellington-place, Bowdon.

"**Photographic News**," "Scientific American," 19 "Amateur Photographer," unbound, 1884; 5 Negative Boxes. Exchange anything useful in photography.—B., 55, Tavistock-road, Westbourne Park.

Second-hand **Facile Bicycle** wanted in exchange for engineer's Vice and cash.—Apply by letter, with full particulars, C., 9, St. Botolph's-street, Colchester.

52in. **Bicycle**. Bown's ball bearings, adjustable, pedals, hollow forks, long distance saddle, K.R.H. lamp, bag, &c. Exchange a good Vertical Boiler, about 3ft. by 16in., with all fittings.—HALL, 10, Stanfield-road, Everton, Liverpool.

"**Gosse's Year at Shore**," 35 coloured plates; "Brown's Manual of Botany," 350 illustrations; "Dr. Dowden's Shakspere: His Mind and Art"; Smiles's Works; whole calf; for Microscope Objective.—BUFFHAM, Comely Bank-road, Walthamstow.

Wanted, Donkey Pump or Pulsometer, in good order. Will exchange new Venetian Blinds, any size or colour.—WAITS, 29, Barnes-road, Fratton, Portsmouth.

Lens wanted (½-plate R. R.), good maker. Exchange.—H. WALKER, Watchmaker, Minster, Thanet.

Vice wanted, about 3 or 4in. jaw. Will give good exchange.—W. J. B., Electrical Dept., Guy's Hospital, London Bridge, S.E.

Wanted, 3in. Treadle Lathe and few Chucks. Exchange ENGLISH CONCERTINA, 48 keys, double action, also Electric Bell, 3in., and No. 2 Leclanche Battery.—WICKENS, 40, Hereford-street, Marylebone-road, London.

Set of **Whitworth Stocks and Dies**, ⅜in., ½in., ⅝in., nearly new. Exchange for small Slide-rest.—A. SMITH, Bowling Green-row, Woolwich.

Gas Stocks and Dies, ¼in., ⅜in., ½in., new: small Ratchet Brace new; strong shifting Spanner, open to 2⅛in., nearly new. Offers as above.

Books (all kinds). Exchange new, second-hand (Engineering, &c.)—160, Great Hamilton-street, Glasgow. All other papers please copy.

Water-Colour Box, with pots, brushes, 7 Rowney's water colours, water tank, polished mahogany, with handle. What useful offers?—WRIGHT, Blandford-street West, Ashton-under-Lyne.

40 splendid **Foreign Bird Skins**. Exchange for Microscope, Telescope, Jeweller's Fittings, or anything in the electrical line.—38, Sunderland-street, Macclesfield.

52in. **Bicycle**, good condition, cost £10. Exchange Photographic Apparatus or anything useful.—COWAP, 22A, Cambrian View, Chester.

Locomotive working model, slide-valve cylinders, complete, eight wheel. What offers? Part exchange, photo, engine, or electric apparatus.—G., 84, Devonshire-street, E.

"**English Mechanic**," from Sept. 9, 1883, to present date, clean, 8 volumes. What offers, or otherwise?—CHAS. MINTO, Byers Green, Spenny Moor.

Salvo **Tricycle**, ball bearings throughout, lamp, going, &c., good as new, cost £26. Exchange.—9, Wellington-place, Bowdon.

5in. stroke **Shaping Machine**, by Kendall and Gent, Manchester, self-acting circular motion, top driving, vise, &c. Exchange.—9, Wellington-place, Bowdon.

Model **Schooner**, nearly 5ft. long, fast sailer, cost £5. What offers exchange?—G. LOWE, Dial Stone-lane, Stockport.

Small **Locomotive Parts**. — Pair Slide-Valve Cylinders, Reversing Eccentrics, Six Wheels, Bedplate, Boiler, with fittings. Exchange for second-hand (Vertical) Copper or Iron Boiler, to burn charcoal or coke; no fittings.—F. W., 7a, Marlborough-street, College-street, Chelsea.

Photographers.—Amateurs making their own Dry Plates.—Will exchange about two gross Quarter-Plates ready for coating, for anything useful.—3, Barrington road, Liverpool.

Magneto-Electric Machine, for shocks, nervousness, &c., by Gaiffe, of Paris, beautifully made. Exchange for anything useful.—3, Barrington-road, Liverpool.

Gramme Dynamo, 100 candle-power, Cylindrical Electrical Machine and Leyden Jar. What offers?—ALBERT ALLMARK, Chester.

Excellent **Vertical Engine**, 2¼in. bore, 4in. stroke, mounted on tank, and fitted with governors, pump, &c. What offers?—A. ALLMARK, Chester.

Highly-efficient **Dynamo** laminated armature, lights seven five candle-power lamps, adjustable brush-holder. Current Electric Motor, drives sewing-machine. Offers.—A. ALLMARK, Chester.

Amateur woodturner's wooden **Lathe**, 5in. centres, 3ft. bed. What offers in Engine Castings or Tools?—EDWIN EDMUNDS, Fareham, Hants.

Bargain.—Powerful **Launch Engine** 6½ cylinder, 13in. stroke, with shaft and propeller. Offers. Want room.—H. HUGHES, 57, Market-street, Holyhead.

Microscope, small, no eyepiece, 3 objectives, in case, cost 63s. Magnet Electro-Machine in case, perfect, no handle.—KING, as below.

Half-plate **Camera** (Rack), 1 double back, rapid rectilinear lenses, &c. Exchange 1-1 camera, 3 double backs. Approval.—KING, 37, Bowling Green-lane, E.C.

Tangent Galvanometer, 10in., mahogany ring, turning about a centre, levelling screws; electro-magnet, 6in. high; offers.—E. ROBBINS, 2, Clement-street, Walcot, Bath.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Patent Heat Conductors, for cooking, save one-third time and firing, and one pound of meat in every ten pounds cooked, retaining all nourishment.

Roasters and Bakers, 2s. 6d.; Boilers, 2s. Of all ironmongers. Pamphlet free. — TALLACK, 25, Hatton-garden, London.

Wimshurst Influence Machine.—Sole manufacturers of new and improved pattern. 12in. from 30s.—KING, MENDHAM, and CO., Bristol.

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Morse Sounder, for learners, practical instrument, with battery and instructions, with exercises, 21s.—KING, MENDHAM, and CO., Bristol.

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Fretwork.—Catalogue of every requisite, with 600 illustrations, free for 6 stamps.—HARGER BROS., Settle, Yorks.

Carbon Plates, best quality, cut and moulded, plain and capped; quality cannot be surpassed.—GEO. G. BLACKWELL.

Pebble Carbon.—Graphite for Leclanche cells, splendid conductor; price very low.—GEO. G. BLACKWELL.

Manganese Oxide specially prepared for Leclanché batteries; high strength and purity, greater E.M.F., constant action; been in use 15 years with immense satisfaction; 7, 14, and 28lb. packets. Prices on application.—GEO. G. BLACKWELL, 26, Chapel-street, Liverpool.

New Illustrated Price List of **Screws, Bolts, and NUTS** for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JUNE 3, 1887.

MICRO-ORGANISMS AND DISEASE.

THE numerous investigations which have been made in recent years have left no doubt that certain micro-organisms are the primary causes of diseases of the zymotic class, and now that Bacteriology has become a study, these organisms are described as pathogenic, to distinguish them from those which are known to be harmless. The importance of the study of bacteriology is widely recognised nowadays, for certain diseases, scarlet fever and diphtheria, for instance, are apparently quite independent of sanitary arrangements, and as frequently invade those houses where hygiene is a first consideration as those in which the laws of health are utterly disregarded. If there is any difference in the two classes the former have the advantage, inasmuch as disease is less likely to attack the strong and healthy than the underfed and weak sufferers from defective domestic sanitation. The fact is well known and has been demonstrated many times: hence the scientist sought for the cause of the disease in conditions apart from the domestic arrangements, and found it in the pathogenic micro-organisms which are mostly disseminated by means of milk, and we now speak of epidemics of milk-scarlatina, milk-diphtheria, milk-typhoid, simply because the cases occur in isolated houses which, however, have their milk from the same source. The milk may become infected in several ways: it may be the recipient of the contagium from human beings while in the dairyman's vessels, or it may be infected from the cows themselves. The subject is not exactly a new one; but it is now attracting much attention in various parts of the world, and even the opponents of the germ theory of disease are fain to confess that there is more in it than they were at first willing to allow. At the Royal Institution last Friday, Dr. Klein delivered a discourse on the "Milk of Diseased Cows as a Source of Scarlet Fever," and we have just received that portion of the "Philosophical Transactions" of the Royal Society which contains the valuable paper by Prof. Thomas Carnelley, Dr. J. S. Haldane, and Dr. A. M. Anderson, of Dundee, on the "Carbonic Acid, Organic Matter, and Micro-organisms in Air, more Especially of Dwellings and Schools." This paper (it is published by Trübner and Co., price 2s.) is a very useful contribution to the science of hygiene, and may be studied with advantage by sanitarians. The authors have analysed the air found in houses of different sizes, and also that found in schoolrooms, and they have compared their results with the mortality statistics. The death-rate is shown to increase in proportion to the rise in the impurity of the air, and a general review of the facts collected points conclusively to micro-organisms as the active agents in the more fatal diseases. The death-rate per 10,000 from diarrhœa, acute bronchitis, broncho-pneumonia, and meningitis is given as 19·6 for those who live in houses of four rooms and upwards, 27·6 for three rooms, 39·7 for two rooms, and 59·8 for those who live in one room. This remarkable increase is not due to the greater proportion of carbonic acid, but to the enormous increase of micro-organisms—at least, that is the conclusion arrived at from a consideration of the results obtained in the investigations of the authors. We have not space here to follow them through their riments; but we may note that in an m to their paper they show that in ntilated mechanically and heated by hot-air blown into the rooms the micro-organisms found were only 16·5, whereas in rooms heated by fires and ventilated in the ordinary way they were 169. On this point the authors make some pertinent remarks, which may be commended to the attention of architects and school managers. The state of the air in the Board schools of Dundee is extremely bad, and the authors suggest that the symptoms ascribed to "overpressure" are probably largely due to the defective ventilation of the schools, for they assume that the conditions found in Dundee prevail more or less in all schools. The plenum method of ventilating is strongly recommended in preference to the exhaust, for a partial vacuum tends to facilitate the entry of sewer gas if there are defective drains, whereas the "blow-in" method has the opposite effect, and in cold weather secures a more equable temperature. The authors also point out that frequent renewal of air is of more importance than mere size of rooms, and they say definitely that ventilation by mere diffusion should never be depended on alone, for though it may remove a considerable portion of the carbonic acid, it has probably but little effect in reducing the organic matter and micro-organisms. The experiments of the authors also show that micro-organisms are not given off in the respiration of healthy persons, or not to any appreciable extent—a fact which Prof. Tyndall had previously demonstrated; but it is probable that they come from their clothes and skin, though the numbers from those sources are small compared with those which come from the room itself. Consequently the authors say that cleanliness both of the person and, more particularly, of the dwelling or school is of the very utmost importance in maintaining the purity of the air as regards micro-organisms. But it should be distinctly understood that no amount of ventilation, no degree of cleanliness, can prevent those diseases which are due to infection by the pathogenic micro-organisms, which may be conveyed from one person to another by food or drink, or by the air. Cleanliness and ventilation—hygiene, in short—ward off disease by helping to keep the human economy in a state of robust health, but the pathogenic microbes are as much specific poisons as the inorganic toxic agents, and if received by suitable hosts the effect follows as certainly as the day follows the night.

Modern science is surely, if slowly, tracking the causes of the zymotic diseases; some are already known, and in time we may hope that the others will be, but we know enough to assert that the germ theory of disease is true all along the line, although we cannot, as it were, put our finger on the specific microbe for each of the diseases. In the discourse above-mentioned Dr. Klein referred to the several cases of outbreaks of specific disease, and in particular to those in which it has been clearly established that scarlet fever can be communicated by milk from diseased cows. There is always a suspicion that milk may have been contaminated, when outbreaks of scarlet fever or other zymotic disease can be traced to its use; but there are instances on record now in which it has been almost demonstrated that the milk was not contaminated by human agents, and that consequently the disease proceeded direct from the cows. In the well-known Hendon case it has been established that the disease which produced scarlet fever in the human beings who consumed the milk was introduced to the farm by some cows imported from Derbyshire, and an examination of some of the animals disclosed the fact that they were suffering from sores in parts of the skin, with loss of hair in patches, ulcerations on the udder and teats, and a visceral disease, notably of the lungs, liver, kidney, and spleen, which, though milder in character resembled the visceral lesions found in cases of scarlet fever in human beings. Experiment proved that the matter taken from the ulcers of the udder was possessed of infective power, as similar ulcers were reproduced in inoculated calves; and a microscopical examination of the matter disclosed the presence in large numbers of a species of micrococcus, which, on being planted on artificial nutritive media, produced in a few days a crop of micrococci possessed of distinct characters by which they are distinguished from other bacteria. When calves were inoculated from a cultivation of this micrococcus they became after an incubation period affected with a cutaneous and visceral disease, exactly the same as that of the cows from which the matter was taken for cultivation, and it therefore follows that cows can be affected with a communicable disease which, in many points of its pathology, resembles human scarlatina. It had already been established that milk from such cows transmitted scarlet fever to human beings, and in order to complete the chain of evidence it became necessary to prove that scarlet fever in man is due to the presence and multiplication in the blood and tissues of the same micrococcus, and that this microbe, if obtained from human scarlet fever, produces in the cow the identical symptoms found in the cows affected by the disease which is asserted to contaminate the milk. This proof has, it appears, been satisfactorily given, and according to Dr. Klein there can no longer be any reasonable doubt that the Micrococcus scarlatinæ is the cause of scarlet fever, that it produces in bovine animals a disease which is identical, and that while the cow is susceptible to infection with human scarlet fever, it can in turn be the source of contagium for the human species. An important point was mentioned by Dr. Klein in connection with a brand of condensed milk, tins of which were forwarded to him by Prof. Corfield last autumn, and every one was found to contain some organisms, while one contained the special scarlatina microbe. So far as bacteriologists are aware, no species of micrococcus is capable of withstanding the temperature of boiling water, while many are destroyed when exposed to 180°—190° Fahr.; hence it follows that there is no safety in condensed milk, which is generally prepared at a much lower temperature. The conclusions which Dr. Klein laid before the Royal Institution have not been arrived at in a hasty manner—they are based on evidence which has been gradually collecting, and which has been tested in the scientific manner. Early in the present year corroborative evidence was supplied by a severe epidemic of scarlet fever in Wimbledon, the cause being traced to the milk supplied from a particular farm. In one of the houses supplied with the milk there occurred cases of scarlet fever, and a pet monkey became ill and died. Dr. Klein made a post-mortem examination of the animal, which had consumed a good deal of the milk, and found there could be no doubt that the cause of death was scarlet fever. From the blood of the monkey he cultivated the same micrococcus as is obtained from human scarlet fever, and experiments made with the cultivation showed that the same disease could be produced both by inoculation and feeding. The fact having been thus established, it becomes important to inquire how the milk of cows can assume the infective power. Dr. Klein says in one of two ways:—either the milk becomes infected during the process of milking by particles of contagious matter being rubbed off the teat or the udder, or the milk *per se* is possessed of infective power, and he is inclined to think that both views hold good. However that may be, the most important question for the public is, How may the spread of scarlet fever by means of milk be controlled and checked? Obviously by preventing the cow becoming infected either by contact with human scarlet fever or that of the bovine species, and by destroying the contagium in milk. The disease in the cow is of a mild type, and is easily overlooked; but one cow is capable of infecting a whole herd, or, at all events, those animals which have never had the disease. Perhaps it is too much to hope that dairy farmers will become experts in detecting the disease; but, at any rate, those who use milk can protect themselves, for Dr. Klein has found that heating milk up to 185° Fahr. is sufficient to completely destroy the vitality of the Micrococcus scarlatinæ. There can be no objection to treating milk in the manner suggested, and if that were done universally the number of cases of scarlet fever might be considerably reduced; but infection from person to person will still occur until it is possible to isolate every patient, and that in the majority of cases is practically impossible. We have in these facts another instance of the manner in which science is tracing disease to its origin, and although it may not be able to prevent epidemics, it at least points the way to secure immunity, and ultimately, perhaps, may succeed in reducing the death-rate from, at all events, the zymotic diseases—or those which are believed to be caused by micro-organisms.

SIMPLE EXERCISES IN TECHNICAL ANALYSIS.—XXI.

BY AN ANALYTICAL CHEMIST.

Valvoline Oil.

(291.) THIS new and excellent lubricant was introduced only a few years ago. The sp.gr. varied from ·870 to ·890, the free acid from nil to ·078, and the rise of temperature with sulphuric from 2° to 20° Fahr. Some of these oils are very thick at ordinary temperatures; but many of them remain fairly fluid even at 32° Fahr. They are purely of mineral origin, quite free from ash, and, as might be expected from the absence of acidity, without corrosive action on metals. They are fluorescent, and of a dark, almost black, colour.

Rangoon Oil.

(292.) The sp.gr. of the majority of the samples, varied from ·901 to ·910, although some were found as low as ·881 and as high as ·958. Many of the latter, however, were not pure mineral oils. Rangoon oil was originally purely mineral; but as it grew in public favour the demand exceeded the supply, and to meet the former, various mixtures of vegetable and animal oils were pushed on the market, and are still to be found there. Pure mineral oil sold as Rangoon can yet be obtained, and is generally preferable to the mixed substitutes referred to above.

(293.) The rise of temperature with sulphuric acid, owing to the additions and adulterations above mentioned, was very variable. It fell below 19° Fahr. in 33 per cent. of the samples examined, varied between 20° and 29° Fahr. in 12 per cent., and between 50° and 70° Fahr. in 30 per cent. Those with a rise below 20° Fahr. may be regarded as pure mineral; those with a rise between 50° and 70° Fahr. as containing a considerable proportion of oils other than mineral.

(294.) The free acidity, too, varied; but was always less when the oil was purely mineral. It is frequently stated as an objection to mineral oils that they have a tendency to develop acidity. My own experience is that mineral oils generally contain less acid than other oils, and have little or no tendency to develop acidity through age. With mineral oils only slight indications of free acid are obtained with either the alcohol or the copper test as a general rule; with other oils the acidity varies from traces to 0·22 (as acetic) per cent.

The pure mineral oils, sold as Rangoon, become very thick at temperatures near the freezing point. The temperature at which fat begins to deposit in the mixed oils varies from 32° to [illegible] Fahr.

(295.) Besides the difference in the rise of temperature with sulphuric acid, there is another means of distinguishing between pure mineral oils and oils of animal or vegetable origin. It is known as the saponification test. A small quantity of the oil is placed in a basin or flask, about double the quantity of a moderately strong solution (in alcohol preferably) of caustic soda or potash is added, and well stirred in or shaken, then heated for some time on the water bath until the bulk of the liquid has evaporated; an excess of hot water is then added, and the whole passed through a filter and washed. The unsaponified oil remains on the filter; the filtrate is a solution of the soap formed by the combination of the alkali with the animal or vegetable fat, which we will assume is present, and if an excess of dilute sulphuric acid be added to the filtrate, and a gentle heat applied, a distinct layer of fatty acids will rise to the surface. These acids can be again separated by filtration, and a subsequent determination of their melting point will afford a clue to their identification. A pure mineral oil when so treated gives on the addition of sulphuric acid to the filtrate a brownish crust quite unlike the fatty acids in appearance. This method, too, gives good results when tried quantitatively.

CRANE'S MINERAL OIL.

(296.) The extreme limits of gravity were ·893 and ·913, but 77 per cent. lay between ·902 and ·910. The oils were, as the name indicates, purely mineral. They were almost invariably free from acidity and from corrosive action on copper. For machinery of medium weight they were good lubricants. At temperatures approaching 32° F. they thicken considerably, and become very viscous.

CYLINDER OIL.

(297.) Is a pure mineral oil closely resembling Crane's in general character. *Cylindrine oil* is similar to valvoline (Art. 291) in quality.

WATCHMAKERS' OIL.

(298.) The oil commonly used by watchmakers is anything but satisfactory. It always contains enough free acid to act injuriously on mechanism so delicate as that of a watch or a clock. When tried on copper (Art. 246) a considerable amount of the metal is dissolved.

(299.) In sp.gr. 90 per cent. of the samples varied from ·914 to ·918, and 67 per cent. from ·916 to ·917. Olive and neatsfoot oils are the kinds generally used.

(300.) In a watchmaker's oil the following are most important: — (*a*) Freedom from acidity and corrosive action on copper or iron; (*b*) a low and nearly uniform viscosity at ordinary and at low temperatures; (*c*) absence of solid fat at temperatures above 32° F.

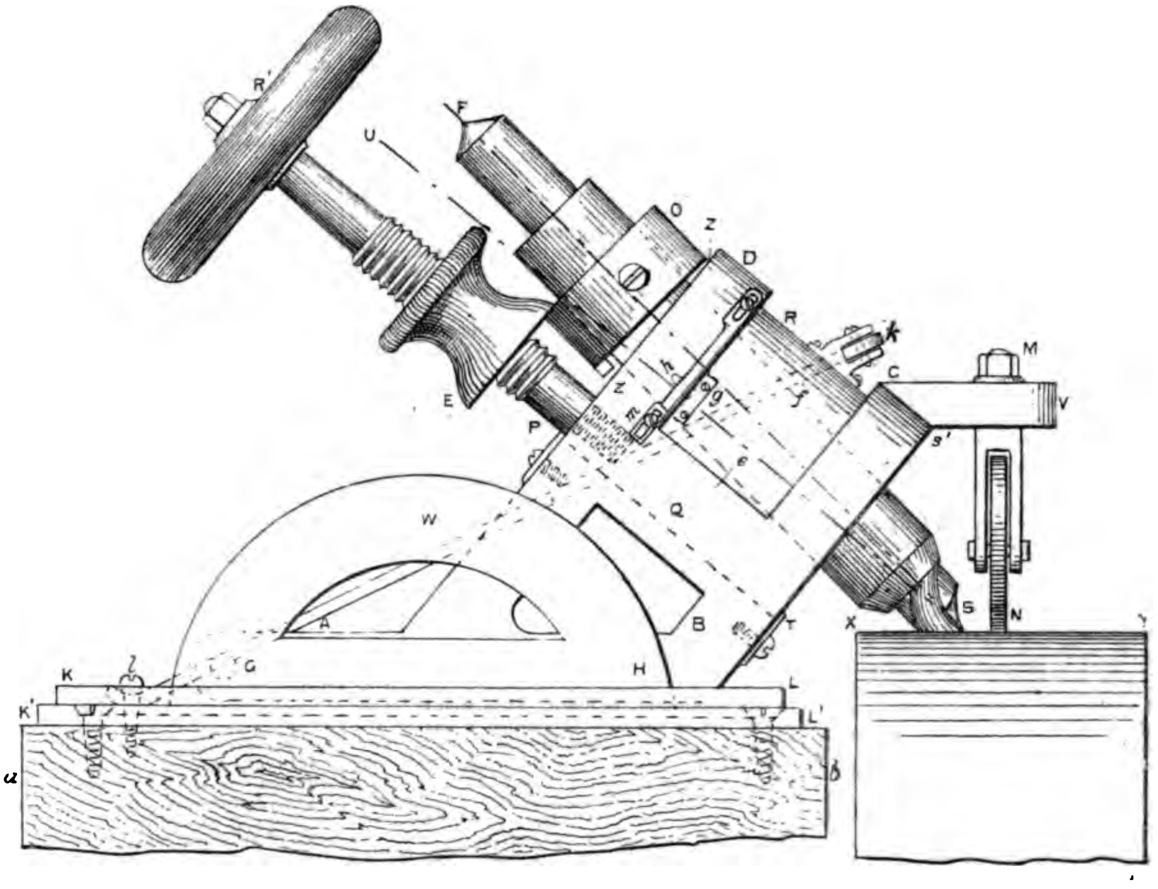
This last condition cannot at present be insisted on, for nearly all watchmakers' oils solidify at temperatures considerably above 32°. But its importance cannot be overrated. It may frequently be observed that clocks in exposed situations stop during winter, and especially at night. These stoppages are occasioned by the thickening or the solidification of the oil, and the consequent increase of friction.

(*To be continued.*)

THE IRON AND STEEL INSTITUTE.

THE spring meeting of the Iron and Steel Institute was held last week, and, beyond the president's address, was noticeable for discussions on points of mechanical interest. The balance-sheet and accounts showed that the institution is making steady progress. The Bessemer gold medal was awarded to Mr. James Riley, of Glasgow, for his work in developing the manufacture of mild steel. The president, Mr. Daniel Adamson, delivered an interesting address in which he referred to the properties of iron and steel, and stated that in his opinion a great deal remained to be done to enable the manufacturer and the worker to act in unison so as to get the highest results with the least risk and useless expense, that the public might be protected and their interests secured by the proper selection and adoption of metals suitable for any given purpose. Having reviewed three classes of metal—viz., the pure iron, carrying only [illegible] tons per square inch, the mild steel, with [illegible] per cent. of alloy, carrying [illegible] to [illegible] tons per square inch, while the hard metal, having [illegible] per cent. of alloy, would carry [illegible] to 60 tons per square inch—he said it would be seen how many intermediate classes of commercial steel could be found. On the gun question Mr. Adamson holds strong views, contending that the metal generally used is not the best adapted for the purpose. There is no doubt, he thinks, that the application of mild steel, possessing a tensile strain of about 30 tons both in its longitudinal and circumferential direction, would be a great gain upon the older or Armstrong system of constructing heavy artillery with weld-up wrought iron coils, possessing a strength of 22 tons circumferentially and only 12 tons longitudinally. The saving to railway shareholders by the application of steel and weldless solid rolled steel tires has been estimated at 1 per cent. of the dividend, and the future development of the steel trade will most likely lie in the production of a mild weldable metal, whether made by the Bessemer converter, the Martin-Siemens open-hearth process, the open-hearth dephosphorising system, or by the dephosphorising Bessemer converter. The steel-maker has before him the chance of competing for one and a half million tons of mild metal per annum as soon as it is established that steel will weld equally as well as wrought iron: in which case the country would gain by a saving of 750,000 tons of coal per annum, while the metal employed would be stronger and somewhat less in weight to perform the same work. In the course of the discussion Sir I. L. Bell referred to the part played by Mr. Adamson in increasing our knowledge of the properties of iron and steel. The influence of temperature in conferring what was known as temper on steel, said Sir I. L. Bell, had been known as long as the substance they now recognised as steel had been used by the human race; but those finer distinctions with regard to the temperature of steel, so far as it affected its tensile power, were, he believed, first made the subject of practical and technical inquiry by Mr. Adamson. In addition to that, Mr. Adamson at an early period foresaw the great utility which would result from using steel of higher strength, and by that means to develop the construction of what was known as the compound system of steam-engines, and he believed that he now contemplated even a quadruple cylinder. Sir J. Kitson, following, said there was no doubt that the introduction of steel for boiler plates would have been retarded many years if Mr. Adamson had not instituted the careful system of testing all the materials he used before he applied them. Mr. Adamson had hit the blot in the use of steel as a material in his phrase "inappropriate application." Steel makers knew that engineers and others had attempted to force the use of steel into the same forms and by the same methods as were applied to iron; but Mr. Adamson had shown the laws which should be obeyed, and in that way had opened out prospects of increased consumption of steel.

Sir B. Samuelson read a paper on the Terni Steelworks, which led to a short discussion as to the necessity for finding new markets now that Continental countries are themselves supplying their wants; and then Mr. G. Allan, of Birmingham, read a paper on a patent composite steel and iron, which he contended is adapted for such purposes as axles, chains, boiler plates, &c., as it combines fibrous iron of a high quality with mild steel—in other words, by surrounding with or imbedding a series of strands of high quality iron in mild open-hearth steel, and subsequently rolling down the ingots into bars, plates, or any desired section in the ordinary way. The combination was really effected during the casting operation, supplemented by the work put upon the material by the subsequent heating and rolling, when the surfaces of the steel and iron were perfectly welded together. Whatever the finished section might be, the iron and steel remained alternated, the resultant composite material being such as to bear working cold or hot, or to support manipulation in every way practically like steel of the mildest quality. He claimed for it that this process gave a material possessing practically the tensile strength, ductility, and elasticity of steel, with a similar capacity for resisting "punishment" either hot or cold, while it retained all the advantages which the non-homogeneousness of iron gave, retaining at the same time the facility of welding which belonged to iron.



gst the other papers read was an able
ion, by Mr. J. Riley, of the effects of
t methods of treating mild steel in the
cture of plates, in which he said that as
amount of "work" which should be
the steel in the production of plates, he
ie to the conclusion that if they wanted
; steel, without caring greatly about its
y, abundance of work should be put
; but if they desired a plate of medium
ı and of high ductility, they must not
excessive amount of work upon it; and
would increase the ductility it must be
d carefully after rolling. With regard
rocess of annealing as a corrective to
done to plates in various ways, it was
but he was clearly of opinion that in
s the ordinary operations of an efficient
orks were concerned, annealing was not
;y, and, if carried out, was of doubtful
This paper led to an interesting discus-
the course of which, Mr. Parker, chief
r of Lloyd's, gave the result of his
ations, which are consistent with the
nts of Mr. Riley, but opposed to those
y some of the great steel makers in this
. He quite agreed that much injury
ne to the steel after it left the steel
in the course of manipulation. Mr.
confirmed Mr. Parker's views, and stated
the occasion of a recent visit to Messrs.
's works at Newcastle he was very much
d by the owner of the works showing
ie samples on which tests had been made,
orming him that all the specimens came
hite heat. The series went on improving
ty until the last sample showed a beauti-
erial of a silky appearance, and with very
rable elongation and diminution in the
the point of breaking. That material
er had any work upon it, but was taken
from the casting. Mr. Spencer said the
ortified the ideas he had had for a very
ne, and it seemed that the minority who
ld those views were now beginning to
e. He considered that the application
ıanical work to steel was a very barbarous
treating it. They must consider that
ıs a homogeneous crystallisable material,
t were treated rationally, as such mate-
uld be treated, he thought that many
mishaps and incongruities which had
d would never have taken place. With
to forgings, he thought they would be
insure as good results in the form of castings as if the metal were treated by the hammer or the mill. In the manufacture of crank shafts especially the forging system was very barbarous; it was subject to every conceivable physical condition, and if the crank did not fail it was simply by mere accident. One of the crank shafts cast by his firm had done a mileage of 200,000 without any accident. The last remark brought out the intimation from Sir J. Kitson that he could show crank axles unbroken which had been forged in the way the best Yorkshire makers adopted, and which had a history of 550,000 miles. Notwithstanding the prediction of the president made at the Paris meeting nine years ago, his firm had made more iron since than in any previous nine years of their existence. Sir J. Kitson said they knew the uncertainty of casting, the impossibility of discovering any internal flaws, and the great responsibility which railway directors and engineers were under in running axles at enormous speeds, and until there was some means of discovering absolutely the soundness of castings it was unwise and imprudent to embark more without a much larger experience upon cast axles, having regard to the excellent results which were still given by axles which had been forged.

Mr. Turner, of Birmingham, read a paper on "The Separation of Silica from Cast Iron." Fibrous silica is produced by a fractional oxidation of fused silicious iron, usually by an atmosphere rich in carbonic oxide.

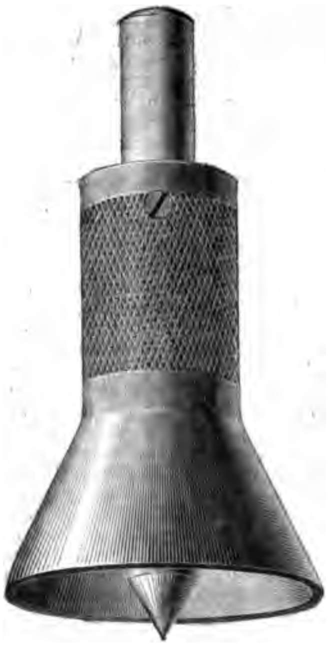
Two papers on "Basic Slag" were read, one by Mr. Percy C. Gilchrist and the other by Mr. J. E. Stead and Mr. C. H. Ridsdale. In both the value of the phosphoric slag for agricultural purposes was referred to as the chief point of interest, and contrary to statements which have been made, it was asserted in both papers that, properly treated and applied on suitable soils, the basic slag is a valuable manure. The usual votes of thanks brought the meeting to a close.

SMITH'S APPARATUS FOR GRINDING TWIST DRILLS.

THE apparatus shown in the illustration is a device for grinding twist drills and other tools of that nature with exact and uniform cutting edges, and has been patented by Mr. G. P. Smith, of Tunbridge Wells. It consists of a frame K W L fixed to a horizontal bench or other support near, or fixed to the frame of the grindstone, of which X Y is the horizontal surface, on which the drill is ground. In this frame and between two similar upright guides, of which G W H is the front one, is hinged at G a frame A B C D, which can move on the hinge in the vertical plane perpendicular to the side, and passing through the axis of the stone. In this frame A B C D is fitted a cylinder or other body of revolution Q T S^1 R which can be rotated in the frame by means of a shaft P fixed in the cylinder and terminating in the handle R^1, the axis of the cylinder being in the aforesaid vertical plane, and inclined to X Y at an angle of about 50°. This cylinder is bored to receive a drill F S, the axis of the drill being inclined to that of the cylinder at an angle of about 10°, represented by the angle F S U, the two axes intersecting at S in the line X Y. From the frame A B C D there extends an arm C V in which a shaft M is fitted, containing a wheel N, which rests on the grindstone and revolves in the same plane. If a drill be fixed in the bore so that the edge of the cutting lip rests on the stone in the line X Y, and the grindstone be turned, the cylinder being at the same time rotated by means of the handle R^1, the effect will be to force the lip of the drill down upon the stone, more towards the outside of the drill, and less towards its axis, and the result will be that the lip will be ground with a required clearance of about 10°. The wheel N running on the stone close to the point of the drill regulates the grinding, which can be greater or less, by means of an adjusting screw on the shaft M. It also neutralises the effects due to inequalities of the stone. If the drill be withdrawn, turned through an angle of 180° and refixed in the bore, the other and opposite lip will be ground in the same manner, and thus the drill will be evenly formed as to both lips. The most important part of the invention consists in the drill being fixed eccentrically in the rotating cylinder as above described. This tool is most conveniently placed as above described, but it can be used in other positions on the grindstone or emery or other wheels, whether of a cylindrical, or plane, or other form. To fix the drill in required position a collar O is fixed on it; in the lower side of O aro inserted two projections Z, Z^1, 180° apart. A slot Z in the upper face of the cylinder Q T S^1 R receives the projection Z for one position of the drill, and the projection Z^1 for the other position. On the shaft P is fitted a milled collar E in which is cut a thread fitting a screw-thread on P. This milled collar on being screwed down, presses on the shoulder of the collar O, and thus clamps the drill immovably in the cylinder. On reversing the screw motion, the milled collar moves upwards so as to allow the collar O, with the drill, to be withdrawn and refixed at an angle of 180°, and again clamped. The frame G W H is made to slide in a grooved plate K^1L^1 by means of an arm or crank *k*, attached to the cylinder and connected with K^1L^1 at *l*, by the rod *k l*, so that as the grinding proceeds and the cylinder is simultaneously rotated, the frame A B C D with the drill is moved forward. By this means the drill, not being confined to one cylindrical portion of the grindstone, is prevented from unequally wearing and furrowing the stone. The angles of 50°, 10°, and 90°, are not necessarily the correct angles, but are selected for the purpose of illustration. For the same reason the drill is spoken of as fitting the bore, though this bore is better fitted with a chuck or other device for holding drills of various sizes. The term cylinder also is used for any solid of revolution, or any body parts of which could belong to such solid. In practice, the edge of the cutting lip is generally better not to be exactly in the line X Y when the grinding commences, but advanced more or less, according to the degree of bite required to be given to the cutting lips. This is effected by an adjustable slot *m n* attached to A B C D, in which slides a pin *h* affixed to the cylinder at *g*. The position of this slot determines the point on the stone at which the grinding is to commence; and its length, say 90° more or less, the angular superficies of each lip to be turned towards the grindstone, without intruding on or injuring the edge of the other lip.

THE CUSHMAN CENTRE PUNCH.

THE centre punch illustrated in the annexed engraving is being introduced to this country by Messrs. Buck and Hickman, of 280-1, Whitechapel-road, E. It is made by the Cushman Chuck Co., of Hartford, Connecticut, and will accurately centre any piece of work that is round, oval, square, or of any geometrical figure from ⅜in. to 1½in. diameter. The illustration is almost self-explanatory; but novices may be told that all that is necessary to do is to place the cone over the work and tap the punch gently, when the true centre of any geometrically-shaped piece of metal or wood will be found by the punch.



VARNISHES FOR BALLOONS.

THE following are recipes for preparing the varnishes generally used for coating gas-balloons by the most experienced aëronauts:—*First procure a large* kettle of cast-iron or enamelled iron. Place it out of doors on a stove (having several lengths of stove pipe); the kettle should have a close-fitting cover, to be used only in an emergency. Fill the kettle one-third to one-half full of pure linseed oil; start the fire, placing the stove so that the wind will waft any fumes from the oil away from the fireplace of the stove. Raise the heat until a slender stick of dry pine wood is charred, or becomes carbonised on its surface, when thrust into the oil to stir it. Watch the oil carefully, and if it takes fire, extinguish by covering the kettle quickly; it is well to set the cover on at first, keeping it loosely covered. Boil, at this high heat, from one to two hours and until the oil—as shown by a few drops cooled on a metallic plate—is thick, viscid, and very stringy. It should have a red-brown colour. When quite cold, a sample of this "cooked" oil should somewhat resemble indiarubber. When sufficiently treated with heat, extinguish the fire, remove the cover, let the sun shine on the hot mass, let the air cool it, and let it settle. After a short time, while it is still hot, decant the clear portion, and when this—which we will call "varnish gum"—becomes merely warm, thin it with recently rectified oil of turpentine until it has the consistency of a suitable varnish. Mark this "Balloon Varnish No. 1." This is the varnish used by John Wise, the experienced aëronaut, and others. The regular varnish makers can readily do the above described work, having all the appliances; but some of them will adulterate the linseed oil, or not give proper care and attention to the process. Second, take pure caoutchouc (indiarubber), and with a wetted knife cut it into shreds, which let dry overnight, or, more quickly, in the sun. Dissolve this caoutchouc in hot, recently rectified oil of turpentine, to the consistency of paste. It is well to let the rubber lie in the cold turpentine a day or two before warming it. Heat in a water bath. To a quantity of "Balloon Varnish No. 1," containing 100oz. of the aforesaid "varnish gum," add a quantity of the rubber turpentine paste containing 5oz. of pure caoutchouc; place on water bath, and thoroughly incorporate by stirring. Mark this "Balloon Varnish No. 2." It was used by Giffard in constructing his great captive balloon at the Paris Exposition of 1878. It is better to give three or four coats of thin varnish than two or three of thicker varnish, because the pores of one coat will not coincide with those of another, and the fabric is, therefore, less permeable to gases. It is recommended that the cloth for the balloon be given one coat of "Balloon Varnish No. 1," used thick (but thin enough to readily impregnate the cloth), or, better, two coats of the varnish used thinner; then one or two coats of "Balloon Varnish No. 2." In each case the drying of each coat should take place in warm sunlight and a dry day; when the air is not moist or "muggy" is best.

SHOULD WE EAT SALT OR NOT?

THE practice of salt-eating, says Dr. Allinson in the *Weekly Times and Echo*, is a widespread one. No doubt, first started as an accident or peculiar taste, it spread, and is now kept up like many other evil things, because it has the sanction of usage and antiquity. The habit of eating salt is not natural, as anyone may judge for himself if he will only give it up for a time, and then try to take it again. Animals in a natural condition will not usually eat salt, nor will the untutored savage. Civilised man has accustomed himself to eating salt, but he is no better for so doing, but, on the contrary, is injured by it. It is related of Peter the Great that he tried to accustom his sailors to drinking salt water instead of ordinary water, so that they might not die from thirst when at sea, but his experiment failed, and many died during the trial as a consequence. Common salt, called, by the chemist, chloride of sodium, is a mineral widely distributed all over the earth, and is found more or less in all water, but most especially in sea-water. It is part of the mineral matter of most plants, and of the fluids of most animals. Being thus found in the mineral, vegetable, and animal kingdom, I may be asked my objection to its use, seeing also that it is usually a constituent of the tears and the urine. My objections to salt are that it is a mineral, and therefore should never be used. Man is not fitted for absorbing mineral matter, and if he takes such material, either as salt or in the form of medicine, he must do himself harm. The only way that man may take common salt or mineral matter is when it forms an actual part of the food that he eats. In other words, the fruits, grains, and vegetables contain all the salts necessary for our systems, and if we add more we do wrong and injure ourselves. The fact that salt is found in all our tissues and fluids is no argument, for most of it got there because it was added to the food. Again, if no salt were eaten, and yet it was found in our systems, we should know it was got from our food, and kept there by the body for its own purposes. You might as well argue that because ashes were found in the fireplace, that therefore the fire must be fed with ashes, as that because salt is found in the tissues, that therefore you must eat salt. Persons who eat brown bread, green vegetables, salads, and fruits, obtain all the salt required by the system from those foods. A human being has no more right to eat common salt than he has to eat phosphates of lime, iron, manganese, or any other mineral. The blood and tissues contain all these salts in solution, but that fact does not make it a necessity for us to eat them. Our system will abstract all it requires if we will only give it proper foods, such as I before named. What are the results if we eat salt? The results are many and varied, but I will only mention a few of the most evident. Salt stimulates the appetite and so we over-eat, and from over-feeding comes seven-tenths of our ailments. In the stomach salt causes acidity and heartburn. That it irritates the stomach we all know, for salt and water is a common remedy used to make a person vomit. Salt being very soluble in all fluids is quickly absorbed by the blood-vessels of the stomach, and taken into the blood. As a consequence it thickens the blood, makes it denser than it should be, and causes the sensation called thirst. To quench this fluids must be taken. If only water is consumed, then digestion is delayed for half an hour, and the kidneys have to do more work. If tea, coffee, beer, or other injurious liquids are drunk to quench this thirst, then we must suffer from diseases produced by these fluids, besides overtaxing the organs named above. Salt delays digestion, as much as will lay on a sixpence delaying digestion for at least half an hour. These are the apparent results noted by our commonest observers; what the other effects are we do not fully know; but that disease must arise from its habitual use all careful physiologists must admit.

Some one may ask, Are there not diseases which will come on if we do not take salt in our food? To this I answer No; no disease can arise as a consequence of abstaining from salt. I may be reminded that prisoners were said to have been devoured alive by worms in the prisons of Holland because the persons in authority stopped their salt. This I at once brand as a lie. I can never find any authentic record of it; it is an antique lie, but none the less a lie because old. Against this statement I can bring forward facts such as this, that I know persons who have lived for years and have yet carefully abstained from salt in everything. If I am not mistaken, at one house they had no salt in the place, and would not use it. Then salt does not prevent worms, neither tape-worms, long worms, nor thread worms, nor do our doctors' books advise salt-eating as a remedy. Worms always come from pre-existing worms. Under these conditions I am justified in branding the Dutch story as an unvarnished lie. The moral I want my readers to draw is to use salt moderately—the less they use the better they will be, and do not force your children to take it or tell them it is necessary.

A QUICK METHOD OF MOUNTING DRY OBJECTS.*

THERE is a certain class of microscopic objects that need little or no preparation for mounting, and require no protection beyond a well-secured glass cover. Many of these objects are interesting and in some degree valuable; but the microscopist considers them hardly worth the trouble of mounting. For such objects the method shown in the annexed engravings is of great utility, as it permits of inclosing the object quickly, completely, permanently, and in presentable form; and while it seems especially adapted to such objects as are common, and liable to remain unmounted, it is, of course, applicable to almost any dry object. To carry out this method, only two articles, in addition to those usually possessed by microscopists, are required; one being the ring, with an internal flange at the top and an external flange at the bottom, the other a heating tool, consisting of a ring of brass attached to a suitable handle. The rings of which the walls of the cells are formed are spun or stamped from discs of Britannia metal, sheet brass, or other sheet metal, with a narrow internal flange or fillet at the top for receiving the cover glass, and a wider external flange at the bottom, for attachment to the slide. The rings vary in depth according to the depth of cell required. The under surface of each ring is coated with thick shellac varnish, and allowed to dry thoroughly. When the varnish is dry and hard a clean cover glass is dropped into each ring, and the ring is placed bottom upward on the warming stand and heated until the shellac melts and thoroughly covers the edge of the cover glass. The ring is now allowed to cool, when the cover will be ready for use. It will, of course, be understood that a quantity of rings and covers are thus pre-id held in reserve. In fact, it is to be hat the manufacturers of microscopists' will furnish the rings and covers thus pre- eady for instant use.

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* By G. M. HOPKINS in the *Scientific American.*

object to be protected is attached to the means of cement, in the usual way. A taining a glass cover is arranged over the and the heating tool is warmed and placed e outer flange of the ring, as shown in the l view, Fig. 2. By this means sufficient mparted to the ring to melt the shellac at portion touched by the heating tool, and to attach itself to the glass slide. It is the an instant to cover an object in this way, slide needs no further finish; but the may, if he choose, lacquer the rings to them from tarnishing. A thin ring pro- ith the coating of shellac may be applied

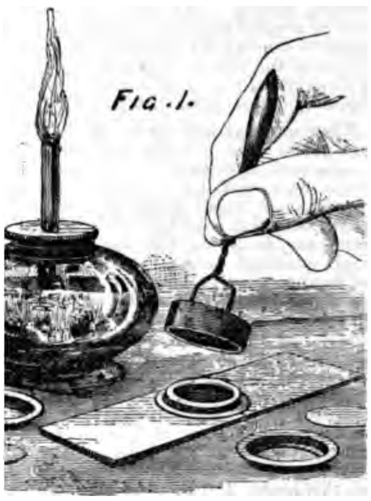
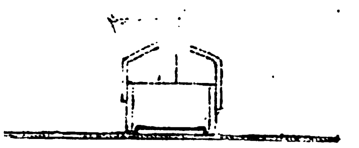


FIG. 2.



ordinary balsam mount to increase its . By applying to the ring a suitable a liquid cell may be made. The object to ted in the liquid cell is wet with the nd placed on the slide. The ring is then in the manner above described, and the afterwards introduced into the cell through ure previously made in the side of the ring. erture is stopped with cement, applied with re or needle.

shing the Power of an Objective.

often desirable to diminish the magnifying f an objective, and at the same time increase tration. For example, if one possesses a 2in. objective, and desires to examine like minerals in the natural state, crystals, c., he will find it necessary to focus up and on the object to see it in all parts. A 3in. bjective would furnish the desired power, not at hand.

rease the focal length, and, at the same large the field and deepen the focus, it is essary to place a double convex lens of, focus about half-way down the draw-tube. on of such a lens is the reverse of that of ifier.

IBBED BOILER TUBES.*

bular boilers, even the most nearly perfect, h as the locomotive boiler, there is still a able loss of heat in consequence of the in- t absorption of caloric. This loss of heat ace notwithstanding the great increase of ting surface. This fact is explained by the as quantity of gas which passes through the ithout coming in contact with their walls. liating power of gas being almost nothing, ws that the transmission of heat can only e by contact. The solution of the problem in the increase of the surface of contact.

is Treatise on Heat, Petiet says:—"The ission of heat can be increased by another ing, which has not been put in practice, hich, in certain cases, might be very efficacious. We have seen that, for the transmission of heat through a plate, it is necessary to distinguish the absorption by one of the surfaces, the emission by the other, and the conduction through the thickness of the metal; under ordinary circumstances the quantity of heat which the metal is able to transmit is much greater than that which it has to transmit. It follows from this that if, instead of using plates made in different ways, we should use plates traversed by ribs or bars projecting a certain distance into the two fluids, gaseous and liquid, one of which is to impart heat to the other, in thus increasing the extent of surface in contact with the two fluids we would largely increase the effect produced."

M. Ledieu says, in his work on marine boilers: "Tubes of small diameter, like those used in boilers, have the advantage of presenting, with the same total cross area, a much greater heating surface, but they do not absorb as much heat as their total extent and the high conducting power of the metal would make us suppose. The gases which enter the tubes run in parallel lines to the outlet; those parts of the gas which are in contact with the surface of the tube are well cooled; but, as they form always the exterior part of the gaseous stream, they constitute a surface or wrapper with very little conducting power for the heat of the gas which is in the central part of the tube, and finally the total mass reaches the chimney without parting with a sufficient quantity of its heat."

This explanation makes it clear why, in a locomotive, tubes of four mètres (157½in.) in length produce almost as much steam, other circumstances being equal, as tubes of six mètres (236¼in.). This shows very clearly the necessity of obtaining the heat which exists in the centre of the tube, and it is this which has led M. J. Serve, of Givors (Rhone), to seek for an increase in the surfaces of contact. He has reached this end by substituting for the ordinary smooth tube a tube carrying inside longitudinal ribs, and to this he has given the name of ribbed or finned tube (*tube à ailerons*). He has thus been able to utilise a much greater proportion of the heat of the gases, as we shall show later.

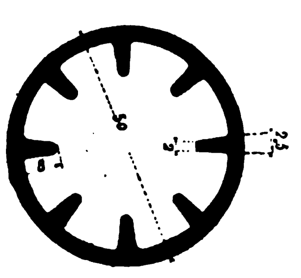


FIG 1.

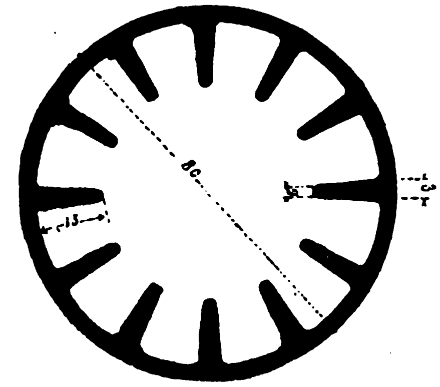


FIG. 2.

The conducting power of the metal transmits immediately to the surface of the tube the heat from the concentric layers in the same tube. It follows that the power of vaporisation is increased in very large proportion. The quantity of heat absorbed (we speak only of that which would otherwise be lost) is proportional to the number of ribs and their projection into the tube. The number of ribs arranged regularly around the tube may be eight in tubes of 50 millimètres (2in.) diameter or less, and ten in tubes of greater diameter; their projection into the interior of the tube from 8 to 15 millimètres ($\frac{3}{16}$in. to $\frac{9}{16}$in.), and their thickness from 2 to 3 millimètres ($\frac{1}{12}$in. to $\frac{1}{8}$in.) The accompanying cuts, Figs. 1 and 2, show two specimen tubes, one of about 2in. and one of 3⅛in. diameter The dimensions given on the cuts are in millimètres. Under these conditions the manufacture of the tubes will present no difficulty, and the price will be only slightly greater than that of the ordinary smooth tubes (La Société Industrielle et Commerciale des Metaux has already delivered a number to the inventor, and is negotiating with him for the exclusive right to manufacture them). We can also add that these tubes can be cleaned out as easily as the ordinary tubes by means of the tube brush. It will also be possible in case of wear in the end near the fire-box to piece out these tubes with an ordinary tube of the same diameter, without sensibly diminishing the useful effect. Certain experiments were made by M. Bounardel in the tubular boilers of his steamboat, *Le Bourdon*, plying on the Rhone between Lyons and St. Louis. The tubes used in this case were of 100 millimètres (3$\frac{15}{16}$in.) diameter outside, and 3·5 millimètres ($\frac{1}{8}$in.) in thickness. The tubes have eight ribs having 13 millimètres projection, 3·5 thick at the base and 2·5 at the point. (Some of the details of this experiment are omitted as not necessary to a comprehension of the results.) The boiler was first used with new tubes of the ordinary smooth kind, of copper. Put in service, it vaporised 6·930 kilogrammes of water to the kilogramme of fuel used. The smooth tubes were then replaced by ribbed tubes of the new system, and the boiler vaporised 9 338 kilogrammes of water to the kilogramme of fuel—the fuel used being of the same kind, and taken from the same lot as in the first trial.

In this case the saving was ·35 per cent.; but it may be observed that in this boiler the heating surface of the tubes was only six and a half times that of the fire-box, while in locomotives it is eight, ten, or even twelve times as great. From the time the boiler was started up it was easy to see that the economy would be considerable. In fact, in working with the smooth tubes, the sheet-iron base of the smoke-stack burned paper held against it, while with ribbed tubes the paper was uninjured.

In the second trial made in the boilers of the steamboat *Le Bourdon*, one voyage was made going and returning with each of the systems of tubes. With the smooth tubes the gases of combustion escaped into the smoke-stack at a mean temperature of 360° C. (690° Fahr.), measured by a Shaeffer and Budemberg pyrometer, and sometimes reached a temperature of 450° C. (842° Fahr.). A ball of lead introduced in an iron cage into the smoke-box melted quickly. With the ribbed tubes the mean temperature of the escaping gases was 240° C. (464° Fahr.), and the lead ball did not begin to melt, which shows that the temperature never rose to the point at which lead melts (330° C.). The fuel consumed in the voyage with the ordinary tubes was 45,000 kilogrammes; with the ribbed tubes, 34,150; showing a saving of 10,850 kilogrammes, or 24 per cent. It must be remembered that, in a steamboat voyage, as with a locomotive, the factors making up the resistance are numerous, and are not often the same. The surest means of realising the economy secured by the ribbed tubes is to take the temperature of the gases at their entry into the smoke-box; in this way no error is possible.

The tubes used in boilers by the Compagnie Générale de Navigation were of so large a diameter (100 millimètres, or nearly 4in.) that they could hardly be available for the complete utilisation by the ribs of the heat produced in the fire-box. With so large a diameter it was difficult to give the ribs sufficient projection to enable them to draw out the heat from the centre of the tube. There was in the use of these large tubes what may be called an injurious or useless space, the ribs having too little projection. The tubes of marine boilers, on the other hand, vary from 70 to 85 millimètres (2¾in. to 3⅓in.) diameter, and locomotive tubes have not more than 50 millimètres (2in.). In these the ribs can easily be made with sufficient projection to reduce the useless space to the smallest possible limits, and with these a closer approach can be made to a theoretically perfect utilisation of the heat. Experiments made by M. Serve with apparatus made for the purpose, and so arranged that heat could be transmitted only through the ribs, the wall of the tube between the ribs being carefully isolated, still showed very favourable results in favour of the ribbed tube. The experiments made by Graham and Petiet show that the efficacy of the heating surface of tubes decreases very rapidly as they approach the smoke-box, and show, consequently, the uselessness of long tubes.

Only a very great increase of heating surface will make it possible to absorb the heat of gases at a comparatively low temperature. The following calculations show that this increase can only be obtained by ribbed tubes, without any other change in boilers. In the table below the heating surface is calculated on the exterior diameter of the tubes, while the section for the passage of the gases is calculated on the interior diameter. The thickness of the tubes is taken at 2 millimètres in in each case and their length at 4 mètres; the interval between each tube, whatever the diameter, remains the same, being taken at 20 millimètres.

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* M. CHOMIENNE, Engineer of the Forges of L. ive-de-Gier, France, in the *Railroad and Engineer- nal.*

PLAIN TUBES.

Diameter.		No. of tubes.	Total surface of tubes.	Interior section of tubes.
Exterior.	Interior.			
Millimètres.	Millimètres.		Sq. mètres.	Sq. mètre.
50	46	180	113	0·2989
40	36	245	123	0·2491
30	26	353	133	0·1870

RIBBED TUBES.

50	46	180	228	0·2629

These comparisons show that, with smooth tubes, if we replace 180 tubes of 50 millimètres diameter by 353 of 30 diameter (occupying the same surface as the preceding) we gain only 20 square mètres of heating surface, while we lose on the other hand 0·11 square mètre of section out of 0·30, or more than a third. By changing plain tubes for ribbed tubes we double the heating surface and lose only 0·025 square mètre of section, or about one-fifteenth. These figures require no comment and show the great superiority of the ribbed tubes. In conclusion, it is claimed that, with the ribbed tubes, there will be a more complete utilisation of the heat and more rapid steaming. In locomotives, consequently, larger blast nozzles can be used and a freer exhaust allowed, reducing the back-pressure. As it will not be necessary to drive the fire and hasten the disengagement of steam, there will be less trouble from wet steam. The gases of combustion being drawn through the tubes at lower speed, there will be less drawing of cinders into the tubes, and less cleaning will be required. The gases will reach the smoke-box at a lower temperature. The ribs will increase the strength of the tubes, and all support in the centre can be dispensed with; this support or bracing is a frequent cause of wear. As the tubes can be made shorter, the effects of expansion and compression will be less felt. The use of these tubes in marine boilers will diminish the quantity of coal which it is necessary to carry for a voyage, thus increasing the cargo space. In short, the economy resulting from the use of these tubes will be considerable in all the applications which may be made of them.

THE NORDENFELT SUBMARINE BOAT.

WE mentioned in the article on "Submarine Boats," p. 381, last volume, that Mr. Nordenfelt was building a large submarine boat for the Government, which would probably be ready for trial in the spring. The boat has arrived at Southampton, and has undergone some preliminary trials. It is larger and swifter than the early boats, the submerging and regulating gear are superior and self-sustained, and means have been taken for retaining a reserve of buoyancy always at command, with consequent facility for rising to the surface when desired. In form the Nordenfelt may be said to resemble an exaggerated Whitehead. Whereas the latter is propelled through the water by means of a supply of compressed air, the former, when totally submerged, is driven along by the force of a reservoir of stored-up steam, after the fires have been extinguished and the scuttles hermetically sealed. The crew, which consists of nine men, including Captain Garrett, breathe the natural air contained in the structure, which will remain for some hours without becoming foul. Simplicity has been studied in all the details, with a proportionate gain in efficiency. Should anything go wrong with the machinery, the unexhausted buoyancy (the minimum of which is equal to 500lb.) will cause the boat to rise without assistance from the pumps, and should, through some refractoriness on the part of the screws, the craft sink deeper in the water than is either desirable or safe, automatic valves come into action and turn off the steam. Viewed at from above, or in plan, the boat looks like the back of a whale protruding out of the water rather than a cigar, having a continuous turtle back, with ridge-like extremities and a sharp and vertical stem and stern. It measures 125ft. in length, and 12ft. beam amidship, with a displacement of 250 tons. The midship section is a perfect circle, the other section being composed of two arcs of a circle gradually decreasing in size fore and aft, so that the depth is less than the diameter, except at the broadest part. She is constructed entirely of steel; but with much stronger scantlings than an ordinary torpedo boat. The bottom plating is about ½in. thick, while the turtle deck is the uniform thickness of 1in. There are two funnels in the middle, with an intervening scuttle admitting to the stokehold. These funnels are movable and are stowed away when the boat goes below, or when she is approaching an enemy with everything battened down; but the manner in which the funnels are disconnected leaves much room for improvement. Two conning towers rise above the deck forward and aft. These are about 2ft. high and as many broad, and are surmounted by glass caps, to allow of observations being made when everything above is sealed. In the former are located all the necessary connections for giving the captain command of all the machinery for driving and steering the vessel, for sinking or rising, for controlling the fans, for regulating the screws which govern the immersion, and for discharging the torpedoes. The boat is propelled by a single screw, which is driven by a pair of double cylinder vertical compound engines, working upon four cranks. The high-pressure cylinders are 15½in. in diameter, and the low-pressures 27¼in., with a stroke of 16in. The engines are capable of exerting a collective indicative power of 1,000 horses. Steam is generated in two boilers capable of working up to 150lb. to the square inch, at which a speed on the surface of 17 or 18 knots is expected to be realised. There are, all told, 11 engines on board for propelling, circulating the water through the condensers, steering the vessel, actuating the fans for forced draught, working the pumps, and turning the screws by which the Nordenfelt is kept at any required depth when submerged. When the vessel goes into action the funnels are stowed away, all the scuttles made watertight, and the fires extinguished by means of the steam, which has in the meantime accumulated to a pressure of 100lb. When she has approached within dangerous proximity to the machine and rapid-firing guns of an enemy, the supreme moment has arrived when the vessel must temporarily disappear from view. This feat is accomplished in the following manner:—Below the inner deck forward and abaft the machinery are a number of tanks. Into these about 23 tons of water are admitted from the sea, which will bring the vessel down to within a foot of the surface. When this degree of immersion is reached, two horizontal screws, working in apertures freely open to the sea in the stem and stern, are put simultaneously in action, and mechanically draw the structure below the surface, the depth, which is measured by a pressure-gauge, being adjustable to a few inches. In this condition it is said the boat can remain for five hours with a continuous speed of four knots, but as the reserved steam can be used in any quantity whether below or above the water the speed can always be increased. For proportionately shorter distances, when the screws are arrested the boat rises by its own buoyancy to the same height as it was when the screws were put in motion, its subsequent emersion being due to the action of pumps, which are capable of relieving the tanks at the rate of a ton and a half a minute. The normal bunker capacity of the Nordenfelt is equal to eight tons of coal, which will drive her 1,000 miles at from eight to nine knots, but for ordinary steaming, when the tanks are not required to be filled with water, she can stow 28 tons.

After the Nordenfelt had been immersed until the base of the conning towers were just awash, she proceeded down Southampton Water as far as Netley Hospital, the party accompanying her in the *Alexandra* steamer. She made a speed of about five knots against a lively breeze, with everything hermetically sealed, though for a shorter distance the pressure of accumulated steam was sufficient to drive her eight knots. The neutral tint she was painted rendered her almost invisible at the distance of a few hundred yards, while as a target she presented nothing open to attack save her two conning towers and the top of her turtle, and as these are curvilinear and formed of steel an inch thick, their vulnerability to torpedo guns is very questionable. Having shipped her funnels, lighted her fires, and got up steam in her boilers, she made a run as far as Calshot Castle and back, a total distance of about 13 miles, at a maximum speed of 14 or 15 knots. It was noticed that when going at her highest rate of speed through the water she produced a bow and stern wave which completely hid her hull in a hollow, and gave her all the appearance of a submerged boat, leaving nothing visible but the funnels. At future trials her sinking powers and performance under water will be tested.

THE UTILITY OF GAS IN THE WORKSHOP.*

THE value of a supply of illuminating gas, and the amount of work which may be done therewith, is not understood as well as it should be by the greater number of mechanics. One of the simplest gas heaters, which can be easily made in any shop, consists of a cylinder of sheet iron 4 or 5in. in diameter, and mounted on some short legs, which will allow it to stand about 1in. above the bench, in order to admit a supply of air. The same effect may be secured by punching a row of holes around the bottom edge of the sheet-iron cylinder. Still another way is to notch the lower edge, making it take the shape of a stave saw. This is the most simple method of effecting the desired purpose, and if "saw teeth" be cut, ½in. from point to point and 1in. high, the air supply will be sufficient. Inside the cylinder and just at the top of the saw teeth, above described, let a row of gas burners be placed, or a common piece of tubing may be bent into the required shape, and a row of holes be drilled all around the ring thus made. The "burner ring" had better be connected with the gas system by a piece of rubber tubing, or, if the heater is to be stationary, it may be fastened to bench or shelf, and piped with ordinary tubing. The top of the iron cylinder must be covered with fine wire gauze, and this had better be done by covering a ring, which can just slip inside the iron cylinder, which may best rest on three rivets placed in the iron cylinder at the requisite distance from its top.

When anything is to be dried or subjected to a very gentle heat, the gas may be ignited at the circular perforated tube or burner, and but a very gentle heat will be caused in the current of ascending air which passes up through the wire gauze. Any degree of heat desired (within certain limits) may be obtained by regulating the amount of gas admitted to the burners. If an intensely hot flaming heat be required, the gas may be extinguished, then turned on to the full capacity of the valve, and ignited on top of the wire gauze. This forms a flame similar to that of a Bunsen burner. It is a solid flame, and is capable of heating small articles for tempering. By igniting the gas below the gauze, all the operations usually conducted in a sand bath may be equally well executed. Glue may be heated without being burned, and all manner of drying may be successfully accomplished. Another pipe may be put into this heater and terminate in an ordinary fish tail burner. When a less degree of heat is required the single burner is best, and, of course, consumes less gas.

There are dozens of times when a small quantity of soft metal is to be melted, and a gas furnace would be a great convenience, and the above described furnace may be made to do much more work by putting a hood over it, and connecting the hood with a chimney. For melting lead, tin, or zinc, the chimney draught will not be required, if a simple sheet-iron hood be drawn up outside the furnace, this hood being simply to prevent cold air from striking the ladle, also to concentrate the heat around the ladle. When small brass or iron castings are required, an "ejector furnace" will enable such castings to be made at will. Even if gas is not to be had, a furnace may be easily made, which will melt from 2 to 5lb. of iron or brass in 15 to 20 minutes' time, using gas, gasoline, petroleum, or even spirits.

If the vapour of any fluid is to be used, a generating box must be supplied, together with a bellows or a blower. When gas is to be used, the whole apparatus consists of a little cupola, built in fireclay, the whole encased in sheet iron and fitted with a bail, much in size and shape of a common water pail or bucket. In the bottom of this furnace a pipe enters, much like the tuyere in an ordinary furnace, and at the end of this pipe farthest from the cupola are two branch pipes, one of which supplies gas, the other pipe air. Both gas and air are under pressure, and the quantity of each is regulated by valves. The gases mix in the tuyere pipe, and are ignited in the cupola among the metals to be melted. When vapour of gasoline or naphtha is to be used, the operation is rather more complicated. The same tuyere pipe is used, and one branch therefrom is connected direct with the blower or bellows which is to supply air. A box or can is used for containing a supply of gasoline. A branch from the air pipe enters the gasoline or naphtha tank near its bottom, and the remaining tuyere branch enters the extreme top of the gasoline can. Now, if the blower be worked, a supply of air is blown directly into the furnace, while a portion of air delivered by the blower goes into the bottom of the gas tank, becomes changed during its passage through the gasoline, and is delivered into the cupola containing more or less gasoline vapour. Valves must be placed in both branches of the tuyere pipe, and also in the pipe leading into the bottom of the gasoline tank; by the proper use of these valves any desired quantity of either gas or air can be delivered at will into the furnace cupola. Melting brass or iron in such small quantity is not to be thought of in general practice, for it will surely cost 10 to 20 cents per pound, but when the cost is not counted, and when the iron can be had when wanted, then the little gas cupola furnace will be worth many times its cost. As a quick method of working up an "off-hand" pattern for sudden jobs, the "plaster of

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* By JAMES F. HOBART, in the *Manufacturers' Gazette.*

ethod has no equal. Mix up some plaster
ır, work it into a semblance of the re-
ıpe, and then whittle up when dry, or a
be cast on the face-plate of a lathe, and
to shape.

L AND SCIENTIFIC NOTES.

:nherited Phenomena of Alcoholism.
D. Crothers, of Walnut Lodge, Hartford,
made a study of a class of phenomena
'e not been previously described specifi-
vhich a liability to exhibit the outward
ntoxication upon excitment appears to
inherited from inebriate parents. He has
classes of the cases—one, in which the
of intoxication are present all the time;
in which those symptoms only appear
peculiar circumstances or exciting causes.
ıt class, some prominent defect, such as
ɔecility, or congenital deformity, is present
case a distinctness irrespective of the
ıtoxication. The symptoms may appear
ı, or be slowly evolved with the growth
ld, and come into prominence at or before
Of course, all the varied phases of idiocy,
, progessive degeneration, and malfor-
on. The presence of a special class of
resembling intoxication so clearly
distinct alcoholic causation. In the second
ıses noted, the alcoholic symptoms are not
unless for some exciting cause
ɔolic) such as anger, fear, or sudden
.t. In this class are idiots, imbeciles, and
of all degrees, who at times display
gns of intoxication, that subside after a
ften in these cases appear the common
and deliriums of intoxication; also, the
lysis and stupor. Teachers and super-
of asylums and schools for this class
danger of excitement on these dements
tives, throwing them into various states
as well as intoxication Several remark-
ents illustrative of these principles are
grouping of which makes it evident to
r that symptoms of alcoholic poisoning
trusted as evidence of the immediate use
, and that the excessive use of alcohol
ermanent defect or impress on the brain,
l go down into the future with great
It may be concealed for a lifetime in the
drinking parent, but may come to the
any moment from the application of its
xciting cause; or it may appear in some
n of defect, which can be traced back to
from the toxication of alcohol.—*Popular
onthly.*

:ulating Primary Battery.—In using
ɔatteries for lighting or other purposes,
e will depend to a large extent on the
ent of the details, for it is not much
ting to find elements and solutions which
l current for nothing. Messrs. Mark
ıd Co., of the Cadby Steam Works,
ane, E.C., have patented a combination
ɔommends itself to all who desire to use
ɔatteries for any purpose. As a rule the
re cylindrical and lead-capped, and the
are so attached to the lifting diaphragm
ping is prevented, while the connections
cted from fumes, and can be readily
The diaphragm carrying the elements is
l lowered by means of a screw and wheel,
e immersion of the elements can be regu-
any desired amount. The details have
l thought out, and will commend them-
all who have had experience with primary

ı-seed Oil.—Two-thirds of the cotton-
ıld in the States goes to the makers of lard
rine, and its use to the extent of about 20
has, it is stated, been one of the most
influences in reducing the price of lard.
being used for cooking, and a large pro-
f the oil taken with salads and sardines is
uct of the cotton fields. Scientific men
ıat it is perfectly wholesome, and some
that it is better than animal fats. It is esti-
ıt not far from 600,000 tons of cotton-seed
in this industry every year, and that from
500,000 barrels of crude oil are produced,
hich is exported from the States. The oil
only product of the seed. The meal, after
s been expressed, is sold, either loose or
ed into cake, for animal food, cattle taking
ndly, and fertilising purposes. When
t is difficult to distinguish between the
d olive oils.

ɔpulation in England and Wales was enu-
on April 4th, 1881, as 25,974,439, and on
hesis that the rate of increase or decrease
ailed between the census of 1871 and that
was maintained, the population in the
f 1886 was estimated to be 27,870,586.
ns an increase of about 7·3 per cent. in the

SCIENTIFIC NEWS.

According to Dun Echt Circular No. 146, Dr. H. Oppenheim has computed an orbit for Barnard's new comet from an observation made at Cambridge, Mass., on May 12, and two others made at Rome on the 15th and 17th. He makes T = 1887, June 24·5559, Berlin M.T.: π − ☊ 24°·21′ 30″; ☊, 244° 54′ 32″; *i*, 17° 9′ 21″; log. *q*, 0·11510. The position at Berlin midnight is—

	R.A.			S. Dec.
June 5	16h.	0m.	2s.	12° 19 1′
7	16	5	20	10° 18 7
9	16	10	46	8° 17·1

At the last given date the brightness will be considerably more than double that at time of discovery, but will decrease after the 17th. Dr. Lamp, of Kiel, who makes T = June 18·85945 B.M.T., says the comet is faint, round, and has a nucleus.

M. de Gothard calls attention in the *Astronomische Nachrichten* to the value of photography in detecting the relative motion of stars. Thus, comparing a photograph of cluster G. C. 4440, taken at Hérény, in Hungary, in 1886 with Vogel's records of measurements made in 1867-69, he found that a small star of the 11th mag. had changed its position to a considerable extent relatively to other stars in the group. This star is No. 48 of Vogel's list, and appears to have a proper motion of 2·3″ per annum.

The death is announced of Mr. Champernowne, of Dartington Hall, Totnes, a country gentleman who devoted himself with much ardour to the study of geology, especially of the Devonian rocks in his district, and who lately presented his maps to the Geological Survey. These maps are models that professional geologists will value, and they will greatly regret the untimely death of the student.

The death is also announced of the well-known pathologist, Prof. Friedländer, of Berlin—again untimely, from our point of view.

Sir Henry Roscoe, M.P., has introduced a bill into Parliament to make provision in day schools by which young persons who have passed through the public elementary schools, and others, may obtain further instruction in technical subjects. The Bill empowers any school board, local authority, or managers of a public elementary school to provide day technical and commercial schools and classes for the purpose of giving instruction in several science subjects which are specified in the Directory of the Science and Art Department, and in which that Department undertakes to examine. The following subjects are also included—the use of ordinary tools, commercial arithmetic, commercial geography, bookkeeping, French, German, and other foreign languages, and freehand and machine drawing. For the purpose of carrying on these schools and classes the power of school boards, other local authorities, and school managers is to be in every respect the same as for providing ordinary elementary schools. Moreover, they are to have power to provide, or contribute to the maintenance of, laboratories and workshops in endowed schools for the purpose of carrying on classes or instruction under the Bill. However, all these schools and classes are to be subject to the inspection of the officers of the Committee of Education or of the Science and Art Department. And before a scholar is admitted he must have passed the sixth standard or some equivalent examination. The Education Committee and the Science and Art Department are authorised to give grants on such conditions as they may lay down for any of the subjects taught in these technical or commercial schools or classes.

The Royal Geographical Society intend to have a soirée at South Kensington Museum on June 8.

The University College Biological Society will give a soirée at University College on June 6, when Prof. Moseley, F.R.S., will lecture on "Life on the Ocean Surface."

Implements of jade are occasionally found along the coast of British Columbia and Alaska, extending to a considerable distance inland, especially along the lower parts of the Fraser and Thompson rivers. It is disputed whether the jade of these implements is of local origin, or has been transported from Asiatic sources. Dr. G. M. Dawson, of the Geological Survey of Canada, has contributed to the *Canadian Record of Science* a paper in which he adduces evidence to prove that the material was worked in the locality, boulders of jade having been found in the Valley of the Fraser, although the mineral is not yet known to occur *in situ* in British Columbia. Dr. A. B. Meyer, of Dresden, some time ago called attention to the occurrence of jade in Alaska as evidence that the American implements were not necessarily worked from a mineral of Asiatic origin.

A large number of mammoth bones and a tusk of large size has been found on Castle-hill, at Elloughton, East Yorkshire. The length of the tusk was close upon 10ft., and its thickness varied from 9in. at the base to 6in. near the tip. An ancient British burial-ground, containing a quantity of human bones and an earthenware food vase, was also discovered near the same spot.

Another piscicultural establishment is about to be started by Mr. F. Langdon. The site is at Dulverton, Somerset, where a tributary of the Exe will provide an ample supply of pure water. Trout will receive most attention, and it is expected that the apparatus will be ready for use by the end of the year.

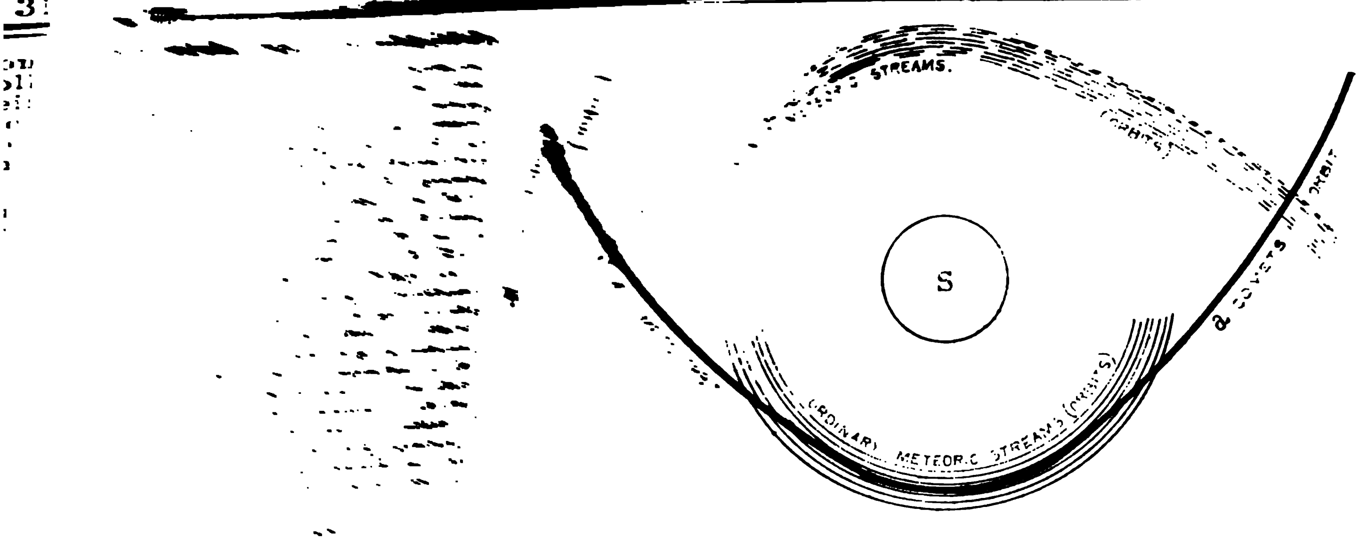
Methods of curing tubercular disease are increasing. Dr. Kolischer, of Vienna, employs hypodermic injections of a "compound described as calcium phosphoricum," which is supposed to "calcine" the tubercles. He is about to carry his experiments further by trying the effects of the "compound" in cases of tuberculosis of the lungs. With reference to the rectal method of applying remedies in phthisis, M. Perret says that the gaseous injections have no action on microbes, so far as destroying them is concerned. They can modify the bronchial phenomena and diminish expectoration, also influence nutrition for good, especially in the apyretic forms, like other medicaments, and hence are of value in relieving particular symptoms; but they are not apparently more efficacious than other remedies.

The demand for cocaine as a local anæsthetic has had an effect on the export of coca leaves from Peru, the quantity sent from Mollindo during the past year being 705 quintals of the value of 17,625 dollars.

Mr. Henry Boardman, of Manningham, Bradford, directs attention to a system of automatic electric call bells, for which he has recently obtained provisional protection. The system has been in practical use for more than twelve months in the inventor's house, and has never failed. As it will be of considerable utility in hotels and other places where it is desired to ring call bells, a brief description may be interesting. In the lobby of his house Mr. Boardman has an ordinary clock, under the face of which he has placed a semi-circle of brass studs representing every quarter-hour from 3 a.m. to 9 a.m. These studs are respectively connected to separate bars of the switch, and a metallic lever attached to the hour hand of the clock strikes one of the studs at the quarter-hour, and remains in contact for five minutes, when it is raised ready to fall on the next stud. The connections are so made that one or all the bells in the different rooms will be automatically worked at a fixed time, or each bell will be rung at the time required, which is determined by a peg placed in the switch. In this manner it is possible to connect a number of rooms with one clock, and "call" the occupants at any desired time. When the patent is completed, we shall probably describe the system in more detail.

A rather curious patent, entitled "Improvement in Petroleum Oils," is intended to protect small consumers who have no opportunity of examining brands or trade marks. The patentee suggests that the different qualities should have a distinguishing colour, so that consumers might have a ready means of ascertaining at a glance the quality of the petroleum supplied. As the patent was sealed last month, both the office and the patentee are evidently satisfied.

It is stated that the Buffalo Electric Light Company has concluded a contract with the Niagara Falls Hydraulic Tunnel and Power



[illegible] being to the [illegible] seen [illegible] which have [illegible] moonlight, so [illegible] them. As there [illegible] observations must be [illegible] the few nights when [illegible] supposed to be nearer [illegible] and a very faint [illegible] was suspected. [illegible] on a subsequent occasion [illegible] was invisible. I am not [illegible] change has taken [illegible] the exact location of [illegible] bright background must [illegible] same difficulty. I hope to [illegible] later on, when the atmo- [illegible] are more favourable.

Kenneth J. Tarrant.

[illegible] May 28.

INQUIRY INTO THE RELATION BETWEEN METEORS AND COMETS.

[illegible] is a recognised fact amongst the [illegible] astronomy that there is a relation in [illegible] between some meteoric streams [illegible] It is my purpose in this paper to [illegible] this relationship, so that if possible we [illegible] get a little nearer to the truth concerning [illegible] I do not wish to offer any theory as [illegible] where meteors originally come from—that is to say, whether they are of planetary origin or not, being ejected from volcanoes, as some savants suppose—this is outside the object of the paper. Sufficient for our inquiry is that meteors are to be found in space and in innumerable quantities revolving round the sun in orbits of their own, and each stream varying in the number of its constituent members, from a few stragglers to myriads. These meteoric streams we have reason to believe are scattered throughout the whole of the solar system. Admitting the foregoing, we must now inquire into their behaviour amongst the solar family.

If a little close attention be given to the accompanying sketch, it will be seen that each separate set of curves illustrate themselves. I have, for convenience sake, drawn those marked "ordinary meteoric streams" with their centre at the centre of S, meteors, of course, having various orbits according to the perturbations caused by the other matter of the solar system upon their original orbits. Meteors which reach the earth without being consumed teach us that they are matter similarly constituted as that of the earth. From this we will assume that they are planetary matter (not necessarily ejected from a primary planet, but planetary in the same sense as the asteroids are planetary matter.) Now, we know all planetary bodies revolve round the sun in elliptical orbits, and from this we will assume meteors also when in their original orbits revolve round the sun in an ellipse. Assuming, then, that there are myriads of meteors revolving round the sun in orbits of their own, it now remains for us to inquire what effect a comet will have upon these meteors during its perihelion passage round the sun. In the sketch it will be seen that at this point the comet would pass along, or nearly so, the orbit of a meteor. And with comets moving with the greatest velocity of all known matter in the solar system—that is, when at their perihelion, we naturally assume that the comet would here overtake a meteor in its orbit. A meteor, being but a very small member of the solar family, would be attracted by a larger body, and if the larger body was the nucleus of a comet, then that meteor would henceforth depart from its original orbit, and revolve in the orbit of the attracting comet. With comets which are purely gaseous—without any solid nucleus—the meteors would simply allow the comet to pass rapidly past them, whilst if the gaseous comet was of sufficient density, as our atmosphere is at the height of forty or fifty miles from the surface of the earth, the meteors through which the comet would pass would, by the velocity of the comet moving through them, be consumed, the same as meteors are in the upper regions of our atmosphere. Thus the meteors would become part of the substance of the comet. If, as appears from the inquiry, a meteor may be drawn into a comet's orbit, we must also assume that there are many meteors which are affected similarly, hence we get meteors with cometic orbits, viz., of parabolical and hyperbolical orbits. When a comet is *approaching perihelion*, the meteors through which it would pass would come into violent collision with the comet, as is illustrated at the left-hand portion of the sketch, and if the comet came into collision with another comet's meteoric stream, the force of the collision would be very much greater than in the case of a collision with ordinary meteors which have not a cometic orbit. The result of these collisions could be got at by a knowledge of the masses of the comet and meteor and their respective velocities; but sufficient for the object of this paper is that at this point of a comet's orbit—when *approaching perihelion*—it could not possibly pick up meteors to henceforth follow in its track, and that it is only at perihelion that a comet can possibly pick up meteors; and in all probability we have here the key to the relation which certain known meteoric streams have to certain comets.

It is a matter for discussion whether or not all meteoric orbits which are pertaining to a parabola are really indications that a comet has passed that way and left these meteorites to tell the tale to the inhabitants of a globe which happens to rush through the swarm. Before concluding my remarks, I wish to point out that any mention made of "comets" in this paper does not mean any appendage which these bodies possess, but rather to the gravitating portion of the comet—the nucleus.

Servia-road, Leeds. **D. Booth.**

STARS VISIBLE BY DAYLIGHT.

[27352.]—I DID not write such nonsense as James Adams attributes to me.* What I say is and was that I have looked up a tall chimney on a clear day, and I have found that the sunlight above as effectually concealed the stars as if I had been in the open. And why not? It is not the light in the other part of the sky, but the light in the immediate neighbourhood of a star which prevents the star from being seen.

Mr. Mist (the evidence is always second-hand) is incredibly lucky if he found a coal-pit without machinery to intercept the view, and if he "has repeatedly seen stars" (which the firmest believer can hardly suppose less than of the third magnitude, if visible) passing over so small a field of view—about 30'—if the pit was 12ft. across.

Let "F.R.A.S.," or any other who has a refractor equatorially mounted, take out the tubes, insert a small pasteboard tube of, say, 6ft. length, and direct it on a known star; then put a cloth over his head and look through the tube. Will he see the star? The length of tube can make no difference so long as the observer is in the dark. I am no longer

London, May 23. **Dubitans.**

SCALES IN DRAWING OFFICES.

[27353.]—AS I see no attempt at an answer to "Three Compasses" (27082, p. 131), I am induced to give my small experience. I have two identical scales, undoubtedly printed at the same time and on the same sheet, one of which is fully $\frac{1}{32}$in. longer than the other in a length of 6½in. This discrepancy may have been caused by stretching in pasting, and may not be a common fault with paper scales; nevertheless, it is a proof of the instability of the material. My opinion is that if paper is used for a scale at all, it should form part and parcel of the paper on which the drawing is made, expanding and contracting with it, and should in that case, of course, not be varnished. I have an American steel scale 4in. long. Inches divided on one side up to 64ths, on the other up to 48ths, and up to 100ths. These hundredths are clearly visible, and may be readily measured off with dividers. The same is the case in a steel scale I use (of Chesterman's, England) in which $\frac{1}{8}$th scale divided into 12ths shows twelve clear measurable divisions. Even the ordinary steel rules are perfectly reliable for use as scales up to 64ths inch, which I much doubt would be the case with paper scales after a little use. The only objection to steel scales is that they become dirty unless constantly handled or carried in the pocket. When rusted they should not be brightened again with emery cloth, but simply rubbed with sand to take off surface rust, the dull surface remaining forming a good protection against further destruction. Of ivory scales for use I cannot speak, always having had a prejudice against them owing to their being slippery. This fault is a very annoying one (especially on a tilted board), and is partly shared by the steel scales and tee squares. I recently suggested to Mr. Stanley the value of glass as a material for set squares for perspective drawing, &c. He told me, in answer, he had made glass set squares 30 years ago, and found them nice instruments; but their great fault was that of being slippery. The boxwood scale I consider the best for general use, and with the addition of the small brass division plate (as shown us some weeks back by Mr. Stanley), this scale should be as perfect all round as it is possible to make an instrument of the kind. A paper scale may do well for ordinary working drawings; but there are also drawings for which, I should say, its use would not be desirable. I should much like to hear Mr. Stanley's opinion on the question mooted by "Three Compasses."

Silke.

ROSES.

[27354.]—HAVING been a zealous horticulturist forty-five years, in three quarters of the world, I can speak from practical knowledge of the "Queen of Flowers."

The treatment depends entirely on climate and local conditions. This is the most satisfactory of flora to grow under glass. If particular attention be devoted to it in a special house, either in the conservatory, border, or in pots and tubs, to my idea, it is better worth house room than any gorgeous exotics, besides blooming before buds are formed on the bushes outside. I am, of course, speaking of a Northern county, where spring appears six weeks later, and winter a month sooner, than southwards. In those memorable seasons of 1879 to 1881, a reverend neighbour of mine, a skilful rose cultivator, lost 250 specimens in the first inclement period, and 150 survivors in the second one—all valuable budded kinds—and then told me he should never have any more! I, too, have gradually lost all mine, except a very fine old grafted La France, 8 or 9ft. high, evidently protected from destruction by standing in a position, between two projecting bow rooms, though as yet it has scarcely any leaves, the sap has a long way to rise, the stock being so tall and thick. Under glass, in small pots, this beautiful kind is on its own roots, and has produced blooms of unusual size and colour, at the same period as Maréchal Niel, Alfred Colomb, and other beauties.

In the steam-bath atmosphere of Lower Bengal, I have grown "Cloth of Gold" like a wild briar, with flowers 3in. or 4in. across, in Southern India 5in. In other parts this empress of the rose tribe would refuse to grow. Again, to be sure of any good blooms of choice sorts in Central India, each plant was put on a raised hillock to check exuberant sap, ending in dense foliage and few buds. In South Africa—notably, in the districts around Cape Town—most of the named roses attained fine quality; but in the islands of the Indian Ocean, under perpetual sunshine and showers, they were perfect specimens. Whether on their own roots or grafted, they were all equally good and floriferous. Not so in every part of India, where most garden roses require to be grafted. Even our common English sweetbriar refuses to grow unless so treated, when it becomes a handsome bush. Yet there are indigenous roses of great beauty, as Rose Edward (*R. semperflorens*), which from its constant flow of sap is usually selected as the stock for grafting, while that very spinous and most odoriferous bush, *R. centifolia*, is grown in many acres as a field crop, for the production of rose-water and essential oil—the latter, when pure, being worth £10 to £12 the ounce. The old wood is cut down annually to the ground, before rise of the sap, and the roots heavily manured. This dense and thorny species is used for garden hedges in India and South Africa. No animal will dare to penetrate it.

Then there are wild roses of great merit, possibly the stray children of Persia, introduced by the luxurious rulers of Hindostan after their conquests, and acclimatised in suitable soil. One especially, known as the "Sugar-ball Rose," attains a very coarse and bramble-like growth in wildernesses, clusters of symmetrical snow-white blooms perfuming the air to a great distance. When we ascend the Himalayas, and enter the Vale of Kashmeer, the traveller is astonished at the great number of the type "Austrian Briar," scentless flowers both single and double, of every known colour and stripe, golden-yellow to blackish-red, the foliage variously scented with musk, lavender, camphor, and such striking odours; exceedingly tender of heat, for all those I carefully prepared six months previously to my return, gradually perished, as I left the altitude of 10,000ft. elevation above the sea for the warm plains of Hindostan. They were carried in a litter specially made for the half-dozen specimens, with canvas curtains over a thick bed of moss, kept damp, &c., with four porters in charge relieved at each of the 14 stages. Since that time (over 30 years ago), when I had friends touring in the valley, I offered to pay *well* for seeds of these desirable species; but the said friends loved not flowers as I do, and I never got anything but *promises*. Along the lower ranges of the Himalayas, there are thickets of a "dog rose," rendering the air nauseous with excess of odour. One blossom will scent a room; hence, imagine the effect of millions on millions, for they form the prevailing jungle of countless miles. As may be supposed, the honey of wild and domestic bees is far too highly flavoured of rose, and was so cheap in those days that you could get 4lb. or 5lb. weight for a shilling. Literally, it was a "land flowing with milk and honey," for the former was never charged for by the peasants, and butter was almost as cheap as the honey. I never found any indigenous form of Rosa in Africa, though most of our European varieties (excepting sweet-briar) thrive well, and many of them, particularly the "Noisette" family, would bring prizes to England. I never saw or heard of a "moss rose" in India or Africa; while in my garden here, after those two icy winters, my specimens, especially the "White Bath," were superb. I have two Himalayan species of "dog rose," so rank and luxuriant (raised from seed) that I have deported them to a hedge-row, the flowers, pink and single, resembling our common sweet briar. Strange to say, my stock of "prairie rose," from seed gathered on the North American wastes, has all died out to one dwarfish specimen: our *damp* not our *cold*, has annihilated it. Rose-growers should study type and origin more than they do, for, in my experience, the treatment and temperature required differ as much as the floral forms. Here is a small sample of my meaning: I got a "Litle Pet" dwarf white fairy rose from a local nurseryman in a pot, with the information that it was an *indoor kind*. It was affected by mildew, which I cured. A few bunches of its pretty scented blooms rewarded me; then it was ravaged by green fly, these I soon settled. I took the precaution to make a few dozen cuttings, most of which became strong rooted specimens, larger than the parent. I could now afford to practise experiments. Besides distributing to all my friends, I planted out my stock in every part of the garden, irrespective of aspect. They have been where they were planted for years. The show of bloom is increasing annually, each specimen now bears dozens of highly-scented spotless flowers, instead of a meagre inflorescence of doubtful fragrance sucked away by parasites under glass. To-day, as I am writing, my gardener has just brought in a bouquet of roses. I find the largest of the La France is 6in. diameter, perfect shape and colour. What adds to the charm of this Belle is the fact that hail is rattling violently on the glass as large as peas, and the hills around me are white with snow. It comes, with some smaller sisters, out of a 6in. pot, where it has lived three years on its own roots. I generally strike over three-fourths of every rose species in cuttings. There is only one baffles me, and I am now for the fourth time trying my hand on this snow-white gem in bottom heat. I have hitherto only got two out of several dozen from a worn-out old bush in a S. border. The parent always affects the constitution of the offspring in plants as in animals. For spring show everybody should grow La France under glass. No heat required till the buds appear. All my roses stand in their pots, even Maréchal Niel in one of the vineries, getting any stray beams of sunshine in the very early months; then they are taken to the stands in the conservatory. I prefer roses to peaches and grapes, and would like to uproot the above and put my favourite flowers under those roofs, for I am in the very worst of all the English counties for outdoor gardening. Only the auriculas, the primulas, and the pansies can surpass other places; exotics, too, under glass perish for want of solar light; and yet further north, in a garden at Aberdeen, I have seen such glorious roses as I thought could only be grown outside in Herefordshire or Devonshire. I suppose the deep burial in snow, safe from bad winds and over-humidity of the atmosphere (as in my case), are the true causes of their success. Again, it is strange to see that ugly climber, Gloire de Dijon, in a very exposed situation here on a wire arch over a walk, bearing annually over 100 fine flowers. A neighbour, who has one on a wall, covers it in autumn with matting and the roots with litter; though his blooms are larger, they are not more numerous than mine. A companion, "Fairy rose" (*red*), though giving dozens of blood-coloured buds for button-holes, *under glass*, refuses to grow an inch in a sheltered south border; there they have remained since planted out, two or three years ago, the foliage dry and sickly. As to the pruning, that requires long experience. A Maréchal Niel, cut down when in full vigour, may bear three or four flowers; if left alone, three or four dozens. So with Cloth of Gold, Gloire de Dijon, and all those with terminal buds. Other species of bushy habit and rapid growth require to be shorn to the very soil, and some to lose only a few inches at the ends of their top boughs. But pruning is very important, if shape, size, and good quality, instead of indifferent quantity, are desired, as with many fruits and flowers (disbudding as it is called). The rose amateur, with time at his disposal, can do wonders, while most of the paid gardeners follow old routine and practice.

Eos.

NIBLETT'S SCREW-GEAR.

[27355.]—I am glad "O. V." has spoken. However much he may complain of his want of mathematics, his mathematical instinct always leads him right. I had come to the same conclusion, but have been too busy to write; but as my explanation is somewhat different to his I send it. I think no figure is needed.

Imagine the disc with its raised ridge-ring to stand square with the mandrel, and let the circumference be divided into, say, 12 equal parts, and number them like the hours on a clock-face, I, II, &c., and let the rocking axis be the line joining III and IX, on which axis the plate rocks to different "slants," so as to give a screw of 0-pitch when square, and a pitch increasing with the slant. Further, draw radial lines (or radii vectores), the centres of disc to the hour divisions cutting the ridge in corresponding points, numbered 1, 2, 3 4, &c.

Now imagine the clock-face to remain square to the mandrel; but set the centre part containing the raised ridge at an angle θ, and with rocking axis (line 9, 3 or IX, III) horizontal, begin to cut a screw, the mandrel rotating once in an hour, say. Of course, the roller or tracer touches the ring at 3, shortly afterwards at 2, then at 1.

If, now, the perpendicular (or ordinate) from 1 on line 9, 3, be double that from 2 on the same line; then, no matter what the slope of disc (on the angle θ), the tracer will have moved horizontally twice as far when it touches 1 as when it touched 2, for the horizontal distance moved = ordinate × $\cos\theta$. All then that is necessary for a uniform pitch is that it should take twice as long for 1 to get to the roller as for 2, and this it does only when the ridge disc is upright, when the times are 10 minutes and 5 respectively.

For any given slant we can modify the spiral; but when corrected for that slant it will do for no other. Thus for a screw of 0 pitch (or next to 0 pitch) the curve must be such that the ordinates are proportional to the angles or times, that from 1 double that from 1. But if this be sloped, and the mandrel revolve uniformly in the hour, when II. comes to horizontal 2 has past. When I. is there 1 is not; therefore, in equal five minutes spaces the traverses have been unequal.

Four times only will corresponding numbers come to the horizontal together at III., XII., IX., VI. And the error is exactly analogeus to the equation of time in astronomy. If I have time I will attack it; if not, this hint should suffice.

Mr. Pocklington's mathematics are right as far as they go. He will now see where the fallacy lies.

Niblett's device is highly ingenious, and in its proper province will do good work. It will enable an unskilled amateur to "strike" a short screw of any pitch easily and correctly; it will not cut a long screw with a point tool mathematically accurate, for it is theoretically imperfect. I should like to possess it, but the cost is too great for a device of limited application. The reducing speed gear seems the great expense. Could not the inventor substitute a simpler and cheaper, if more clumsy, arrangement, as, for instance, a tangent screw?

I should like to give a long letter on screw-mania; but I doubt if it will ever get to the Editor. even for the waste basket.

The error, if any, in Niblett's year, increases, with inclination of swashplate, and diminishes therefore, as the size of disc is increased.

Assuming the plate to be 6in. in diameter, and the cutting to take place during $\frac{1}{3}$ of the turn, and each interval of rest to last $\frac{1}{8}$, with a reduction in speed of 24 to 1, we get guidance for 8 threads, that is for 1in. traverse when cutting 1in. Whitworth.

Suppose, now, the spiral accurate for a very fine pitch (say a million to the inch or so), then to cut 1in. Whitworth we must slope the plate till 3 sin. 60° . sin. $\theta = \frac{1}{2}$ when θ = inclination—

$$\therefore \theta = 11^\circ \text{ approximately}$$

and this (see Godfray's "Astronomy") gives the greatest error about $\frac{1}{2}^\circ$ in 45° of turn, or, say $\frac{1}{180}$ of the dist. cut as the tracer passes over the middle $\frac{3}{4}$ of the cut (from -45 to $+45$), that is $\frac{1}{240}$ of the whole inch cut.

To cut four threads to inch, we must slope the plate about 22°, and the error is about four times this or $\frac{1}{60}$in., and, in fact, for moderate inclinations the error varies as square of inclination directly, and as square of diam. of disc inversely.

The error is not greatest at end of cut, but approximately at the 45°, that is about $\frac{1}{8}$ of the distance from each end on the suppositions taken above.

Lastly, the error would be reduced by making the interval of rest shorter as the slope required would be less. Also still more, perhaps, by forming the spiral true for some intermediate pitch, or, still better, by using two or more spirals as suggested by "O. V.," though in this last case the error would be, perhaps, difficult to calculate, and into it I've no time to enter.

As the above was worked out in my head chiefly during a singularly dull sermon, I can't be responsible for accuracy, but it seems all right. It also occurs to me that the length of roller would be about $\frac{1}{2}$in. under the conditions, and the error might be destroyed for any single pitch by using a properly-shaped non-cylindrical roller, and this suggestion containing the germs of another screw-cutting device.

Bow.

TWIST-DRILLS AND SCREW-CUTTING APPARATUS.

[27356.]—I read a communication some two numbers back from "A Novice" on the above, and I thought I would test his remarks. First, as regards screw-cutting apparatus being useless for general work. I visited the large turning works at the Crystal Palace, and ascertained that the men there cut out their screws by hand for every sort of work. Their lathes and tools are all of the most common description, yet I doubt if one amateur out of 50 could show such good results. I questioned them, and they would not have any screw-cutting appliances if supplied to them free of expense. They agree with "A Novice" that if they had to cut screws by the gross it might be desirable, but not otherwise.

I next visited a large firm of manufacturing opticians, and here, again, found all their screw-cutting done by hand. Their twist-drills also they grind by hand.

I quite agree with "A Novice" that amateurs are much too fond of apparatus. If opticians can work correctly by hand, why not an amateur? Screws cut by hand may not, perhaps, be so absolutely correct as those cut by machinery, but they are near enough for all practical purposes.

I think, with "A Novice," that it would interest very many amateurs if some of our correspondents would take up the question of turning as carried out at the Crystal Palace. £10 would, I am certain, provide everything, and enable an amateur to make hundreds of useful articles.

Another Novice.

SILKE'S SCREWING DEVICE.

[27357.]—REFERRING to remark of "F. A. M." *re* "Silke's" screwing device, it is a great pleasure to have criticism from him, favourable or unfavourable. I am sure many more readers would send in their "ideas" if only competent correspondents would reward them with a remark. In the majority of cases there is only profound silence.

The cord should, I think, be of gut, and the rod would surely travel exactly at the rate of the periphery of the pulley (or reel as I called it, not "rule" as printed) the underside of the cord being a tangent. My plan is to allow the rod to lie on the pulley. I have always been an advocate for learning to chase by hand, but since the wholesome remarks of "F. A. M." as to the impossibility of really doing it correctly, I have changed my mind. I think my advice would give an accurate screw without encumbering the lathe, and would be a cheap and useful appliance. I hope some one will give it a trial and report. **Silke.**

UNIVERSAL CUTTER, BY G. BIRCH AND CO.

[27358.]—YOUR readers know that I have sent up several photographs of universal cutters, all having their own advantages and drawbacks. The one I now send appears to me to be the best I have yet seen. If the photographs are too small to admit of reproduction by photography, I hope the engraver will kindly do his best to show the details distinctly.

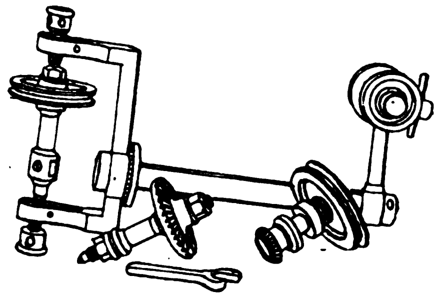


FIG 1.

When the universal cutter is used to drive the single point or fly cutters, it requires to run at a very great speed, and then gearing is out of place, as however well made, it will rattle, cause vibration, and mar the perfect smoothness of the cut. Messrs. Holtzapffel have adhered for this reason to the old form of universal cutter, though it has four guide pulleys. In the cutter before us one view shows the instrument arranged as for driving fly-cutters at quick speed by band only; here the gearing is removed. Only two guide pulleys are required, which are not at all in the way, and which will act as fair leaders even when the spindle of cutter is placed horizontally, only requiring to be slightly turned round upon their upright stem as the spindle is inclined more and more from the vertical position. In the second view the fly-cutter spindle and the guide pulleys are seen to have been removed, whilst the spindle for carrying circular cutters is in position, and it is driven by means of a second spindle and a pair of bevel wheels to reduce the speed. Here I think the gearing is properly applied—namely, to reduce the speed for the circular cutters, and, so used, it should do no harm. No guide pulleys are used, as the band will run straight up whatever may be the angle of cutting. We have here a combination instrument as suitable for work with the fly-cutters as with the circular. **F. A. M.**

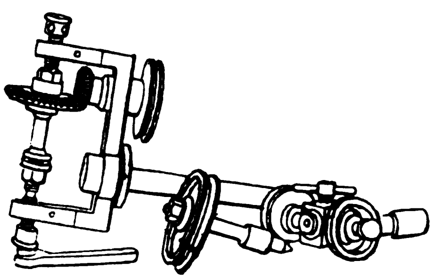
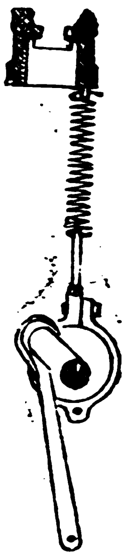


FIG. 2.

COUNTERBALANCING LATHE FLY-WHEEL.

[27359.]—THE inclosed sketch represents a device for counterbalancing lathe wheels by, I understand, Herr Waltz, of Berlin. It has the advantage of being easily removed if the work in hand requires the lathe to run backwards. I do not like the wheels as ordinarily balanced, as they do not run evenly. The supposed advantage of the counterbalance is the facility of starting; I say "supposed," because I have frequently known them to stop on the centre notwithstanding heavy counter-weight. I never take my foot off the treadle while working; therefore, with an unbalanced lathe I always have it under perfect control, and, by practice, I can always stop it in such a position that I can start again without touching the pulley or band by hand.



1in. to the Foot.

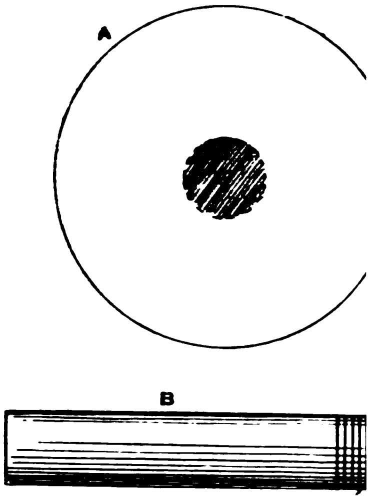
Treadles sometimes have a back-balance; but they never work well, because, if one takes one's foot off, the treadle stops, and the connecting rods become unhooked if the wheel continues to revolve. The back-balance is also in the way. To obviate these disadvantages, I designed a treadle which, while it is perfectly balanced, has no projecting parts, and will always move with the wheel. It possesses, I believe, but one disadvantage, i.e., costliness. **A. F. Shakespear.**

Lüttichaustrasse 4, III. Dresden.

USEFUL CHUCKS.

[27360.]—IN my experience, for turning metal the most useful of all the many chucks, and the one most easy to construct, is the form for "soldering on" flat work. I particularly recommend it to young amateurs; it is self-centring, and of course, holds the hardest of all. The solder can be made as fusible as you like by the addition of bismuth. I keep this chuck in three or four sizes, the largest about 3in. diameter of ½in. sheet brass, on an iron shank. This is screwed into the brass disc as tight as possible, about ¼in. of the screw end being allowed to project. Now fit the iron shank into the main chuck, and revolve with the treadle, turning the projecting screw into a taper point of rather over $\frac{1}{16}$in. in length. Then face the disc till quite true and smooth. My smallest chuck is made of a foreign copper piece about 1½in. diameter. You have only to heat the work and the disc, spread the solder on each, put the indent mark of your work on the point, and press together as quickly as possible. When quite cold you can go to work at once. I attached 2lb. weight of boiler-plate firmly in this way to my chuck, and made it spin round as if on a face-plate. Here is an immense advantage: you can reach every portion of your work with tools while revolving, as you have only to heat plate and work to separate them, and change sides in the same fashion. This dodge will save an outlay on many expensive chucks, only fit for the amateur with a long purse or large workshop. In my next, I will
scription of a nice chuck for cylinders I
the pages of our "E. M." some fifteen
I think, cheap, and easy of construction
hold anything of a reasonable diameter i
grip too.

A, face of chuck, showing end of iron



dotted lines, with centre point turned
same. B, shank with screwed end and p
point, cut out of lined portion, same p
three sizes, 3in., 2in., and 1½in. diameter
rods for shanks of two lesser chucks.

MILLING, WHEEL-CUTTING, SLOTTING, &c., IN LATHE

[27361.]—DURING the last few mont
have been numerous inquiries for tools fo
for making twist drills, and similar wo
ordinary lathe; but I do not see that anyt
practical has been proposed. For mor
year circumstances obliged me to pack up
shop, and my lathes and other tools hav
months in their packing cases undistur
until lately my MECHANICS have been
at, and I see that I have lost much that w
interested me. But changing house,
workshop (which latter I commenced doi
six months ago), claimed all my time and
and though I am most desirous to ad
arrangements to my lathe, I have only oc
been able to take any steps in the ma
January I observed an advertisement
MECHANIC of a new tool maker of "
tools." I wrote to inquire of him
January last, if he had anything that w
me. I, at the same time, drew his attenti
tools described by Mr. Northcott as hav
added to his own lathe, in his book o
which I thought would meet a ready sale if
amateurs could get them at a reasonable p
replied that he made a much more comple
cutting machine than Northcott's to fit
saddle of a screw-cutting lathe, which, he
also available for milling from the saddle.
fitted with compound slides, and would
kinds of spur, rim, mitre, skew, and ske
The spindle can be brought to a horizo
tion, and end mills can be used for nut
slot-drilling, and milling work while in c
lathe. He said he was then making
Government, and promised to send me a ph
but has not yet done so. I think it is just
that would suit me and other amateurs.
said he had made Northcott's machine for
cutter making, but found it unsatisfact
working tool, from the difficulty of ma
shaper plates. He asked me to remind hi
end of two months, if he did not send t
I have just written him to do so. A seve
of rheumatism, brought on by the east wi
me up, and the time passed without my
ing to do so. My confinement to bed has
me to look through the back numbers
MECHANIC, and I was pleased to see "F.
"Eos," and other old correspondents w
contributors. I should like very much to
acquaintance of "Eos"; his writings ha
particularly interesting to me, for I spe
years of my life in India, chiefly in a
regiment. **W. M. Skues,**

17, Linden-grove, Nunhead, near Peck

THE EDMUNDS LATHE MA

[27362.]—IN No. 1157 Mr. Newall di
question of cone-fittings for chucks
points of view. As to the ideal an

g views, I quite agree with him. There
o doubt that the coned mandrel-face pro-
y him can be more easily made than the
base combined with the flat face as in the
ds" mandrel. The flat mandrel face is as
ade as the coned one, and can be re-
at any time if necessary like the cone.
l finishing of the cylinder-base doubtless re-
re and delicacy, just as all gauge making
ut the extra cost of making the cylinder
a mere trifle on the cost of a lathe, and
ade is very enduring, owing to its position
g it free from damage by blows, and its
from pressure causing the abrasion of it by
to be infinitesimal.
he user, the making an internal cone to
he external is the difficulty. Mr. Newall
oes not think he can remember a chuck
ving the lathe a perfect fit for the mandrel
d adds that they almost always require
to make them fit equally all round. If it
e to find the flat face of a chuck fit without
, surely the internal cones of chucks will
uire scraping to make them fit, and this
nore difficult than in the case of a flat face.
suggest that this scraping should be done
he chuck leaves the lathe. If the finishing
t the merest scrape, the faces often do not
less the metal was of very uneven density,
ever failed to make them fit all round by
re, a perfectly sharp tool, and moderately
ed for the finishing touch, both as regards
w-threads and also the face. It is quite
t in the case of a cone, one can take out
till a fit is produced, and that, in making
rical recess in the chuck, one can easily
y too much and spoil the work. What
If one makes the recess too large, one must
e chuck aside so far as accurate work goes.

agree with Mr. Newall that the centring
ck by means of its screw-thread, as usually
practically a cone setting. In the form of
-head he proposes, there will consequently
ble cone-setting; the chuck will be fixed
the cone-base and the cone formed by the
the screw-thread. It will, therefore, be
nt for its alignment not only on the cone
t also on the screw-thread cone.
tter cone is subject to far more wear than
er, and if it wears away unequally, or is
ther way deformed, the alignment of the
ill be impaired, however perfect the cone-
y remain. This impairment of the align-
want of truth in the screw-thread, whether
or subsequently produced, is to my mind
t fault of the ordinary chuck fitting, and
ittings in which a screw is used as a
ing agent. It appears to me a fatal
to its use for this purpose when accuracy
rance under pressure and friction are re-
A chain is not stronger than its weakest
in a mandrel-nose the screw-thread is the
int; it is the part liable to strain and
. If, then, we reduce the function of the
that of a mere holdfast, this is surely an
It is true, as Mr. Newall says, that "to
full advantage of the cylinder fit, the
ngth of such fitting part on spindle and
ould bear alike." But if this full ad-
is not obtained in any case through want
elism in the surfaces, yet the concentring
mains perfect. The unequal bearing of
aces merely increases abrasion at some

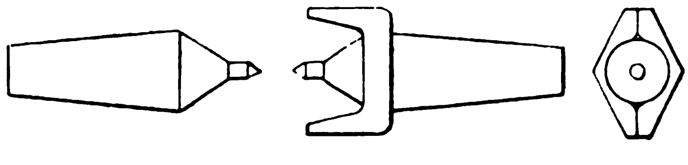
the question of abrasion. The cylinder-
ade of steel, hardened and ground. It is
to little or no stress, and to very little
; it serves merely as a guide to the position
uck. I can hardly conceive of it wearing
reciably with fair usage anything like so
other portions of the lathe, such as the
and the bed. Probably it would last
years without being appreciably the worse,
h constant and heavy use. The mandrel-
ubject to much more abrasion than the
base, but can be easily reground if
.
rew-thread on the other hand is subject to
ess and abrasion, since it serves as a hold-
e chuck revolves upon it four to eight
r once on the cylinder-base, and when
ome the friction increases enormously,
the pressure produced by the screwing
The cylinder-base is subject to only one-
e rubbing which takes place on the first
the screw-thread, and to an amount of
arying with the weight of the chuck, but
ent of the screwing action. Now sup-
e screw-thread to be originally true, in
dition would it be after 20 or 30 years of
l constant use?—how far would the align-
chucks dependent on it be affected? If
of the cylinder-base is an objection to its
how much more objectionable must be a
ead as a concentring agent.
is another objection to the cone-fitting.
ng of a flat face and of a cylindrical re-
omparatively easy operations; but I know
of no simple means by which the angle of a cone can be gauged, and the truth of a screw-thread is a still more difficult matter to determine. It still seems to me that as regards accuracy and endurance, no plan yet proposed is equal to the Edmunds mandrel with the buttress-thread. The only advantages possessed by the cone fitting are that it avoids the risk of spoiling the work by making the cylindrical recess in the chuck too large, and it is rather less expensive.

I hope we shall soon hear again from "J. K. P." as to the comparative strength of the buttress and Whitworth threads, and also as to the objection he has to the buttress-thread on mechanical grounds.

A. Gray.

CENTRES FOR SOFT WOOD.

[27363.]—I SEND sketch of centres for soft wood which I think would prove satisfactory.



Silke.

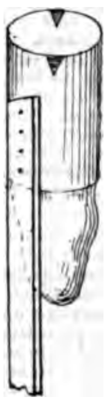
MECHANICAL MATTERS.

[27364.]—"ORDERIC VITAL" asks "Eos" if he has met with any mineral of similar nature to emery. There is found in the neighbourhood of Redon (France) a material which is becoming a great deal used for purposes for which, hitherto, emery alone has been employed. It is a kind of sand, composed entirely of minute precious stones, such as garnets, rubies, emeralds, &c. Perhaps this would suit the above correspondent, if it could be ground fine enough.

Cosmopolitan.

FRUIT PICKER.

[27365.]—I INCLOSE a sketch of a somewhat simpler device for fruit-picking than "Silke" (27285). A short piece of stove pipe is fixed to a rod of suitable length. A V-shaped notch is cut on each side, and the edges filed sharp. The stalk is placed in the notch, and cut by a turn of the wrist, and the fruit falls into a canvas bag attached underneath. The only objection to this device is that it is unsuitable for a lady, as I find it tires the wrist after a few hours.



Toodles.

MAGNETISM.

[27366.]—CAN any of "Ours" give an explanation of the following, over which I have puzzled some time? As I understand Professor Hughes' theory of magnetism, the molecules of iron or steel consist of a number of little natural magnets which, in their ordinary condition, are all jumbled up together, so that they mutually neutralise one another's magnetism. When, however, a bar of these metals is magnetised, either by electric current or otherwise, all the molecules range themselves along the bar with their longer axes in the direction of its length, and this disposition makes one large magnet of the aggregate. His experiments with a tube of iron filings and the effects of torsion on a steel magnet go to prove his theory correct. But if it be necessary, in order to confer magnetism on the molecules, that they should have their longer axes in a line with the bar, how is it that the sides of the bar (towards which the *shorter* axes face) can attract anything? and also, how is it that, if the mere drawing along the bar of a magnet can cause its molecules to resume fresh positions, the bar does not fall to pieces for want of cohesion thereof under a thousandth part of the strain it generally requires to break it?

Probably these are stupid questions to experts, but then, like the engineer in Little Dorrit, I only "want to know, you know."

B. Harcourt.

KEYLESS WATCHES.

[27367.]—COULD you spare room in your valuable paper for a few remarks from a practical watchmaker on a subject which I trust will be both useful and instructive?

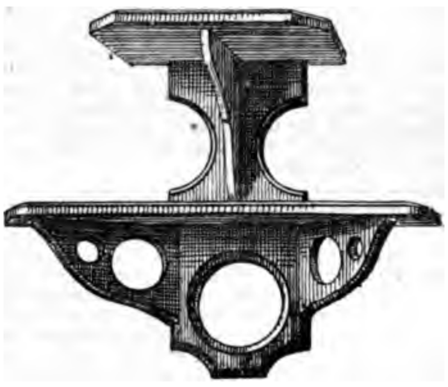
The internal mechanism of keyless watches has been brought to such a perfection that, both as regards price and strength, they are close upon perfection; but, strange to say, the outward construction is exactly in the same primitive state as when keyless watches were first made 50 years ago. All, or nearly all, keyless watches are wound up, and the hands set, by a knob or crown fixed at the top of the pendant of the watch. It is clear that this winding knob should be so placed that the watch can be wound with the greatest facility and certainty. But is that so? With the exception of one patented lately, all keyless watches are made with a ring surrounding the winding knob, obstructing the process of winding. It certainly seems very absurd, but it is nevertheless a fact that we continue to make large bows to keyless watches simply because our forefathers had bows to their watches, forgetting that at that time watches were not keyless, and that the bow in a not-keyless watch does not in the least interfere with the winding of the watch. Apart from the question of bad construction, there are other reasons why the old kind of bow to keyless watches should not be made: they can not be fixed to the watch properly, on account of the winding spindle having to go through the pendant; there is no screw or pin to fix the bow, as in not-keyless watches; but it is merely snapped on, and can therefore be taken off by a very slight twist. Hundreds of keyless watches are lost through the bow coming off, and yet watchmakers continue to make them. It is really as unreasonable as to continue to make muzzle-loading guns. The large gold bow is expensive, and not wanted.

Christian Lange.

23, Great Portland-street, W.

A CHEAP AND HANDY BRACKET.

[27368.]—I ONCE wanted a bracket to support a clock, and only had a strip of wood at hand 6in. wide. Inclosed is the thing I contrived, which might be of use to some of your readers as a simple pattern. It looks full, considering the material.



Silke.

AMBER.

[27369.]—THIS highly interesting substance is again coming to the front for decorative purposes. More than a century ago it was highly esteemed by the fair ladies of Old England; but fashions are but capricious ideas, and the once-prized ornamental material was put aside, and consigned to the lips of genteel smokers. How our seasons must have changed, too, for I have heard my grandmother say (over 50 years ago) that one memorable summer caused the amber earrings to bend, and lose their shape when she was a child!

At the Manchester Royal Jubilee Exhibition there is just now a good show of jewellery in this pretty material, sent by a foreign firm at Liverpool. *Opaque* amber has always been most valued by the

Turks, the mouthpieces of their long chibouques being usually composed of the above kind, mounted with rings of gold and precious stones. The transparent bright-hued sort, comparatively cheap and plentiful, is the one used in Europe for tobacco-smokers' meerschaum pipes. This fossil resin is found in many parts of Europe, Asia, and Africa. Very large pieces are occasionally washed up by the sea. The largest on record is exhibited at Berlin in the Royal Collection, weight 18lb., dug up near the surface of the soil about twelve miles from the Baltic, on which shore numerous specimens are found in that region.

Probably few persons are aware that there are amber mines regularly worked in Burmah. Dr. Griffiths, the Government botanist and traveller, is, I think, the only European who has visited the spot, viz., Hookoom, in the Shan States, bordering on Assam. I was once in the vicinity, but was dissuaded from entering the country as tribal fights were going on at these mines. Dr. G.'s book is now very scarce, and I am sorry I gave it away long ago; there were several nice illustrations—one of Hookoom, I think. Just now that Burmah is a newly-annexed country, the work will be doubly valuable. Every year presents were sent down to the heads of our Assam administration, among the curious gifts ear ornaments of an amber having a fiery, ruby colour. These are taper cylinders, 3in. or 4in. long, sloping from 1in. to ½in., made to suit the prevailing Burmese and Assamese tastes of enlarging a hole in the ear from childhood. Common yellow amber is used by the better sort of persons; the poor carry an enormous cigar of home-made manufacture, hoping some day to go in for the more ornamental appendage. At the auctions held for the disposal of State presents, the above fiery-coloured pillars never fetched less than £2 sterling, and were few in number, while the smaller kind, of a smoky yellow material, were plentiful at 8s. to 10s. the pair. It is possible that rich colour may be factitious—the result of some oil or varnish burnt in. I still possess some of the inferior article I got with the intention of adorning my pipes—just the very shape for working into mouthpieces. In due time I expect those mines will come into European hands, for lead, gold, iron, coal, and coral are all very abundant in that region. I have seen manufactured articles from all those metals—massive bracelets of the precious metal, ductile as lead, bent open to put on the wearer's arm, and closed again by easy pressure. On the higher ranges of the Northern Himalayas a favourite necklet of the women consists of rough pieces of very bright yellow amber, irregular in shape, with holes bored through them. Many of these find their way to the plains of India in trade and barter, and supply the Sikh priesthood with their national rosary of this material. I found the Sikhs the best of all Indian artisans in this line, and got men to work on my premises. After making me sundry mouthpieces, they did a beautiful bit of work for me: a pair of melon-shaped earrings with gold foliage, thought much of in England. Of course, I gave them a model design. Palæontological botany has established the fact that amber is the fossil resin of many Coniferæ of the Eocene epoch, minute scales and extinct insects being frequently observed in the masses; moreover, the fossil wood found in the amber districts of N. Europe, when heated over a fire, give forth the true odour of the succinic gum. "Flies in Amber" were long ago considered rare curios, so Pope says:—

> "Like flies in amber, neither rich nor rare.
> We only wonder how the d—l they came there."

"Bastard Amber," or East Indian copal, sold in England as "gum anime," is of a more transparent yellow than amber. It is so brittle that small articles I got made from it are easily fractured by a fall. Frequently the bodies of ants and small flies are seen in the lumps. Candles giving out an incense-like perfume are made of this substance, and when dissolved in drying oil it constitutes a varnish generally employed in the east for carriages and furniture. Amber, pine resins, and shellac are all highly electrical, supplying the schoolboy with many small scientific toys.

Eos.

ON ACCUMULATORS.

[27370.]—From the numerous inquiries, both in "Ours" and from correspondents writing to me direct, I feel sure that a few words on these will interest many.

A popular but fallacious notion is that an accumulator is a something in which we can bottle up electricity wholesale, and can draw from this store as we require it. In other words, it is looked upon as the same sort of a thing as a gasholder. Now, what are the facts? An accumulator is really very similar to a primary battery, and any primary battery which, when run down, can be restored to its original condition by passing a current of electricity through it in the opposite direction to that *in which* the current it generated flowed, has a claim to the title of accumulator. I propose, however, to treat of what we all understand by the word, as that is the only form which has any commercial importance. I allude to the accumulator in which both positive and negative plates are of lead. If we take two plates of pure lead, and immerse them in dilute sulphuric acid, and then pass a current of more than 2·1 volts through them, we find that one of the plates remains apparently unaltered whilst the other gradually assumes a rich chocolate colour. Gas is evolved all the time more or less copiously, according to the quantity of current which has passed.

Now, what has happened in the cell? First, the current, in passing through the cell, has split up the water contained in the dilute acid into its constituent elements, oxygen and hydrogen. The oxygen forms at the positive plate (that at which the current enters), and as fast as it is formed oxidises the surface of the lead plate, forming a film of chocolate-coloured lead peroxide (PbO_2 or PbO,O). The hydrogen is carried over to the negative plate, and part of it is absorbed, or as it is called, "occluded" (shut up or hidden), the remainder rising to the surface of the liquid in bubbles.

Now, what is the reason of all this? Water is composed of a positive element and a negative one—that is, relatively to one another. Of these, hydrogen is positive and oxygen is negative, consequently, the oxygen flies to the positive pole and the hydrogen to the negative. As the lead combines readily with oxygen, it becomes oxidised, whilst the hydrogen, becoming absorbed by the other lead plate, renders the surface of it spongy. It will be noticed that these effects are only superficial, for however long we continue the flow of current, we find a limit to the depth of oxide and lead sponge which cannot be passed. If now we disconnect the wires from the charging battery and connect them to a voltmeter, we find that we get an E.M.F. of slightly over 2 volts. If we short-circuit through an ammeter or galvanometer of low resistance, we get a strong current to start with, rapidly falling to almost zero. If we now test on voltmeter again, we find the E.M.F. has fallen to little or nothing. On short-circuiting, we very likely find that we injure the coating of peroxide so that it is liable to come off in flakes; but this can be obviated by running down through suitable resistance. When the current ceases, if we examine the plates we find that the chocolate colour has paled down, and both plates are more or less covered with lead sulphate. If now we repass the current through the lead plates in dilute acid in the opposite direction to before, we find that the plate which was before spongy is now chocolate-coloured, and *vice-versâ*. We also notice that if the current is continued long enough, the peroxide and sponginess both bite deeper into the plate than before. The oftener we reverse, first running down the previous charge, the deeper we bite or form the plates.

This is the original Planté accumulator. It is also important to note that it is stated on good authority that to facilitate formation Planté used red lead (sesquioxide Pb_3O_4 or PbO,PbO,O) in contact with his plates by which they were formed more quickly than by acting on the lead plate itself. I will treat of this at greater length presently; but I mention this fact because the credit of first using red lead is generally wrongly attributed to Camille Faure, whereas it seems Gaston Planté was the first to employ it long before Faure ever dreamt of it. This is important because it opens the use of red lead to anyone. The only valid patents for this would be for some special mode of use, such as employing it in the so-called "grids," which are really not grids at all, not being built of bars, but being cast in a mould, and containing square perforations, and not oblong openings, as a grid or gridiron does. However, this is digressing. This original form of Planté cell, made by "forming" the lead plates, is the method I recommend to amateurs for home manufacture, as, although it takes time to form, it works well for years, and is less liable to go wrong than those formed with red lead. The cause of the storing (falsely so called) energy in the accumulator is then due to this: the current in passing through the cell produces chemical changes in it, which changes give rise to a counter-current when the source of electricity is removed and a circuit established—that is to say, that the salts formed by passing the current through the cell tend to reform themselves into the same condition that they were before the current was passed, and by so doing evolve electrical energy equivalent to the amount of energy running down in the cell. As the internal resistance of these cells varies, within wide limits, inversely as the current taken out of the cells, we find the E.M.F. remains constant at 2 volts for the greater part of the discharge. When it falls to 1·8 volt the cells require recharging, and should on no account be run any longer. In cells containing red lead in contact with the lead plate, the red lead on the positive plate is raised to peroxide, and on the negative plate is reduced to spongy lead, and the whole charge is done more quickly. In the E.P.S. cells the plates are made full of perforations, into which the red lead, previously mixed with sulphuric acid, is forced by pressure. The acid, by converting some of the red lead into sulphate, sets the plugs into a hard mass. The fault of these cells is that when the plates buckle, owing to the formation of sulphate, the plugs are apt to fall out, which is a serious matter.

Woodward's plates are formed after quite a different plan, and expose an enormous active surface in a small space with the minimum of weight. It, however, does not become me to say too much of these, as I am making some improvements in them.

In the new accumulator of Dr. Frankland (my former instructor in chemistry), he makes short cylinders of red lead and acid, flattens two of their sides between metal plates, taking care that there is a small space between each of the plugs, and then runs lead in between them. This seems a good idea, and is sure to be so, or it would not be Dr. Frankland's.

I would say something about making accumulators, but that others have gone into that at length in "Ours," and so I will content myself with the following hints: Never use solder, always burn the joints with pure lead only. Be careful to separate the plates well; use *pure* sulphuric acid 1 to 6; take great care in forming; over rather than under charge; keep plates well covered with acid; have a film of oil over the top of your acid; replace evaporation with water only; have the lugs long enough to avoid creeping of acid up them; paraffin them for part of their length; keep connections clean and good; have them sufficiently stout; insulate the cells thoroughly from one another. Do not form too deep into the plates.

Electrician.

ON THE LAWS, REACTIONS, AND CONSTRUCTION OF SOME FORMS OF PRIMARY BATTERIES.

[27371.]—Last week we considered two forms of single-fluid cells, in which the oxidant was dissolved in the solution. I pointed out that the fact of the zinc being in contact with the oxidant was very wasteful. We now come to consider those forms of single-fluid battery in which this wasteful local action (as it is sometimes loosely termed) is obviated by employing the depolarising substance in the form of paste or solid, and not dissolved in the solution.

The first form I will notice is the Leclanché. This cell is usually made as follows:—

In a glass containing cell is placed a rod of amalgamated zinc, immersed in a saturated solution of sal-ammoniac (ammonic chloride). Inside this glass cell is a porous pot containing a plate of carbon, tightly packed with alternate layers of small lumps of carbon and granular peroxide of manganese. The proportions usually employed are 2 parts carbon to 3 of manganese by weight, or about half and half by measure. When the porous cell is almost filled with these alternate layers, some composition made of pitch and other ingredients is melted by heat and poured into the top of the cell to seal it. An opening is afterwards made to let out any gas that may form.

After the cell has been set up for the first time, an interval of about 12 hours (or less if the solution is made with warm water) should be allowed to elapse before the cell is used. This is to allow the solution time to penetrate the porous cell and saturate the contents. In this cell the hydrogen set free by the dissolution of the zinc (forming zinc chloride and oxychloride and ammonic hydrate) meets with the peroxide of manganese, from which it abstracts some of its oxygen, reducing it to a lower oxide, and converting the hydrogen into water. As the hydrogen often accumulates on the carbon faster than the peroxide can oxidise it, owing to its (the peroxide's) granular form, which does not act as quickly as a liquid, we find the cell rapidly polarise. This always occurs when the hydrogen is evolved faster than the peroxide will take it up. However, as the peroxide continues its work after the current has ceased, we find the cell quickly become depolarised and ready for more work. Hence this cell is largely used for intermittent work, such as bell-ringing, and in some forms for lighting small lamps for a few minutes at a time.

Another form of cell has been introduced called the "Agglomerate Leclanché," in which the porous cell is done away with, being replaced by two blocks (more or less porous) of peroxide of manganese, each with one face closely pressed against the carbon plate. These are held in place by two rubber rings, which have generally a small ring or socket attached to hold the zinc and insure its not touching the carbon.

The E.M.F. of the ordinary Leclanché is about 1·5 volt, and of the "Agglomerate" about 1·4 This lower E.M.F. is, however, more than compensated for by very greatly reduced internal

e. The local action in this cell may be l, and for bell work it is, in my opinion, ised.

r words on the management of these cells be out of place, as they are in such common are so troublesome if not properly looked

the ordinary Leclanché care should be purchasing to see that the cell is carefully nd that the wire in connection with the well covered with insulation. On no buy cells if too cheap; there is sure to be ıg wrong, and generally the peroxide is of 'erior quality, and will give but little nd that little for but a very short time. ging, use a saturated solution of sal- ıc, and drop a few extra crystals into the f the cell. Fill a little more than three- full with warm solution. After twelve e level of the solution will have fallen to o-thirds full, which is about what it should er this a little oil or melted paraffin should d on the surface of the solution. (Melted is far preferable, as the oil is apt to pene- porous cell.) This serves the double of preventing the salts creeping up to the s, and of checking evaporation, which is e a source of trouble, especially during ather. The connections should be always n and bright, and the nuts screwed well

Agglomerate form the solution should r the tops of the agglomerate plates, and d then be poured on the surface for the ons as before. There are also various forms cell in which the peroxide is applied y. For instance, it may be intimately th the carbon, or perforations in the carbon lled with it as in Gaiffe's cell.

r's sulphur and sal-ammoniac cell is some- ilar in construction to this; but he employs in lumps about the size of a pea, in place roxide. In this cell the hydrogen meets hur on its way to the carbon, forming tle-known sulphides of hydrogen and m, and a little of it passing off if the cell vorked as sulphuretted hydrogen. This ely warning by its smell if the cell is not rly treated. It also gives warning when , as yellow crusts of sulphide appear about n plate. This cell bids fair to rival the é, but I have not had sufficient experience t to offer a very sound opinion on the

Electrician.

IN REPLY 62433 (RADIUS OF IS); AND OTHER MATTERS.

.]—THERE is a careless error in my reply ird part of this query. It should be

$$\frac{1}{R} - \frac{1}{r} = -\frac{2}{F} \text{ or } R = \frac{Fr}{F - 2r}.$$

ve conclude that the negative focus will greater than $2r$, when the first radius e. And in the example, the above rule ve $R = -15$; being negative, like the ırface. But suppose the negative focus is be 8 and the concave radius 3? Then

$$R = \frac{8 \times 3}{8 - 6} = 12.$$

iles are only partially correct, and I think etter to use the general formula; which, ble convex lens, is

$$\frac{1}{F} = A\left(\frac{1}{R} + \frac{1}{r}\right).$$

the decimal part of the refractive index ıss. For crown glass it would be about for flint glass about 0·6, or say half and hs respectively. The formula will serve kind of lens by making R or r negative se surfaces are concave.

y to "A. W.," query 62490, I will, in a two, seek out a note I copied from Cod- "Optics," which may perhaps serve as an the second part of his query. But as the first part, I wonder if your corre- has any idea of the time and labour such igation would require. I will, as I have to let him have some formulæ relating to urves, which he will find not a little ; but as regards conoidal curves, combined ly and refractively, I hope he will forgive ecline to face the task.

ios."—In the book on North Borneo, g the explorations of the late Frank find the following remarks relating to nean "parang," and the Malay "kris." de is of Kayan manufacture, made from n, and tempered by a process pretty gene- wn in Borneo; but concerning which no has yet been able to give any informa- European blade is more finely tempered e Kayan weapons; I have seen some of will cut a strong nail in two without he edge." . . . "The kris is peculiarly a weapon of war, and is made in Brunei, where the native artificers in metal are remarkably clever. While the parang has only one cutting-edge, the kris is a two-edged sword." And, quoting the words of Mr. Carl Bock, who visited Dutch Borneo, "The process of grinding and sharpening is very slow, and to polish and put a proper edge on a plain blade occupies more than a fortnight. Many of the blades are beautifully inlaid with brass along the sides and near the back, while others have open scroll patterns cut right through the blades. How this work is done I could not ascertain, as both Dyaks and Malays were very wary of giving any information, and very unwilling to show any of their tools."

Is anything more known of this tempering process?

O. V.

QUACKS OF VARIOUS TIMES.

[27373.]—MR. GREY, in page 296, is doubtless right in the epithet he applies to the author of the "Decline and Fall of the Roman Empire," though the statement he quotes from that author is quite apart from any previously mentioned. I had spoken, page 272, of "the quack from whom Mr. Grey heard," or copied, that the Josephus passage about Christ was "universally held a forgery" (letter 27217). That is surely a very different statement from saying that this or that "authority," or ten thousand, held it a forgery, or that it was one. It differs from them so widely as to be characteristically new or to-day's quackery, which they are not. This dodge of "universally held" was a kind of stuff not utterable in Gibbon's day—not even passable enough to be coined. We may be as sure, without seeing a page of his, that he never said this, or anything like it, as that he never travelled by railway. It belongs to a stage in our people's Decline and Fall much nearer their end, one wherein the "three R's" are general, and their possessors more thoroughly, as I said, "quack-ridden"; which implies two manner of people, some to ride, and some to be ridden, Mr. Grey being of the latter, and both Gibbon and his present informants of the former.

That the said "authority," if alive to-day, would be an arrant quack, beyond perhaps the Lyells, Darwins, or any late servants of him below, far be it from me to question. He contained so plainly the making of at least a Huxley or Proctor or two, that I cannot doubt this. But, as a matter of fact, he has said his all, and said it before the market for this currency existed. The particular lie now quoted, that "no traces of the alleged supernatural occurrences can be found in any writer of the period," does by no means imply that any passages current as of Josephus or Philo are "universally held to be forgeries"; though it implies that Gibbon meant them to be so held.

Some whole nations hold that Mohammed rode to heaven and back on the animal Borak; but I much doubt whether, even in Mecca, any teachers have yet come to assert that this is "universally held."

E. L. G.

[27374.]—MR. WM. JOHN GREY, F.C.S.'S, letter (27328) anent that now "notorious" interpolation in "Josephus," does not state half his case.

Lardner says "it was never quoted by any of our Christian ancestors 'before Eusebius.'" It disturbs the narrative. The language is quite Christian. It makes an "orthodox" Jew write like a Christian for four or five lines only in the entire book! It is not quoted by Chrysostom, though he often refers to "Josephus," and could not have omitted quoting it had it been then in the text. Neither Justin Martyr, in his dialogue with Trypho the Jew; nor Clemens Alexandrinus, who made so many extracts from ancient authors; nor Origen against Celsus, have ever mentioned this testimony; but, on the contrary, in chap. 35 of the first book of that work Origen openly affirms that Josephus, who had mentioned John the Baptist, did not acknowledge Christ. That this passage is a false fabrication is admitted also by Ittigius, Blondel, Le Clerc, Vandale, Bishop Warburton, and Tanaquil Faber.

This interpolation is almost certainly the work of Eusebius, who, in chap. 31, book 12, Evang. Prag., tells us "how it may be lawful and fitting to use falsehood as a medicine, for the benefit of those who want to be deceived." **F. W. H.**

LAMINATED ARMATURES.

[27375.]—I FAIL to see what W. Tilley (letter 27343) could be thinking about in writing such nonsense about my dynamo to my fellow amateurs, when, at the same time, he never made such a dynamo up to do the work he speaks of. I think it would have been far better if he had taken the trouble to have walked down to me and taken the right size of it, before giving my fellow amateurs such a lot of trouble for nothing. I write to explain it, to show what it will do, and I challenge W. Tilley to disprove it. In the first place, this dynamo never has worked half a day right off. I punched all the punchings, and fitted them up ready for winding, so I think I have some idea about it. Armature is 2¼in. long by 2¼in. diam. without paper; the field-magnets are 2½in. by 1½in., 6in. long. The most done by this dynamo was it lighted a 10c.p. lamp marked 11 volts, at a speed of 3,000 per minute at the time Mr. Tilley said it is nearer a 5-volt lamp than an 11 volt. So I hope when W. Tilley writes to the "E. M." again, he will write the truth. I am sure my fellow amateurs do not want to make up such a dynamo, and find it will only light 10c.p. lamp. I may add the quantity of wire on field and armature was unknown, and Mr. Bottone never said it was a great success.

A. Parkington.

Suffolk County Asylum, Melton, Woodbridge.

THE ACCIDENT NEAR HARRINGAY PARK.

[27376.]—"NUN. DOR." page 297, asks me to offer some explanation of the almost incredible circumstances which led to the Harringay Park accident, and does not appear to consider the case so clear as I believe it to be.

The signalman said, "Are you right, driver?" the driver, thinking he said "Right away, driver," put on steam, ran past a fixed signal at danger, and having run two miles on the wrong road, dashed into a passenger train.

The signalman had been on duty eleven hours, and bore an excellent character; the driver had also been on duty eleven hours, and is, the report states, a steady man, the only entry against him of any consequence being one of leaving a station with the starting-signal at danger.

This accident shows the danger of verbal or hand-signals being used where fixed signals exist. I am aware that in some cases signalmen do, either by word of mouth or hand-signal, call a driver past a fixed signal at danger. Several accidents have been caused thereby, and such a dangerous practice should be discontinued, as, if an engine be allowed to pass signals when "on," all the safety of interlocking is rendered valueless. In the Harringay Park case the driver had no right to pass the starting-signal when it stood at danger.

Clement E. Stretton,

Consulting Engineer Amalgamated Society of Railway Servants.

St. Pancras Hotel, London, N.W., May 27.

CONTINUOUS BRAKES.

[27377.]—MR. GOBERT (27335) admits "there is nothing new" in the fact that in the Crook case the driver had to release the Westinghouse brake when he wished to alter its power; and this admission is to me all the more pleasing because it is made by a gentleman who was until recently an official of the Westinghouse Brake Company. But he says, "This manipulation is necessary more or less according to the skill of the driver"; and he suggests that the driver in the Crook case "had not the necessary dexterity." According to the evidence, the first driver worked the brake as follows:—He kept alternately letting the train run, and applying the brake to check the speed by reducing the air-pressure about 25lb. This would put the brake full "on"; and my point is that with the Westinghouse brake full "on" when the speed is being reduced too much or the brake is skidding the wheels and the driver wishes to alter the retarding power, it cannot be taken off a little; it must be taken off altogether and a fresh application made, and I defy Mr. Gobert to do any different with the brake under such circumstances.

Here is a case in point. The 10.10 p.m. passenger train, Harrogate to Leeds, on 15th August, 1884, got into collision at Leeds Junction because the Westinghouse brake could not be graduated. The driver had nearly 500 yards view of the signals being against him, and when he first applied the brake, it was stopping him too soon, and he released it, the speed increasing itself again. After two applications the brake skidded the wheels, and the train slipped along. The driver, knowing that if he attempted to release the Westinghouse brake slightly, it would come off entirely, let the continuous-brake alone, and tried hand-brake, sand, reversing, &c., and after all fouled the junction, and himself got rather seriously injured.

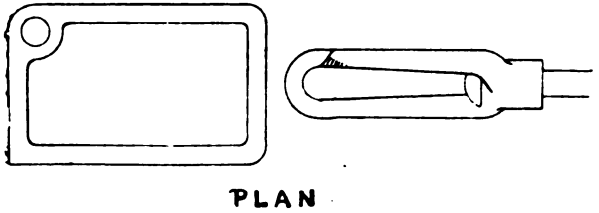
Now, Mr. Gobert, be good enough to answer this one question: With the Westinghouse-brake full on and skidding the wheels, how should you relieve or take off the skidding without releasing the brake entirely and making another application?

You say, Mr. Gobert, that had the vacuum automatic brake been on the Crook train, and been worked under the same circumstances, the result would have been the same. I think you know better; but if you persist in the statement, I will tell you how that brake would have gone on. There would most decidedly have been no collision.

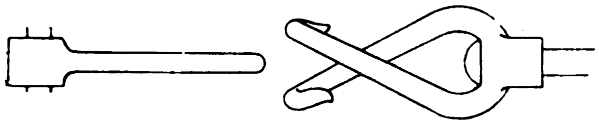
Samuel Davies.

Fig. 4.

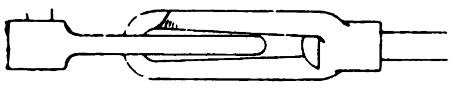
ELEVATION



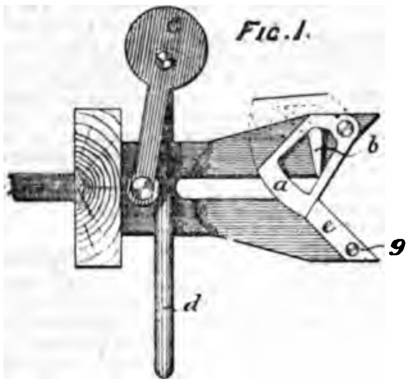
PLAN



PLAN . COUPLED



PART SECTION LINK PUT BACK



PLAN WITH LINK IN PLACE

LINK IN PLACE FOR COUPLING

Fig. 5

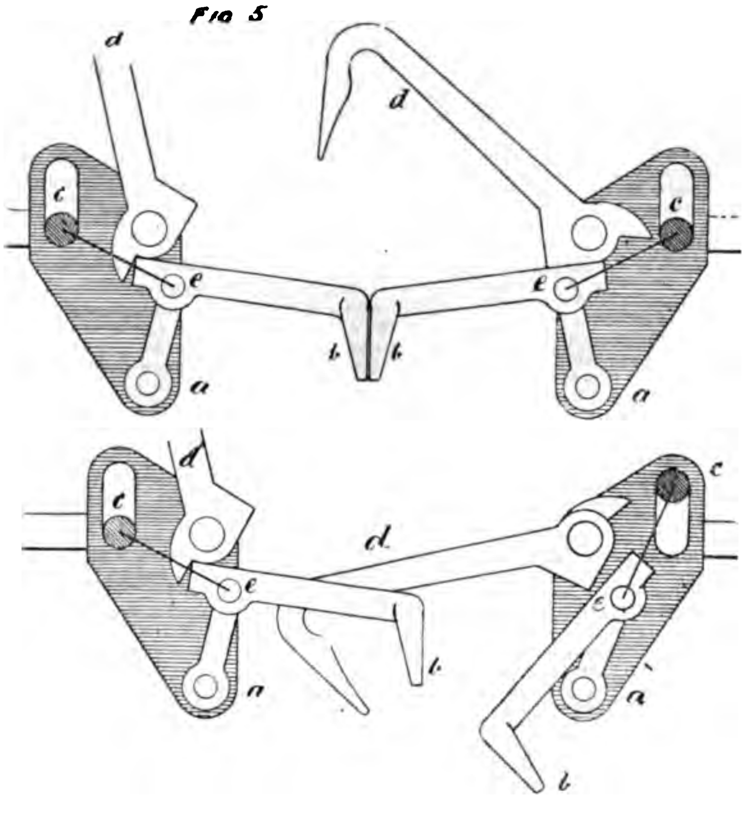
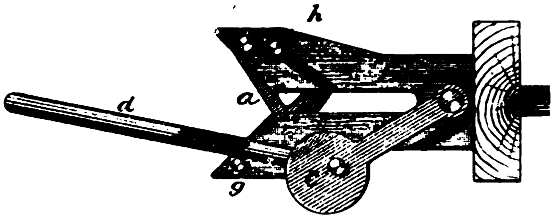
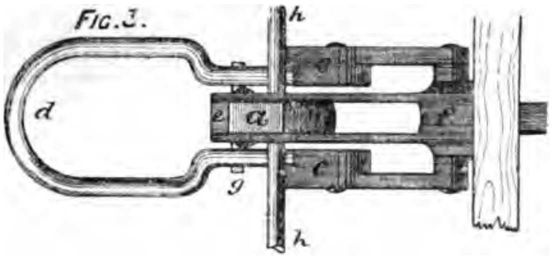
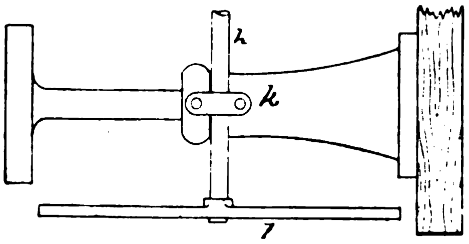


Fig. 2







RAILWAY COUPLINGS.

[27378.]—In these days, with the possibility of a perpetual motion exploded, there is probably not a more engrossing problem to a mechanical mind than the railway coupling. The thousands of patents on the subject are one proof of the variety of ideas possible, and the fact that none have been adopted with great success testifies to the almost impossible character of the problem. Undoubtedly the majority of your inventive readers have had a "try" at a scheme. I send sketch of my coupling, and two of many ideas that suggested themselves, in hopes they may call forth others, and draw readers to the discussion of a most interesting subject—one that has been dismissed from these columns in much too brief a manner to please me. There are many points that some of your readers could give interesting remarks upon. To begin with, is it at all possible to make an automatic coupling to fulfil all the present requirements, and if not, is there any chance of an imperfect piece of mechanism taking the place of the present perfect screw coupling? Should not the first change be towards establishing a standard buffer? What is the object of encouraging inventors to utilise the draw bar-*hook?* If a good coupling is ever made, the hook will never more be wanted. With present arrangements, couplings should lock at different heights of the carriages, on curves, with different lengths of buffers, with either end of a carriage in place, they should uncouple under strain, without carriages backing, should allow considerable play, should allow of perfect locking, allow a man to uncouple from the ground, and from the footboard with one hand. There are many ways of making a perfect coupling device as far as the essential locking is concerned, but it degenerates to a makeshift when adapted to meet all the above requirements. It would be interesting to hear if anyone has ever proposed to alter some of these "requirements" to suit a means of coupling instead of vice versâ.

Figs. 1, 2, 3.—*m* is the drawbar to which is attached frame *f*; *a* is a locking-piece, which can be raised by cam *b*; *d* is a link pivoted on *c* and resting on *g*; *c* is pivoted on the frame *f*, and by its weight and a stop retains the link *d* in position shown ready for coupling—when not wanted is put back as in Fig. 1; *h* is a rod, to which cam attached, and passes over buffers on each side carriage, and is provided with suitable handles, shown in Fig. 3. In coupling *d* advances on lifting it; after passing a certain point *a* dr and forms a perfect lock, any pressure on *a* tend to close rather than open it; cam *b* will, howev effectually secure link *a* if necessary. To couple, cam *b* raises *a* and releases *d*. arrangement is perfectly flexible, allows play (be made with a stepped locking-piece to suit s buffers), uncouples under strain, couples at differ heights. The other figures require no explanati excepting that *c* (Fig. 5) is joined to *e* by a l left out for the sake of clearness; *e e* are horses links, *b b* being lugs outside.

Silk

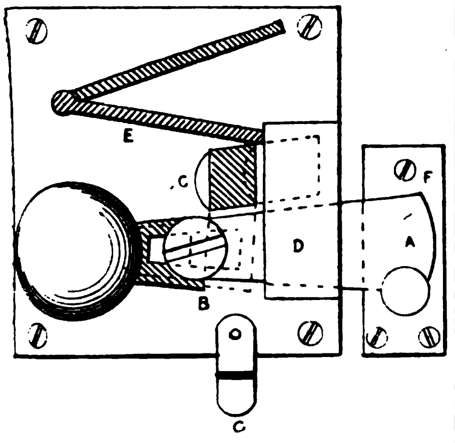
SOLDERING.

[27379.]—The dodge recommended by "Epso is certainly worth recording. I only gave wh consider to be the essential points to insure s cessful soldering. With the simple stock (spiri salts, zinc chloride, and a lump of sal-ammoni anything may be soldered in the common metals. "Epsom's" sal solution, though excellent, necessitates another pot, and robs a small iron of some of its heat. I find a rub on an old brush is all that is necessary when the tin is still on the iron. Again, nitric acid may be used for cleaning brass, but is not *necessary* in soldering. Though tallow is recommended and used by plumbers, I maintain that zinc chloride is a better flux. Perhaps sawing open some of the plastered "tallow" joints would make this clear. I have made hundreds of joints on lead and compo pipe with only chloride and a minimum of solder, and I can answer for each joint being fully as strong as any part of the pipes joined, and that the solder really *adhered* to all the scraped places. I cannot agree with "Eos" that a "jagged hole follows the bit instead of a joint" if ordinary fine solder and chloride of zinc are used. I have made small boxes in zinc (standing the sides on the bottom piece, and running solder round *outside*, afterwards snipping off the edge), in which the parts joined looked like one piece, the only things used being weak acid on the zinc and a moderately hot iron. For pewter, fusible solder must, of course, be used, though with care ordinary solder will do as a makeshift. **Silke.**

AN IMPROVED PATENT BOW LATCH.

[27380.]—I BEG to inclose herewith a sketch of a patent improved bow latch, invented by Mr. R. G. Lacey, of 6, Khyber-road, Clapham Junction, London, S.W.

Upon the latch A is a pin or pivot B with a head. Upon this pin or pivot slides a slotted piece of metal, D, which has attached to it or formed therewith a bolt or plate, C, of the depth of the keep D above the latch, and which, when pulled back to its fullest extent, is clear of the said keep, and has pressing upon it the spring E of the latch. Upon turning the handle, then, in this position, the spring E is lifted, and the latch and bolt all move together, the latch A thereby being released from the latch plate F. When, however, it is desired to lock the latch in place, the bolt C is shot into the keep as shown by the dotted lines, and fills up the space so that the latch is prevented from rising therein, and cannot be withdrawn from the staple or latch plate. The back of the bolt C may be formed with a recess into which the spring E may be dropped when it is pushed home in the keep, and thus will prevent it dropping back accidentally. G is a piece of metal at bottom of latch to keep it open at will. **G. E. Lacey.**



6, Khyber-road, Battersea, London, S.W., May, 25.

SPEED OF LIGHT.

[27381.]—I WISH to ask "A Fellow of the R.A.S.," who so kindly through your columns from time to time gives us such accurate and useful information, a question which may be very foolish, but which I ask in real humility. The assumed speed of light's progression is, I believe, founded upon the distance of Jupiter, or of his satellites, from us, and built upon that are, we all know, many statements in various publications as to the time, e.g., which would expire before we should on this earth be aware of the extinction of the light of a given star whose parallax is known. If my premises are correct, I would ask "F.R.A.S." (who, I hope, as he is great, will be merciful), Is it an absolutely true consequence that because light travels at a certain rate from Jupiter to us, that the same rate must hold good for the space between us and, say, α or β Centauri? We do not know the nature of the media beyond a very limited space between us and Jupiter. We only know that light travels from Jupiter to us in a certain space of time which gives a certain average.

J. F. Turner,
Grafton and Armidale, N.S.W.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61903.]—**Harmonium.**—I note "Queen's" reply to me on p. 299. The "mystery" now is clearly explained, and the "real cause" of the defect is fully brought to light and made obvious to those readers of "Ours" who understand the subject. "Queen," on p. 299, seems quite satisfied that the seat of the "mystery" was in the setting of the reeds. I must certainly differ from his opinion if his experiment with "borrowed" reeds is correct, according to his statement. The narrow reeds, according to "Queen," sound all right; but the broads reeds do not, even though he has set the tongues according to his own judgment. There is no fault with the pan, otherwise the narrow scale reeds would not produce the extraordinary "pipe-like tone" which, be it noted, was never found before in any ordinary harmonium. The Mustel organ and the better class of American organs are the only reed organs in which a pipe-like tone can be looked for. Taking it now for granted, firstly, that the pan is all right; secondly, that the reeds are right also; thirdly, that there is no fault in the lift of the pallets—this being the case, the real cause of the defect remains clear, and any further reply to this query is absolutely unnecessary. I have previously stated the principal causes from which the defect may proceed, and I hope that my reply, with that previously sent by an old and esteemed correspondent, has helped "Queen" to arrive at the seat of the so-called mystery. "Queen," or any other correspondent, is quite welcome to any assistance which I can possibly render to them through the pages of "Ours."—G. FRYER.

[62055.]—**Musical Clock.**—The size of barrel of my piano is 8in. diam., made of beechwood well seasoned. I have one hammer to each note, and the 8in. barrel will play 32 bars of music in $\frac{6}{8}$ time, and repeat the quavers in one revolution, but it will not repeat semi-quavers in 32 bars of $\frac{3}{8}$ time music.—FISH.

[62181.]—**Lunar Clefts.**—TO "F.R.A.S."—It is quite true that Proctor did make use of the words quoted by "F.R.A.S." on page 268; but this was in 1873. Writing in 1878, he (Proctor) says:—"When I first advanced this theory (in 1873), I had not fully recognised the evidence both *à priori* and *à posteriori* in its favour. I said then that 'I should certainly not care to *maintain* it as the true theory of the origin of the small craters, though I pointed out that as yet no plausible theory has been urged respecting this remarkable feature of the moon's surface.' I now view the subject differently. The evidence in favour of the meteoric theory of the small craters is much stronger than I at first supposed, the difficulty of forming any other plausible theory much greater. I may even go so far as to say that it would be a problem of extreme difficulty to show how a body formed like the moon, exposed to similar conditions for the same enormous time intervals, could fail to show such markings as actually exist on the moon. A theory of which this can be said stands on a somewhat strong basis."—A. E. FASNACHT, Clayton, Manchester.

[62195.]—**Colliery Grease.**—I do not think Mr. Murray would find the mixtures I gave so expensive as he appears to think. Low price is not always synonymous with cheapness, and a mixture which costs more than another to make is often cheaper in the long run. The basis of the low-priced greases is a paste made by stirring 9lb. of powdered slaked lime into 10lb. of rosin oil, and applying a gentle heat. Coal oil, water, and soda can be added in varying proportions, according to the condition required in the grease—that is, we may make a "soap" or a "syrup" as regards consistence. If Mr. Murray will make a few experiments, he will no doubt soon find proportions which will suit his purpose. In the back volumes there are, I know, a good many recipes of the kind; but I cannot spare the time to hunt them up now.—NUN. DOR.

[62196.]—**Post Office Batteries.**—I am much obliged to "Nun. Dor." and Wm. Rowland Hart for their obliging answers to my question, and I would be very glad if the latter would also give me descriptions of the Siemens and Halske's and Baltimore and Eagle batteries, as I don't know them.—LONDINIENSIS.

[62230.]—**Glaze in Teapot Strainer.**—Why not break out the glaze through the holes? The drill to use would be one of the diamond sparks used by the china-menders.—NUN. DOR.

[62231.]—**Weight of Flywheel.**—Formula will be found in No. 1071, p. 105. The number of revolutions will depend on the valve arrangements mainly. I think the querist should look up his back numbers.—J. T. M.

[62236.]—**Sulphuric Acid Bulbs.**—What is the difficulty? If the bulb has a little tube neck, warm gently, and dip the aperture into the acid. As the air cools a drop or two of sulphuric acid will be forced in, and the neck can then be closed by means of the blowpipe flame.—F. I. C.

[62240.]—**Chloride of Calcium Solution.**—A saturated solution of chloride of calcium boils at about 350° Fahr. If "C. C. S." can make it boil at a lower temperature, corrections ought to be made in the textbooks. He should add the chloride of calcium until the water will dissolve no more.—M. C.

[62242.]—**Chloride of Silver Battery.**—As "More Light" says he cannot find complete directions for making a pocket chloride of silver battery in previous numbers, it becomes necessary to ask what it is that he wishes to know, for full instructions have been given over and over again. There are directions and a diagram in No. 1094, p. 39; ditto in No. 1090, p. 487. See also No. 927, p. 391. I think, too, if "More Light" looked through the indices for "pocket battery" he would find a few references to the subject.—NUN. DOR.

[62243.]—**Multiplex Back for Dry Plates.**—Will not querist find illustration of what he requires in No. 961, p. 569?—I. H. J.

[62247.]—**Electric Saw.**—Surely Mr. Wood does not imagine there is such a thing as an electric saw, or that electricity is a motive power. If I remember correctly, he must be referring to a cranky idea for felling trees by means of an incandescent platinum wire. The wire is supposed to be made white hot by the passage of a current of electricity, and is gradually drawn through the trunk of the tree just as the cheesemonger draws his wire through the big cheddars. They do not use the electrical method in the backwoods, and it has not yet supplanted the ordinary circular or band saw in the woodworking shops. Nor are they or it likely to!—SAML. RAY.

[62251.]—**Bookbinding.**—Is not the work referred to by querist done in the hot arming press? I would recommend "Hand Stamp," if he wishes for information, to look through your back volumes.—SELIM.

[62256.]—**Violoncello.**—The querist has only to take the dimensions given many times for violins and increase them pro ratâ, when the "instructions" for one will serve for the other.—KENT.

[62259.]—**Chemical.**—In burning leather, carbonic acid, nitrogen, and small quantities of other gases are given off, but there is nothing specially injurious to health, although the odour of the fumes is certainly not pleasant.—F. I. C.

[62264.]—**Duodecimals.**—Your correspondents who advocate duodecimals appear to have overlooked the fact that 12, being a complex number, is much more difficult to work with than 10—a simple one. For instance, to multiply 365 by 10 you have only to add 0, and the working is done; or to multiply by 5, you add 0 to the number and divide by 2. But to work such sums with 12 or 6 is a much more complicated affair.—PONTO.

[62264.]—**Duodecimals.**—The valid reasons given in favour of duodecimals for calculation compared with decimals, do not cover the whole range of arithmetical problems in relation to the common everyday reckonings. In this aspect, we find the octonary limit and replication of numbers is in more common use than any other method. Most of the workmen's off-hand reckoning is by eighths. Share-market reckonings in fractions are by eighths. — I think always. Gladstone, when he altered the Income Tax, made it seven-eighths of twopence half-penny. Book sizes, musical notes, many measures of length are octonary, and, being divisible to an integer 1, it seems the better system to base calculations upon than either the decimal system or the duodecimal. I have found, in teaching children arithmetic, that it is not well to make one —the figure 1—a starting point, for it is not really a starting point, it is the completion of an integer; 0 or zero as a starting point, I have always pointed out, is the symbol which marks the separation of integers from fractions, and that one on either side of zero or 0 meant one whole, or one-eighth, tenth, or twelfth of one, as the method of division into fractions might be adopted. Thus, decimals—the usual fractions — were made obvious to the children's understanding. The figure 8 is admirably suited for a first replicating number, as it is two zeros "$\overset{0}{0}$" joined. The French have the verbal arrangement in calling seventeen sixteen-one. I am collecting an account of the methods of replication of numbers of various nations or tribes, from the remotest vestiges of antiquity to the present time. I shall be glad of any contributions of knowledge to help me, and also to elicit objections to the octonary method. Its advantages are palpable in many of the simple reckonings of trade and science.—J. CHARLES KING, 40, Elgin-terrace, Maida Vale, N.W.

[62264.]—**Duodecimals.**—Your correspondent, W. B. Leigh, takes a very despondent view, in which no one else need share, of any change in our present barbarous systems of money, weights, and measures; still, when reading through the lines there is great hope discernible, for he admits that twelve is a better number than ten as a base for counting, and that our present want of system is pervaded by twelve or its aliquot parts. Knowing that it is admitted on all sides that the people must be mentally trained, the issue stands thus: Will the educated of this generation accept a little trouble in order that facilities may be offered for the mental elevation of the individual for all time, and that England may be placed in a fair position to compete with other nations? Or shall we allow the present but wholly unnecessary obstacles to hinder this country from maintaining its present elevation amongst nations? Now, my contention is that, apart from the mental elevation that would arise from the removal of these hindrances, as much time and money would be saved to the individual and cost to the nation, as would provide all the technical education, which is now seen to be a necessity, that a working population would require. Authorities state that one year would be saved in each child's education by a reform in our arithmetic. But that is not all; instead of being, as at present, a source of trouble and annoyance, puzzling, irritating, and disgusting for all time, it would become simple, easy, pleasant, and in many instances an excellent and bewitching study through life. Two rules in arithmetic—reduction ascendly and descendly—would be wiped out, and the direct, inverse, and compound rules of three would be absorbed in that climax of all mathematics, the equation which is understood and practised by every civilised nation. The slide-rule would soon be in the hands of artisans, who could thereby and at a glance solve ten thousand times more problems than all the ready-reckoners put together. To introduce twelve as a base, the only additions required to our present system would be two signs for ten and eleven; the Roman character X might stand for ten, and the Greek Σ for eleven. Undoubtedly a little attention would be required on the introduction of the system, but nothing so stupendous as "W. B. L." imagines; because already the very terms required are in existence—viz., the dozen and the gross, which are as well known as "household words," and are used by every individual, and more especially in .trades where large numbers at a small price each are sold. The only trouble would be in remembering that dozens and gross are being dealt with instead of tens and hundreds; thus 6Σ5 would represent, not six hundred and eleventy-five, but six gross eleven dozen and five, terms and numbers which are understood by all; again, fifty weeks would stand 44—that is, four dozen and four; and a quarter of a year 11—that is, one dozen and one. It is to be lamented that when the very admirable and useful discovery was made that a figure could be increased or decreased in value in a geometrical ratio by altering its position, that the best of all numbers—twelve—was not chosen as a base; but it is to be hoped that because other nations have adopted ten, which is (prime numbers excepted) one of the worst that could have been selected, Englishmen will not follow like sheep, but adhere to what reason says is the best number—twelve—which can be utilised here at one-fiftieth of the trouble and one-tenth of the cost that any other number could be. Any little trouble would fall on the educated, who are well able to overcome it, and, provided with a table for conversion, which need not cost more than a penny, a little difficulty would soon vanish—S. H.

[62264.]—**Duodecimals.**—A friend has just sent me your valuable paper of 13th inst., in which I find, on page 253, a very interesting article on Duodecimals, and I have now much pleasure in forwarding you a few papers bearing directly or indirectly on this question, it having been my privilege to discover what I purpose calling the Anglo-Metric System, based on the DECA Notation of Twelve Units, which, if ever adopted, will undoubtedly prove to be a step in the right direction. There can be no doubt, Sir, that our notation is wrong by two units; for "twelve" written as a "ten," which in Greek is called DECA (the letters for "DEC" being the 4th, 5th, and 3rd of our alphabet, thus giving us the 4 + 5 + 3 = 12) ought to be the radix of "Natural Notation." I write the numbers as follows:—

1	2	3	4	5	6
one	two	tri	for	fiv	six
7	8	9	ϕ	†	10·
sev	eit	nin	ten	elv	dec
11·	12·	13·	14·	15·	16·
decone	dectwo	and so on	. .	. .	. .
17·	18·	19·	1ϕ·	1†·	20·
. .	. .	. .	decten	decelv	twodec

ϕ = for 10—i.e., one and zero written as a unit; † = for 11, two "ones" crossing each other. Thus the dozen is always a "Decimal" (which word now receives a wider meaning as representing the "one-nought"), and in order to distinguish *between* one class of decimals and the other, I will call the present decimals the Arabian or X (ex) decimals, and the new ones the Natural or DECA decimals. In this natural system of decimals we should read the vulgar fractions as follows:—

0,1	0,2	0,3	0.4	0,5	0,6	0,7	0,8	0,9	0,ϕ	0,†	1,0
$^1/_{12}$	$^1/_6$	$^1/_4$	$^1/_3$	$^5/_{12}$	$^1/_2$	$^7/_{12}$	$^2/_3$	$^3/_4$	$^5/_6$	$^{11}/_{12}$	1.

0,01	0,02	0,03	0,04	0,05	0,06
$^1/_{144}$	$^1/_{72}$	$^1/_{48}$	$^1/_{36}$	$^5/_{144}$	$^1/_{24}$
0,07	0,08	0,09	0,0ϕ	0,0†	1.
$^7/_{144}$	$^1/_{18}$	$^1/_{16}$	$^5/_{72}$	$^{11}/_{144}$	1.

and so on. Were it only a matter of "Change of Notation," I myself would be unwilling to recommend a change; but in this correct system we find new and heavenly horizons for true science based on a true notation, and the discoveries it has been my good fortune to make point to the fact that creation is a scientific system of the vastest splendour based on the natural law of figures. The fact is: "Behold I make all things new," and this must be our watchword in rebuilding the scientific edifice. It may take years to accomplish, but "Rome was not built in a day," and having, like Romulus, put my hand to the plough, I, for one, will not look back, but with the help of such enthusiastic reformers as "Theta Phi," whom I hope to gain over to be a Deca-Phil, will resolutely bring this reform before the British public as soon as a sufficient number of members have joined the Universal DECA Association. The French decimal system totally ignores the fundamental properties of the circle, which undoubtedly requires the division by "twelve" or "twenty-four." The "decimalisation" can therefore only be accomplished by adding two units. Instead of taking the quadrant (or $^1/_4$ meridian, which is an ellipse of rotation) we purpose taking the Equator as basis. Instead of the 10,000,000th (ten-millionth) of the quadrant (meter) we take the 10000000· (deca-millionth) $= 10^{\cdot 7} = 12^7$ 35,831,808th part of the Equator, or a measure of 44in., which we use either as a yard-stick or 4ft. of 48 metric inches, or as a natural mètre of 100· = 144 natural centimètres, thus giving three centimètres to each natural inch. 11 English inches = 12 or ·10· natural inches. Moreover, we find that the tenth part of the English mile is the natural hundred-thousandth part of the Equator in this DECA system as follows:—

$^1/_{10}$ Engl. mile = 176yds. of 36in. = 6336in.
= { 144 nat. mètres of 44in. = 6336in.
= { 100 „ „

The circumference of the earth at the Equator is—
24883,2 Eng. miles

Or in tenth of miles—
(12^5) = 248832 $^1/_{10}$ Engl. miles
$(10^{\cdot 5})$ = 100000· (100·) Nat. mètres.

Total circumference = 10000000· natural mètres. On investigation we find that the whole of creation is a Deca "decimal" system, and we obtain marvellous results in physics, geography, astronomy, chronology, &c., with which I will not now trouble you, but will forward you, and anybody reading your paper, what has so far appeared, hoping shortly to publish other works on this subject.—CHARLES A. KESSELMEYER, Pres. DECA Assoc., Villa "Mon-Repos," Altrincham, Cheshire, 28th May, 1887 (1893 Corrected Era = 1119· DECA).

[62264.]—**Duodecimals.**—The reply of "Theta Phi," p. 253, is so far from "exhaustive" that it has not touched the main point, but as regards notation of abstract number totally errs; though I agree fully with his "anti-decimalism" as to metric units, and am glad to see one besides myself broaching the views I did years ago, when I incurred general ridicule by pleading the superiority of our "quarto-duodecimo-vigintal" money (as they called it) and sexagesimal time, and our "troy weight," and small long-measure (up to the fathom), and even the worst of our tables, to the barbarising retrogression of the Sansculottes toward Chinese decimals. No longer standing quite alone, then, as to anti-decimal weights and measures, let me try to show "Theta Phi" why I am for combining them with our old notation, which I would retain even were we all Goliaths with a θ finger and a φ finger; and indeed, will defend against him Dame Natural Selection (if to her we owe our present number) as having evolved the very best for us. He fancies the main fault in our "simple arithmetic," that necessitated "compound" besides, to lie in the badness of its base 10; and does not see that it lies entirely in the sameness of base, repeated at every step, and would, in the long run, be as bad with any constantly repeated multiplier, even 12, and only slightly worse with even an odd base. Twelve, he says, of course, has twice as many "aliquot parts" as ten has. Just so; but now raise each to successive powers, and try thus:—

10	has	2	divisors	12 has	4
100	has	7	„	144 has	13
1,000	has	14	„	1,728 has	26
10,000	has	23	„	20,736 has	48
100,000	has	34	„	248,832 has	64
1,000,000	has	47	„	2,985,984 has	89

If you call the index of any power i, you will find the numbers in the second column to be each $= i^2 + 2i - 1$, and in the fourth $= 2i^3 + 3i - 1$; so that the latter, at every step, fall more and more short of being twice the former. Though 12^4, you see, exceeds the double of 10^4, its divisors are three fewer than twice 23; and though 12^6 is very near thrice 10^6, instead of having thrice as long a "practice-table" (as the school-books say), it has not even within five of twice the number! Involved then only to this moderate power, the 12 becomes actually a worse base than 10, merely because larger; and whatever the two bases you compare, or their relative goodness at first, a few steps will bring you to powers at which the larger is plainly the worse, and the smaller the better of the two. The difference between 10 or 8 as bases would be practically very little; but 12 would, in the long run, be worse, and 6 decidedly better than either. It may have been on this principle that Sir G. Airy once emitted the strange idea that our arithmetic might be most improved by bringing all to the binary notation, using no figures but 1 and 0, and writing a million, thus—11,110100,001001,000000 (the first 1 meaning 524288, and the last, ·64.). A thousand is 1111,101000; a hundred is 1,100100; and ten is 1010. The fraction ⅓ would then be ·0101 *ad infinitum*, and ⅔ = ·1010 *ad infinitum*. "Theta Phi," then, is quite right about fractions making all the bother; but does not see that the difference thus arising between "simple" arithmetic and "compound" is in nature itself, and fundamentally necessary. We and all civilisations above that of Chinese or Sansculottes always require, and shall always, besides an arithmetic mounting in uniform progression by the powers of one base (naturally our fingers number), another combining wisely and artfully the first few prime factors, 2, 3, 5, and, perhaps, up to 7, or even 11. But observe, I say only "another" arithmetic, not a dozen others. That is where the shoe pinches, and our barbarism appears; that our mediæval guilds never came to realise the simple fact, as obvious as the sun (nor can we yet), that there must be one certain table, or way of dividing and sub-dividing the biggest unit down to the smallest by certain steps, which is the best way absolutely—not the best for this or that, for wool weight, for money, for land measure, for the day, for "Troy weight." Whatever was, or is, the best for any one of these is eternally the best for all and each of them. And this one best division, or best series of multipliers, alike for all conceivable measurables, vendibles or thinkables, it was always the business of those pretending to civilisation to have found, reasoned out, and applied to all things alike. Ancient nations do seem to have attempted this; and at least one of the earliest, the Babylonians, evolved alike for all reckonings, something far better than "Theta Phi's" duodecimals—namely, the rising by alternate steps of 10 and 6, making the repeated base really 60, their mode having survived till now in our time-units, and those of angles and arcs. But they had plainly "Theta Phi's" delusive notion of unifying or confounding simple and compound arithmetic into one, that is neither this nor that; and decimals at length drowned their sexagesimals. Now the whole problem of this best-table inventing, or division-finding, will turn on getting into the system as many as may be of a certain set of numbers that I exemplified to you before, but have never seen elsewhere given. One may call them "meristic," implying superlatively divisible, or having the most possible aliquot parts:—

Meristic No.			Divisors.
$4 = 2^2$	....	has	1
$6 = 2.3$	....	has	2
$12 = 2^2 3$	....	has	4
$24 = 2^3 3$	....	has	6
$36 = 2^2 3^2$	....	has	7
$48 = 2^4 3$	....	has	8
$60 = 2^2 3.5$	....	„	10
$120 = 2^3 3.5$	....	„	14
$180 = 2^2 3^2 5$	....	„	16
$240 = 2^4 3.5$	....	„	18
$360 = 2^3 3^2 5$	....	„	22
$720 = 2^4 3^2 5$	....	„	28
$840 = 2^3 3.5.7$	....	„	30
$1260 = 2^2 3^2 5.7$	....	„	34
$1680 = 2^4 3.5.7$	....	„	38
$2520 = 2^3 3^2 5.7$	....	„	46
$5040 = 2^4 3^2 5.7$	....	„	58
$7560 = 2^3 3^3 5.7$	....	„	62
$10080 = 2^5 3^2 5.7$	....	„	70
$15120 = 2^4 3^3 5.7$	....	„	78
$20160 = 2^6 3^2 5.7$	....	„	82
$25200 = 2^4 3^2 5^2 7$	....	„	88
$27720 - 2^3 3^2 5.7.11$	....	„	94
$45360 = 2^4 3^4 5.7$	....	„	98
$55440 = 2^4 3^2 5.7.11$	....	„	118
$83160 = 2^3 3^3 5.7.11$	....	„	126
$110880 = 2^5 3^2 5.7.11$	....	„	142
$166320 = 2^4 3^3 5.7.11$	....	„	158
$221760 = 2^6 3^2 5.7.11$	....	„	166
$277200 = 2^4 3^2 5^2 7.11$	....	„	178
$332640 = 2^5 3^3 5.7.11$	....	„	190
$498960 = 2^4 3^4 5.7.11$	....	„	198
$665280 = 2^6 3^3 5.7.11$	....	„	222
$720720 = 2^4 3^2 5.7.11.13$	....	has	[illegible]

are the first 34 numbers with this property ch has more divisors than any number below u see that only two of them, 4 and 36, have number, because these alone are squares; :cept these, no meristic can be any exact They have to be all deduced successively ıe beginning, there seeming no way to dis- ny such number till we know the next under ich can never be under its half. There can five of these that share with number 2 the :y of being each more divisible than any its double. The six only numbers with this are:

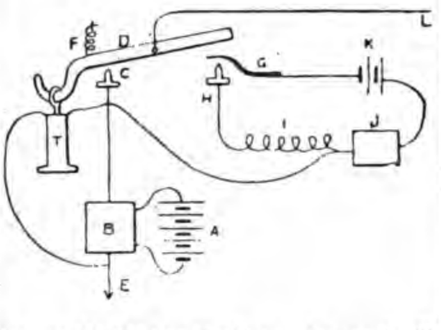
2 6 12 60 360 2520.

to the ratio between 7 and 11 being greater between any two successive primes above here is no number above 2520 needing to bled before gaining additional divisors; 0 × 11 gives 27720 with the unique property over 2520) of gaining none when augmented alf. It has to be augmented as 11 to 18 in the next, 45360. Among these pre- t metric numbers, you see we find that of n a pound (but not of cents. in a dollar or a on)—that of Fahr. degrees between freez- d boiling (but not Reaumur or Celsius); also the old Babylonian units, and those ng in troy weight (not avoirdupois), and the number of inches in seven furlongs would, therefore, be better than 8 as our length unit). Our "long-measure" table, y one of ours that adds to the three simplest actors, 2, 3, and 5, skips the 7 to go to 11— rdity. But Russia and Sweden have agreed nmon standard with this measure (so that ee Powers holding the Arctic Circle set the example now of having commensurable and Russia adds the factor 7 in her table, r besides our 11 I know not. Our "avoir- " weight keeps the greater absurdity of but the factors 2 and 7; and the inter- 3 and 5 might be supplied by simply g its pound into one ounce less than we do. things ought to follow an identical well- l table; and one better than any extant result by merely making the lowest three 72, 8, and 1. Still better might the lowest as 504, 56, 7, and 1. I believe it was by ccident that the highest English coin ever had the value of 2520 half-pence, which are lly the lowest in use. What a rare oppor- lost! Now let me give "Theta Phi" one eason for liking my fingers. Every meristic beyond those in the above table, he will ust be a multiple of 7, 11, and 13, conse- of 1001 (a decidedly handier multiplier e pounds in our ton, or even cwt.). But 1 must be, in his notation, 6*p*5 (six gross, dozen, and five), and I wish him to com- s dealing with that in calculation, as well ds, with the present "thousand and one." se, he has proceeded far with his logarithm base 12, and I should like to see the first figures of the log. 2 beside our present 0. Another constant much wanted, our has these five figures quarterable, thirdable, wn to twenty-fourthable; but in his nota- e first five, 3·1849, are not a seventh so near th, and represent a value, in our notation whose aliquot parts I should like to see.

G.

5.]—**Pitch of Propeller.**—The pitch of a ropeller depends on so great a variety of s and circumstances that it is quite difficult ent a rule that will guarantee its capacity to ct letter; but the following is the rule given d's book:—Take a lath from the stern-post, t it just touching the leading edge of blade, ribe the lath and blade; shift it to the fol- edge at a point on the blade exactly e where the first pop was put; scribe the nd lath again. The distance between the on the lath is piece of the pitch; on the piece of the thread. Square each of these, btract one result from the other. Now ex- quare root of remainder, and this will give f circumference; take the circumference of peller at the place where the measurements ken, and make a proportion as follows:— e of pitch : whole circumference : : piece of whole pitch : answer.—F. R. S.

6.]—**Microphone Coil and Telephone.** E. M.," I think, will find this arrangement ections suit him as well as any. Instead nduction coil, a magnetic coil I is used, the ce of which is proportioned to that of the one and the number of cells used. J, one; K, the speaking battery; G, spring connection with H when the telephone is f the hook; D, lever for carrying the tele- F, spiral spring; B, call-bell and key; A, ttery; L, line; E, earth. The station at r end is connected up similarly, and it will that when the telephone is off the hook, the c coil for incoming currents is shunted by ophone and battery, and this constitutes its greatest advantage. Telephones without permanent magnets may be used, and on short lines



they may be of a lower resistance than usual.—W. HABGOOD.

[62350.]—**Dead-Black on Brass.**—If you hear of nothing better, try the following: Polish your brass, and apply mixture of nitrate of tin and chloride of gold. Leave this on some time, and then wash the brass. Have your mixture acid.—HENDON.

[62395.]—**Siemens-Alteneck Dynamo.**—TO MR. BOTTONE.—Thanks for your advice. I did as you told—viz., connected the dynamo up for shunt; but I could not get any current. I tried in many different ways: by putting little and much resistance in outside circuit—by adding a bichromate battery; but all was useless. Will you kindly tell me what you think might be wrong with it?—HOLLAND.

[62406.]—**Pulleys Slipping.**—What does Mr. Bull mean by linseed-oil varnish? However, his linseed-oil will surely dry some time or the other, and then he will probably take the better advice which has been frequently given in these columns, and dress his belts with castor-oil. If a belt that has been dressed with castor-oil will not run well and last, it certainly will not when dressed with any other preparation.—SAML. RAY.

[62406.]—**Pulleys.**—I am greatly obliged for the information kindly given by various correspondents, and especially Mr. W. G. Bull, who rightly concludes that I am trying to get my "Leval" up to a proper speed; his hints and suggestions are most valuable. I purchased this machine, intending to drive it at 5,500 revolutions per minute with a horse gear, at which speed the makers state it should separate 40 gallons of milk per hour; but I find that at that speed it leaves at least 3 per cent. of cream on the milk, so that I presume it will not skim clean at a lower speed than 6,000, but would be glad of further information on that point. Since writing, I tried to get up the speed by adding an additional spur wheel and pinion to the horse gear, and driving the intermediate off a 7in. pulley going at 360 revolutions. I found two horses could hardly drive, so must resort once more to the large pulley and slow speed, and try to get rid of the slip as best I can. Would Mr. Bull kindly say if he found the note of his separator by experiment? I should think the note is produced by the air impinging upon the open end of the skim milk tube at the mouth of the bowl, and that any slight alteration in its shape would alter the tone; nevertheless, the tuning-fork idea is excellent. Would Mr. B. kindly say if he has found a round leather belt better than the endless rope supplied by the makers? Would he also say what he means by linseed-oil varnish? The best method of driving these high-speed machines (which must soon come into common use with farmers) with the least loss of power, especially when horse-power is used, is one upon which many of "ours" could give valuable information. N. J. Fjord, in his report upon the Inval and Petersen machine, states that one horse working in an ordinary mill can only drive the Leval at 5,600 revolutions with 255 kgr. of milk passing through per hour, and that a horse only exerts 0·81 of nominal 1H.P. Is this so?—DOCTOR MEDICINÆ.

[62410.]—**Income Tax and Inhabited House Duty (Distraint for).**—TO "B.SC." and "COMMISSIONER."—Thank you. I may be wrong; but my view of the matter is this: The goods were carried away for the satisfaction of the co-called, but purely hypothetical, "expenses" in the name of the Inland Revenue. Now, the I.R. is a State Department, and I apprehend that, in the eyes of all Departments of State, all citizens are equal, and that whatever immunities may be granted by them to one person, the same can, if the circumstances are similar, be naturally and legally claimed by another. I know of cases, in the same town, where these "expenses" have been waived, although the justification for doing so was far inferior to what it would have been in my own—and that, too, to the collector's full knowledge. It is, no doubt, the fact that the I.R. knows nothing about my matter. They received my taxes in due time, and that is all they know of me. Nevertheless, the execution was carried out, in their name, after they had received those lawful imposts, and I consider I am entitled to the same immunity as anyone else, and should like to be put in the way of claiming it, and of securing the restitution of my furniture on the grounds stated. VICTIM.

[62418.]—**Wood-Boring.**—Fit your back-poppet with a disc instead of the pointed centre, and if your wood is very hard, use a half-round boring bit, held in chuck, bringing up your blocks by means of back-poppet. For moderately hard wood a shell auger would do, and for soft wood use a twisted auger with a plain point, not a screw. If your blocks can be chucked at all, it is more satisfactory to make them turn whilst the boring tool advances than to make the boring tool revolve.—HENDON.

[62421.]—**Printing.**—I have got a splendid black tone by using borax. The solution is as follows: 4·0 grains of borax; 1 grain of chloride of gold; 8oz. of water. Mix, and let it stand an hour before using.—W. JACKSON, M.

[62422.]—**Mechanics.**—The work done by the engine is equal to mean pull × 300 seconds $\times \left(\frac{44+0}{2}\right)$ feet, 44 being the number of feet travelled over in a second. This work has to overcome the frictional resistances of the train, and to impart to the same a certain amount of kinetic energy. The latter sum can be written:—

$$\frac{2240\text{lb.} \times 150 \text{ tons} \times 44^2}{64} + 150 \times 10\text{lb.} \times 300 \left(\frac{44+0}{2}\right)$$

The above expression must be equal to the work done by the engine. Therefore, we can write, X being the mean pull—

$$\frac{2240 \times 150 \times 1936}{64} + 1500 \times 10 \times 300 \times \frac{44}{2} = X\, 300 \times \frac{44}{2}$$

$$\text{Hence} \qquad X = \frac{200640}{66} = 3040\text{lb.}$$

The above method simply consists in writing that the work done by the engine is equal to that of the train resistances + that necessary to overcome the inertia of the train; but 10lb. is too small a resistance.—E. GOBERT, 7, Ducie-street, Longsight, Manchester.

[62425.]—**Electrical Tricycle.**—All vehicles propelled by other than animal power come under the Highway and Locomotives Act. A man must precede the machine 20 yards on foot (not necessarily carrying a red flag) to give warning of the approach, speed not to exceed two miles in town or village, or four miles in open country. In addition to the statute, the county and borough authorities have power to make by-laws regulating the hours during which such vehicles may be upon the highway, &c. A licence also will be required, costing £10.—G. H. D.

[62426.]—**Valve Gearing.**—"T. C., Bristol," would make it appear to be dangerous to reverse an engine whilst in motion. To prevent a false impression, I beg to say that I have reversed engines in motion thousands of times; also "notched up" with full steam on, and never had any mishap.—G. H. D.

[62426.]—**Valve Gearing.**—The point of suspension of the link moving on an arc of circle, and the valve-rod being, in most cases, guided so as to move in a straight line, the link must, of course, slip on the block. This is what is called relative slip of the block. Its magnitude is affected to some extent by the dimensions of the valve-gear and the mode of suspension of the link. For a proper study of this subject, consult Auchincloss's treatise on valve-gears and link motions, published by Van Nostrand, of New York. It is a splendid book on the subject. Zeuner's treatise is also a capital book, but requires a knowledge of the higher mathematics. I think these books can be got at E. & F. N. Spon's, in London.—E. GOBERT.

[62434.]—**Painting Roofs.**—Molesworth says: One gallon of paint will cover 50 to 70 superficial yards of wood, or, in feet, 450ft. to 630ft. The gallon made up of 6 pints raw linseed oil, 1 pint boiled oil, 1 pint turpentine, and 12lb. to 14lb. dry paint.—HENDON.

[62439.]—**Electrical Business.**—Yes, ordinary galvanised iron wire would do for the line, and earth for the return, if you have plenty of battery power at your disposal; but, then, you can get 40 yards of s.c. copper wire for a few shillings, which would be better in every respect for that short distance.—W. JACKSON, M.

[62440.]—**Power of Telescope.**—To find the distance to which any celestial body will be apparently reduced by any given magnifying power, divide its actual distance by the magnifying power. Thus, a power of 100 will bring the moon to within apparently 2,400 miles of the observer. This is theoretical. Practically, atmospheric and instrumental imperfections render the view much less perfect than it would be to the naked eye at an equivalent distance. For example, a power of 40 increases Jupiter's apparent size to about that of the moon's disc as seen from the earth; but could we be transported in space to where Jupiter would appear that size without instrumental aid, we should probably see much more of his surface with the naked eye than any telescope magnifying 40 will now show us.—ARTHUR MEE.

[62441.]—**Luminous Paint.**—I think that "Solar Radiance" will find that, if he thoroughly moistens the paint in cold water, and then raises the temperature to nearly boiling heat, stirring all the time, he will obtain a viscid material which he can treat like ordinary paint, and which will adhere to most surfaces. There is very frequently starch mixed with the Balmain powder, hence the above mode of treatment which I have suggested. —PI.

[62441.]—**Luminous Paint.**—I think Mr. Hart must have reversed the processes in his reply on p. 302. Full directions can be obtained from Mr. Horne, the agent, 6, Dowgate-hill, E.C.; but I do not think they will be found to advise the use of a neutral base after the application of the luminous paint. The neutral base, as its name suggests, should be applied first, then the luminous paint, and subsequently the over-varnish. The querist has, however, obtained some other preparation than Balmain's well-known paint, and might surely apply to those who sell it to tell him how to use it.—SAML. RAY.

[62443.]—**Acute Asthma.**—I have seen wonderful relief given by the "Queensland Asthma Cure" (Euphorbia pilulifera); the plant can be procured in a dry state from any large druggist at about 8d. per oz. One ounce in two quarts water, boiled down to one quart, and a wineglassful taken thrice a day.—TUKANG BESI.

[62443.]—**Acute Spasmodic Asthma.**—I desire to express my thanks to the gentlemen who have been kind enough to assist me with their views upon this case. "Dens," "B.Sc.," and S. Bottone lay particular stress upon the necessity of at at once restoring the power of proper mastication by means of artificial teeth, and I entirely agree with them, although it is a point which the regular medical attendant has hitherto entirely overlooked; but I am also quite agreed with Dr. Mitchell when he expresses the opinion that the lady's emaciation arises, to a great extent, at any rate, physiologically, from defective gastric power. The case, however, has no hereditary root, and I called it "acute spasmodic asthma" because it has been so defined by the usual medical adviser, and, certainly, the paroxysms do occur very suddenly, and frequently without much, if any, premonitory symptoms. Espic's cigarettes have been used; but have not afforded as much relief as the powder named. All the advice so kindly given is receiving the most grateful consideration.—COSMOPOLITAN.

[62444.]—**Bills of Sale.**—I am much obliged by the replies of Mr. Wetherfield and "B.Sc., Plymouth," to my query under this head. Would they kindly add to my obligation by saying whether, in cases where re-registration is not kept up, the Statute of Limitations could creep in between holders and their securities after six years from the dates of last re-registrations of similar documents.—IGNORAMUS.

[62447.]—**The Bansoolah.**—Though the query is not addressed to me, I take the liberty of informing "Anglo-Celtic" that if he really wants such an implement, he may obtain a much better thing in the shape of a "hand-adze" from any dealer in tools. The article is manufactured in Sheffield, for export chiefly, and is illustrated in Shelley's text-book.—HENDON.

[62451.]—**Chemical.**—Perhaps the following will answer your purpose: Dissolve copper in nitric acid until the acid will take up no more. Dip your articles in this wash, and heat them over a clear fire. Repeat this process until they are black.—HENDON.

[62453.]—**Natural Philosophy.**—Let n = number of vibrations corresponding to the successive fifths. r the diameter, l the length of the string, t the tension, d the density, then

$$n = \frac{1}{rl}\sqrt{\frac{t}{d}}$$

In this case, as $l = 1$, $d = 1$,

$$n = \frac{1}{r}\sqrt{t}; \text{ whence}$$
$$t = (n\,r)^2.$$

If a, b, c, d = number of vibrations per second of *the strings*, whose respective diameters are 1, 1·5, 2·5, and 3, and let the tension on the string a be one, then

$$(a \times 1)^2 : (b \times 1{\cdot}5)^2 :: 1$$
$$(a \times 1)^2 : (c \times 2{\cdot}5)^2 :: 1$$
$$(a \times 1)^2 : (d \times 3)^2 :: 1$$

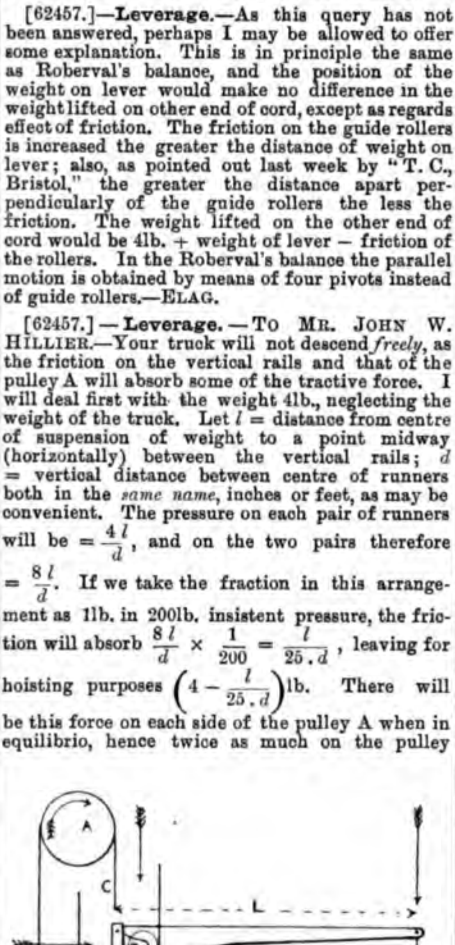
If I interpret the meaning of successive fifths rightly, the number of vibrations per second will be (starting with the key-note as 24) 64, 40, 24, 15. Let s equal the specific heat of the copper, then 556 $(95^\circ - 24)\,s$ is the amount of heat in calorics given out by the copper ball, and $(125\,s + 400)$ $(24^\circ - 15^\circ)$ is the amount of heat gained by the water and calorimeter, these two amounts being equal.

$$\therefore 556\,(95^\circ\ 24^\circ)\,s = (125\,s + 400)\,(24^\circ - 15^\circ)$$
$$39476\,s = 1125\,s + 3600$$
$$39476\,s - 1125\,s = 3600$$
$$38351\,s = 3600$$
$$s = \frac{3600}{38351} = 0{\cdot}09387 \text{ nearly.}$$

I would recommend "J. B." to get C. J. Woodward's "Arithmetical Physics," Part I.A, published Simpkin, Marshall, and Co., price 2s.—S. R. C.

[62457.]—**Leverage.**—As this query has not been answered, perhaps I may be allowed to offer some explanation. This is in principle the same as Roberval's balance, and the position of the weight on lever would make no difference in the weight lifted on other end of cord, except as regards effect of friction. The friction on the guide rollers is increased the greater the distance of weight on lever; also, as pointed out last week by "T. C., Bristol," the greater the distance apart perpendicularly of the guide rollers the less the friction. The weight lifted on the other end of cord would be 4lb. + weight of lever − friction of the rollers. In the Roberval's balance the parallel motion is obtained by means of four pivots instead of guide rollers.—ELAG.

[62457.]—**Leverage.**—TO MR. JOHN W. HILLIER.—Your truck will not descend *freely*, as the friction on the vertical rails and that of the pulley A will absorb some of the tractive force. I will deal first with the weight 4lb., neglecting the weight of the truck. Let l = distance from centre of suspension of weight to a point midway (horizontally) between the vertical rails; d = vertical distance between centre of runners both in the *same name*, inches or feet, as may be convenient. The pressure on each pair of runners will be $= \frac{4\,l}{d}$, and on the two pairs therefore $= \frac{8\,l}{d}$. If we take the fraction in this arrangement as 1lb. in 200lb. insistent pressure, the friction will absorb $\frac{8\,l}{d} \times \frac{1}{200} = \frac{l}{25\,.\,d}$, leaving for hoisting purposes $\left(4 - \frac{l}{25\,.\,d}\right)$lb. There will be this force on each side of the pulley A when in equilibrio, hence twice as much on the pulley bearing. The coefficient of friction for the pulley may be taken (if well lubricated) as 0·1; hence the friction of pulley will be $2\left(4 - \frac{l}{25\,.\,d}\right) \times 0{\cdot}1 = 0{\cdot}8 - \frac{l}{125\,.\,d}$. If R = radius of pulley, A and r = the radius of its bearing, the force on the rope C requisite to equal the pulley friction will be $= \frac{R}{r}\left(0{\cdot}8 - \frac{l}{125\,.\,d}\right)$. For example, let l = 12in., d = 4in., R = 12in., and r = 0·75in.; then the weight required at W to *balance* the 4lb. as shown will be $W = 4 - \frac{l}{25\,.\,d} - \frac{r}{R}\left\{0{\cdot}8 - \frac{l}{125\,.\,d}\right\} = 4 - \frac{12}{25 \times 4} - \frac{0{\cdot}75}{12}\left(0{\cdot}8 - \frac{12}{125 \times 4}\right) = 3{\cdot}8321\text{lb.}$ The weight hoisted would be less than this according to the *speed* at which it is raised. To find the effect of the weight of the truck, &c., proceed in the same way, but replace l by the distance from the vertical rails to *centre of gravity* of truck a —FRANCIS CAMPIN.



[62459.]—**Clock Pendulum.**—You invented in a crude form Ellicott's pendul cerning which, and the reasons for its failure, you had best consult Beckett's "Clocks." There, too, you will find wha other requirements of a good pendulum, fear your design very imperfectly sa W. A. S. B.

[62461.]—**Sour Yeast.**—If you boil yo you will destroy its power of exciting ferme Scalding it will have a like effect, but n same extent. Yeast, when in an active c always exhibits a slight acid reaction. roughly washed it is much less active, bu dition of a minute quantity of acetic or acid will restore its power. A large qua acid arrests fermentation.—SM.

[62463.]—**Registration.**—There is thing as registering an association merely sake of protection against infringem "Tillett" wishes to form an association u Companies Acts, 1862-80, let him purch brook's "Law and Practice of Joint-Sto panies," 2s. 6d., published by Harrison a Pall Mall.—B.SC., Plymouth.

[62465.]—**Solidified Oil.**—Both quer most indefinite, and I am almost at a loss t stand fully what is required. How can which has been solidified by exposure to cold be used in the ordinary manner at the temperature? Is it not how to make thick "blown oils," which are also known by th "oxidised oils," "base oils," &c., that is re These are a class of oils which have du last few years been introduced into comm lubricating land and marine engines, an heavy machinery. These oils are obtai blowing a current of air through such fatt cottonseed, rape, linseed, lard, &c. The heated to a certain initial temperature in start the reaction, after which it is disco as the heat produced by the oxidisation sufficient to maintain the oils at the temp required. If this is not what Mr. M. B requires, if he will be a little more definit query, and give me fuller details, I shall pleased to give him any other information require.—HENRY J. HARDY, F.C.S., She

[62466.]—**Tin Alloy—Melting Gold.**— crystals of saltpetre dropped into the c when the metal is fused will generally rem dross; failing that, a little bichloride of m —OS.

[62467.]—**Essex Chuck**—I bought one three years ago, with two sets of jaws, fr Britannia Company. I have used no lathe much as this; it has been worked for hou time, yet it is as strong and serviceable as e conclude your metal is at fault, and will n the pinch of screwing up on drill.—EOS.

[62469.]—**Telegraph Lines.**—Mr. Preece read a paper on "Fifty Years of Tele before the Society of Arts on May 18th. been copied into *The Electrician* for May 2 27th. Has Mr. Hart seen this? I have n it, being pressed for time; but it might give information as to what he wishes to k ELECTRICIAN.

[62470.]—**Wheels without Flanges.** quirer" asks whether certain locomotives no flanges upon the middle pair of wheels, of getting off the rails, it is as safe as with wheels? The answer is, Certainly; when rails, it can make no difference whatever. are plenty of locomotives of the six-wheel which the centre pair are without flanges; are useless in such a position.—NUN. DOR.

[62470.]—**Wheels without Flange** plan of having no flanges upon the middle wheels is very old indeed, having been int by George Stephenson. I presume the engi to New South Wales must have to run ov very sharp curves, and that no flanges are the middle wheels in order to assist in round such curves. I am not in favour of without flanges; indeed, I may say they a dangerous if the leading axle should brea sharp curves it is far better to adopt the An system, and place two bogies under the ten CLEMENT E. STRETTON.

[62471.]—**Railway Query.**—At the brake trials the friction of carriages was f be 9lb. per ton = 0·40 per cent. of the gross of the carriages and vans. With vehicles i order, and the axles running in oil, 8lb. would be the force necessary to move a carriages on the level. If "Loco" will g length of train and its weight, I may be give some further information upon the su CLEMENT E. STRETTON.

[62471.]—**Brakes.**—The Westinghouse

ipe is 1in. diameter, and the vacuum brake-pipe 2in. diameter. It therefore follows that the con- ɜnt of the vacuum pipe is four times greater than hat of the Westinghouse. I am aware that Mr. Kiernan, in a recent lecture at Manchester, ex- ressed a contrary opinion; but the question is one f fact, not of argument.—CLEMENT E. STRET- ON, Consulting Engineer Amalgamated Society of ailway Servants, 306, City-road, E.C.

[62472.]—**Brakes.**—The contents of the West- nghouse train pipe are: $400 \times \frac{1}{12^2} \times \cdot7854$ = 2·181c.ft., or 3770c.in. The diameter of the acuum pipe being double that of the Westing- ouse, the contents of the former are, of course, our times those of the latter for the same length. Therefore, the volume of air contained in the rain pipe under the atmospheric pressure is × 2·181 = 8·724c.ft., or 15,080c.in. This shows lainly that the contents of both pipes are not qual; but I think that the lecturer would mean hat under normal working conditions the volume f air to be withdrawn from the Westinghouse ipe to put the brakes full on is greater than that dmitted in the vacuum pipe to produce the same esult. In fact, with 75lb. effective pressure, there re in the Westinghouse pipe 11c.ft. of air, nearly; whereas with a 24in. vacuum, in the larger pipe the air left therein occupies 1·748c.ft. under the tmospheric pressure—that is to say, to put the vacuum brake fully on, we have only to admit in the main pipe only 7c.ft. of air under the atmo- spheric pressure. But this is nothing in favour of the automatic vacuum brake, as I am going to prove; it does not render it at all quicker in action. The velocity of air escaping under 75lb. pressure into the ambient atmosphere is 267ft. per second; the last and all carriages would be braked fully in a time equal to $\frac{400}{267} = 1·5$ second. This s certainly below the results obtained in prac- tice, as we did not take into account the numerous bends of the pipe and the de- reasing pressure of the escaping air. Now, lthough the diameter of the vacuum pipe is much larger than that of the Westinghouse, and hat, in consequence thereof the friction is greatly educed, we find that the velocity of the atmo- pheric air rushing into the 24in. vacuum is only 50ft. per second. The time in which the last car- age of the vacuum train will be braked with full orce will be $\frac{400}{150} = 2·66$ seconds. This result is ost decidedly below those found in practice for e same reason as stated above. But in the case the automatic vacuum brake there is another ery important one which cannot be disputed—it the well-known fact that the spaces under the orking side of the pistons have also to be filled p with air. The additional quantity of air to be pplied for this purpose cannot be left out of onsideration. The length of a carriage piping eing on the average 25ft., there would be in the ain in question sixteen carriages. Admitting at the diameter of the vacuum brake pistons is in., and that they have not a stroke greater than in., then the additional quantity of air to be sup- lied is—

$$\tfrac{4}{5} \times 16^3 \times 3 \times \cdot7854 = 7718\text{c.in.},$$

hich, added to those of the main pipe, give then 2,798c.in., or 13·2c.ft. The time required in tting the brakes fully on would then be cor- ectly—

$$\frac{13·2}{150 \times \cdot7854 \times 1/6^2} = 4 \text{ seconds.}$$

his result shows that the capacity of the space ft under the pistons cannot be neglected. urthermore, it must not be forgotten that we ave not again taken into account the resistance aused by the bends in the pipe. It has been ound experimentally that on a North-Eastern ailway train composed of thirteen carriages fitted ith the Westinghouse brake, the thirteenth arriage was fully braked 3½ seconds after the andle of the driver's brake valve had been moved n. Admitting that the time is proportional to the umber of carriages, we should have for the six- een 4·3 seconds as the time required to brake the hole train. It is nearly three times the theoretical alue found above; but when we come to the imple vacuum brake, we find that in the experi- ents referred to the brake was never fully on he thirteenth carriage. Let us hope that this is ot the case with the automatic vacuum brake; ut it is certain that it will require over 4 seconds efore the last vehicle gets fully braked. Experi- ental data on this point are wanting. In calcu- ting the speed of the air under the two pressures, hich are supposed to be the usual working pres- ures of the two brakes, I made use of the follow- g formula:—

$$v = \sqrt{\frac{266·76 \,.\, P\,D}{(0·0238\,L + D)\,d}}$$

v = velocity of the gas.
P = effective pressure.
D = diameter of the pipe.
L = its length.
d = the density of the gas; air in this case ·0238 D'Aubuisson's resistance coefficient in the case of a straight pipe.

The above formula supposes all data given in metric measurements; but the conversion into English units is not difficult. In the case of the vacuum, we are far off the seven miles a minute its supporters boast off. It will also be noted that I made a reasonable allowance for the vacuum brake, as I took 24in. vacuum to be the usual degree of rarefaction of air in the main pipe; 20in. are generally maintained in daily working. However difficult the proper theoretical solution of these points may be, I nevertheless think I have proved beyond doubt the inferiority of automatic vacuum brakes as far as quickness of action is concerned. The speeds of the air in the two brakes are in the ratio of 1 to 1·78, and the times of application as 1 to 2⅔. Thus the automatic vacuum brake does not gain anything over the Westinghouse air-pressure by having a lesser quantity of air to let in the main pipe to put the brakes fully on. It must not be forgotten, however, that a reduction of 25lb. in the Westinghouse main pipe sets the brakes fully on; this is also a great saving of air and time, which the automatic vacuum does not present.—E. GOBERT, Longsight, Manchester.

[62473.]—**Engine Query.**—I presume you mean boiler pressure when you say "initial pressure," as it is a compound engine; if so, the total pressure above a vacuum is 75lb. Taking it at 75lb., terminal pressure in h.p. cylinder is $\frac{3}{7}$ of 75 = 32lb., which is also initial pressure in l.p. cylinder less loss in filling pipes and clearance, which reduces it to perhaps 25lb. If admitted to large cylinder throughout the stroke the terminal pressure in that will be ⅓ of 25lb. (as the areas of cylinders are as 1 : 3)—say, 8lb. The back pressure in h.p. cylinder ranges between this 25lb. and 8lb. (probably 17lb.), and as the average pressure on other side of h.p. piston is nearly 57lb., the average pressure effective = 57 – 17 – 40lb. Similarly, in l.p. cylinder average pressure = 10lb., and back pressure 2lb., or effective as 8lb. The cut-off appears very early for this pressure. Valve to l.p. cylinder has some amount of lap so as to cut off at —say ¾ to ⅞; slide-valve also has lap when cut-off valve is used. From above, I make I.H.P. to be about 680; but, of course, cards are necessary to know exactly.—T. C., Bristol.

[62474.]—**Foul Zincs.**—Use the chromic acid solution frequently mentioned in these columns.—Os.

[62474.]—**Foul Zincs.**—The zincs of bichromate cells should not "become coated with a hard red deposit." Use more acid, about one-seventh, and amalgamate the zincs from time to time.—SM.

[62474.]—**Foul Zincs.**—The red deposit is mercury chromate. Under certain circumstances this forms very rapidly on the zinc plates of bichromate cells. Amalgamation is of very little use in this class of battery.—S. BOTTONE.

[62474.]—**Foul Zincs.**—The crystals noticed are "chromic alum." If you substitute hydrochloric acid for the sulphuric acid in your solution there will be no crystallisation, and the solution may be more completely used up. I would never think of using sulphuric acid now I have tried hydrochloric acid. The solution may be prepared according to "Sprague." Equal parts cold saturated bichromate of potash and of hydrochloric acid.—ELAG.

[62474.]—**Foul Zincs.**—The red crust is a chromate of mercury of the formula $CrO(Hg_2O_2)''Hg_2O''$, which is insoluble in the solution. This is an inherent fault in all cells in which the chromic acid comes in contact with the zinc, which *must* be amalgamated to reduce local action. Again, zinc reduces chromic acid, and so wastes it. The chromate of mercury offers a high resistance, and is one of the causes why single-fluid bichromate cells so soon lose power. The only remedy is to use the two-fluid type, which is four times less costly to use.—ELECTRICIAN.

[62474.]—**Foul Zincs.**—The red, or rather reddish-purple, deposit on the zincs of the bichromate cells "Principia" speaks of, and which is difficult of removal, consists of potassium chrome alum formed by the reduction of the potassium bichromate in the presence of sulphuric acid. It is tolerably easy of solution in water, so by placing the zincs in water, preferably hot, it will soon be dissolved off. The zincs can then be cleaned by placing them in a little dilute sulphuric acid and re-amalgamating.—HENRY J. HARDY, F.C.S., Sheffield.

[62475.]—**Stearine Refining.**—Pure stearine is obtained from mutton suet or tallow by mixing the fused fat with six times its bulk of ether, and subjecting the mass to great pressure (when cold), to remove the fluid constituents of the fat. By repeated crystallisation from ether, it may be obtained free from margarine. From stearine stearic acid may be obtained by saponification with potash, and decomposing the soap with hot hydrochloric acid. Washing the precipitate in cold alcohol, redissolving it in hot alcohol, and allowing to crystallise completes the process. A very exhaustive account of the mode adopted in commerce for the purification of stearine will be found in Muspratt's "Chemistry," under the heading "Candle," p. 429.—S. BOTTONE.

[62476.]—**Microscopic Turntable.**—You will find the instrument described perfectly trustworthy, except in one point—that is, if the cement with which the cell is formed be too liquid, it is apt to spatter through centrifugal tendency. The same arrangement, with the modification of making the brush a fixture and the table rotary, removes all objections. I have made one out of the tin lid of a coffee canister, 3in. in diameter, with a tin tube soldered in its inside to serve as a pivot to turn upon, the other portion being filled in with plaster of Paris, to give it sufficient weight. The whole can be made for 1s. 2d.—S. BOTTONE.

[62477.]—**Wimshurst Machine.**—You will find a thorough description of the mode of constructing a Wimshurst machine, with sketches to illustrate the text, at p. 100, No. 1,123, Vol. XLIV., of the ENGLISH MECHANIC. Substituting paraffined mill-board, or preferably pasteboard made of good brown paper carefully and heavily paraffined, for the glass discs, you will get good results.—S. BOTTONE.

[62477.]—**Wimshurst Machine.**—It seems to me that M. Isador will not find any better form for his machine than that so fully described in your issue of Nov. 14th, 1884, p. 242. He will, I think, find the material known as dermatine simpler and better for his use than paraffin cardboard; or let him try guttapercha. In the letter of last week, 27283, the friction caused by the rubbing of the discs together is noticed as a feature, which, of course, must become fatal to the use of any material which permits the rubbing; but the experiment is, nevertheless, useful, for it indicates so certainly the difference of the electrical potential upon the inner surfaces of the discs at the several parts, and affords data in support of the theory. For the benefit of your readers I may say that flexible discs are strongly attracted together at the top and the bottom, and that they are repelled at the horizontal line. I used the stiffest quality of dermatine which the company could produce, and then drove at a velocity of 3,000 revolutions per minute; nevertheless, failed to prevent the rubbing together. I shall be pleased to learn the results of any further experiments.—J. W.

[62480 and 62486.]—**Dynamo Design.**—Allowing about 1 yard per volt, let the diameter of the armature be such that the length of wire you are going to use shall wind it all round at not more than three layers deep. The depth of the armature core will vary somewhat with the type of machine; but it should be a trifle less than the diameter in the Gramme form, rather more in the Mather-Platt form, and twice as long in the Siemens pattern. The pole-pieces, field-magnets, and yokes of dynamos should weigh at least ten times the armature. Having found what quantity of wire will give 80 volts (somewhere about 80 yards), it is easy to find what wire to use for plating, &c. For plating you need only 3 or 4 volts, so that a wire of 4 yards long (on the same machine) will give sufficient E.M.F. But it must be twenty times as thick if it has to carry the larger current. The exact relative proportions for series and shunt-winding have been given at p. 184, No. 1,152, April 22, of the ENGLISH MECHANIC. See also Thompson's "Dynamo-Electric Machinery."—S. BOTTONE.

[62482.]—**Driving Mill Stones.**—If you only intend to drive one pair of stones, use the 3ft. 11½in. pulley with a 4in. single belt; but if more than one pair, then use the larger wheel. You must put same size wheel on lay-shaft as you use on engine, if you run engine at 86 revs. a minute. "Nominal horse-power" all nonsense; but nominally the engine is of 11H.P. If worked at 60lb. and cut off at ¾-stroke it will indicate 26H.P. As this is too much for you, you will reduce at the valve, but keep pressure up.—T. C., Bristol.

[62484.]—**Coil Core.**—Iron wire is used in preference to a solid core because it is so much easier to get pure soft iron wire than pure soft iron rod; also because the bundle of wires acquires and loses magnetism much more rapidly, or has much less "coercive force." If you put a metal tube over the iron bundle, you get little or no inductive effect. The iron bundle without the metal sheath will give a far more powerful effect.—S. BOTTONE.

[62484.]—**Coil Core.**—It would certainly strengthen your coil to use a bundle of iron wires alone without any tube. The bundle is capable of being magnetised and demagnetised more completely and rapidly than a solid piece of iron. If the coil is for medical purposes, a tube of brass, which can slide over the core, is used to regulate the strength; but if it be an induction coil with a condenser, then full strength is wanted, and a tube would be detrimental. If the querist wishes the iron bundle to be well bound up he should use tape.—BOBADIL.

[62487.]—**Action from Dry Plates.**—The best way to find if dry plates will give electrical action would be to try it with a sensitive galvanometer. An ordinary compass, with two or three turns of fine wire wound over and under the needle, makes a very sensitive instrument for detecting the presence of a current. I, for one, doubt very much if any action will result unless liquid is employed.—BOBADIL.

[62487.] — **Action (Voltaic) from Dry Plates.**—There would be a difference of potential, which could be measured by a quadrant electrometer in the hands of a skilled and careful observer. As air is a very bad conductor, the current would be infinitesimal.—ELECTRICIAN.

[62487.]—**Electrical Action from Dry Plates.**—The mere contact of two dissimilar metals sets up a current. A very delicate "mirror galvanometer" will indicate this. But for practical work this is no use. But if you twist the extremities of a piece of No. 16 German silver wire and No. 16 copper wire together, so as to form a Y, and keep the twisted end warmed with the flame of a small spirit-lamp, you can maintain a steady current (through a small resistance) of about one-tenth of an ampère, and this can easily be read on one of my cheap galvanometers.—S. BOTTONE.

[62488.]— **Fixing Glass-Cloth to Wooden Drum.**—Glue it on. How does querist imagine it is done?—OHMI.

[62488.]—**Fixing Glass-Cloth to Wooden Drum.**—Nothing better than ordinary glue for this purpose.—OS.

[62492.]—**Hot-Air Engine.**—I do not think the 2in. extra stroke would give you more power unless you slightly increased the heater. You would have to experiment to find out the best proportion between heater and cylinder, and you could do this by lighting the fire and turning the engine round by hand when the connecting rod was taken off; then, as the displacer rose and fell, you would see the piston work up and down a certain distance, and you might then make a crank to give that amount of stroke, no matter if it were less than the cylinder would allow. The governor may apply a brake to the flywheel, or it may open a small cock in the heater allowing air to suck in and out. Probably you could regulate sufficiently by hand.—F. A. M.

[62493.]—**Boiler.**—If hemispherical ends were put in, the bursting pressure would run into the thousand pounds per square inch. But discard such a thing for a boiler; it would be more trouble firing than it is worth. If you must use it, do not use a single cylinder larger than 2in. in diameter by 3in. stroke.—T. C., Bristol.

[62495.]—**Photography—Vague Formulæ.**—Should not this querist make a few experiments for himself, and thereby learn something useful? Ten per cent. solution means anything he likes—10oz. in 100oz., or 10lb. in 100lb., and as no special caution is made as to the difference between weighing and measuring, can he not see that it does not matter? Many people make difficulties for themselves because they will not take the preliminary step of "trying."—I. H. J.

[62495.]—**Photography, Vague Formulæ, &c.**—A 10 per cent. solution is one to ten, and your difficulty is easily got over by weighing both the liquid and the solid—i.e., weigh the water, 10oz., and the alum, 1oz., and mix. (2) The exposure depends not only on the focus, but on the aperture of the lens. If the 4in. and 12in. are of the same class, and the aperture of the stops of the same ratio—viz., the 12in. three times the diameter of the 4in.—then the exposure will be exactly the same.—B.SC., Plymouth.

[62495.]—**Photography, Vague Formulæ, &c.**—When a percentage solution is mentioned, it is always understood by weight. Hence, whether you take 10oz. in 100oz., or 10dr. in 100dr., or 10gr. in 100gr., the proportion is always precisely alike. In the case in question, the exact amount of alum in the water is not practically of much moment; but 10gr. of alum in 1oz. of water means 10gr. in 480gr., so that is much weaker than 10 per cent., being nearer 2 per cent. It is impossible to answer your question with regard to the exposure, unless you also mention the aperture used with each lens. Supposing that the apertures in both cases were alike, then, as a lens 12in. in focus would produce a picture nine times as large as one 4in. in focus, the intensity of light would be one-ninth that of the smaller lens; hence nine times the *exposure* would be needed.—S. BOTTONE.

[62495.] — **Photography—Vague Formulæ, &c.**—It does not make any difference whether you make up your solution in ounces, drachms, or grains in the examples you give. It would still be a 10 per cent. solution, only differing in the total quantity of solution. If you take 10 parts water to 1 part chromic alum by weight, it does not matter what weight you make each part. 10 grains in 1oz. water would be about a 2 per cent. solution. With the same size aperture, the exposure necessarily varies as the square of the focal length. Thus, the 12in. focus lens would require from $\frac{12^2 \times 3}{4^2} = \frac{432}{16}$ $= 27$secs. to $\frac{12^2 \times 5}{4^2} = 45$secs. exposure under the same conditions.—ELAG.

[62495.]—**Photography—Vague Formulæ, &c.**—There is nothing vague about a 10 per cent. solution of chrome alum. It means 10 parts of alum in 100 parts of water, and it does not make any difference what unit you use, whether tons or grains. Weigh out ten drachms of alum, and dissolve in a small quantity of the water; then make up that quantity to 100 drachms by weight of water. A drachm (of 60 grains) is troy weight, while a fluid ounce of water weighs an ounce avoirdupois, so that the water must also be weighed with troy weight, and few people have weights large enough for this purpose. In making these solutions, it is far preferable to use the cubic centimètre or gramme measures, as you can then weigh the solids and measure the liquids and still be correct. Get a set of gramme weights from 10 grammes down, and a graduated glass which will indicate 100 gramme measures, a measured cc. or gramme of water also weighs a gramme, so that you can weigh the alum, &c., and then fill up the measure to 100 grammes with water. These weights and measures are not more expensive than the ordinary ones.—OS.

[62495.] — **Photography—Vague Formulæ, &c.**—The term ten per cent. applies to the three examples of solution quoted by "K. G.," all of which are identical. Ten grains in 1oz. of water is 10 grains in 437½ grains of water, or a little over two per cent. Certain weights of the same name in apothecaries', avoirdupois, and troy weight differ very much, but the weight of the grain is the same in all. In photographic formulæ, apothecaries' weight is always implied unless otherwise specified. If "K. G." wishes to be very exact, more than is generally necessary, as considerable latitude is usually allowed, he can take the grain as his unit, remembering that the fluid ounce of water as measured in his graduated glass is the $\frac{1}{20}$th of a pint, and weighs the same as the avoirdupois ounce—namely, 437·5 grains. The glass measure only serves to indicate the quantity of water which weighs 1oz. Other fluids of the same bulk weigh more or less than an ounce, according to their specific gravity. At the same time, when liquids appear in formulæ, 1dr., 1oz., &c., mean the measured volume without reference to this weight, and is sometimes expressed as one fluid drachm, ounce, &c., or 1dr., 1oz., &c., by measure. It seems a pity that photographers do not adopt the French system of weights and measures, instead of sticking to our complex and confusing one. At present there appears to be little hope of this, as, except Capt. Abney in his "Treatise on Photography," no English writers, as far as I know, give their formulæ on that system, and even he, in his "Instruction in Photography," adopts the English weights and measures.—G. G. B.

[62496.]—**Induction Coil.**—TO MR. BOTTONE.—This appears to be made on the lines of the one described by me last autumn, as a medical coil. As such it seems all right. Do not, however, play with the secondary coil, as 2½lb. will give a shock enough to knock down an ox.—S. BOTTONE.

[62497.]—**Incandescent Lamp.**—The reason is self-evident; the voltage of the dynamo is not sufficient to overcome that of the lamps of 47 ohms resistance.—S. BOTTONE.

[62497.]—**Incandescent Lamps.**—If machine was shunt-wound, the external resistance being lowered, less current would flow through F.M.'s, so they would be cooler. If arc lamps took 10 amps. 42 volts, and the glow-lamps were the Edison-Swan, we should get, in case 1, 4 arcs 40 amps., 30 incandescents at 1·3, 40 amps.; total 80 amps. at 42 volts. Case 2, you would need, say each lamp took 1·25 amp. current, 100 amp. E.M.F. 47 volts required; hence the difference. Perhaps at last you used more economical lamps, such as W. and R. or Shippey, only taking 1 amp. each at 42 volts. All depends on nature of dynamo and relative economy of lamps. If machine was shunt-wound the first reason given would be the true one; if not, the other. Is it a Siemens alternate.—ELECTRICIAN.

[62498.]—**Micro. Gilding.**—Make, or procure, a solution of yellow phosphorus in carbon disulphide. It should be strong enough to cause a piece of paper to take fire when a few drops are placed on the paper and allowed to evaporate. Dip the fronds of the fern in this solution, wave them in the air for two or three seconds, and then immerse in a solution of silver nitrate. This will cause a deposition of metallic silver upon the plant. Of course a fine copper wire should be previously attached. Next immerse the fern in a bath of copper sulphate (saturated solution made acid), and connect with the zinc of a Daniell cell. A copper plate in the bath is attached by a wire to the copper of the Daniell. Deposit a thin film of copper on the fern, which is next to be gilt in a similar manner. The gilding solution is composed of potassium cyanaurate. It should be used warm. Two Daniells are required to deposit the gold, or you may use two small Grove cells, worked by partially exhausted acids. Potassium cyanaurate is prepared by mixing hot concentrated solutions of gold chloride and potassic cyanide. On cooling it crystallises in large colourless tables. These are dissolved in water containing a little potassic cyanide. If you require fuller details, you will probably find methods of electro-metallurgy given in back numbers.—SM.

[62500.]—**Driving Band.**—Half-inch gut is quite unnecessary for driving even a 6ft. lathe. I have turned up a 10in. face-plate with $\frac{3}{16}$in. gut, and found it quite strong enough. I often do heavy metal-turning with it without back-gear, using a small pulley on driving-wheel.—J. R.

[62500.]—**Lathe Bands.**—Use a wire hook shaped like the letter C. You will see these used to join the bands on sewing machines. I have employed this method for years: it answers perfectly.—SM.

[62500.]—**Lathe Bands.**—I do not see why you should be afraid to use gut. I found no trouble with the hooks and eyes—at least, very rarely. I taper the ends slightly, grease them, and screw on well. That is all; but do not omit the grease, as you can screw them on tighter. Half an inch is too large; ⅜in. is quite large enough for a 7in. lathe, or $\frac{5}{16}$ for 5in.—T. C., Bristol.

[62500.]—**Lathe Bands.**—You would find an immense amount of information on this subject if you could look through back numbers—almost every volume contains something. Supposing yours to be a foot-lathe, you do not want ⅜in. gut; it would be so stiff that it would cause extra resistance in bending over the small pulley. My band is only ¼in.; I put it on when I first got the lathe seven or eight years ago, and the hooks have never come off, though I have once or twice strained them terribly by carelessly passing the band over the back-shaft, and then putting it on the pulleys. If it gets at all loose you have only to twist it up a little tighter; unhook and turn the hook or eye half-way round or once round and hook again, and you will find it considerably tighter. Nothing could be simpler or more convenient. I am astonished when I find people recommending the flat band in preference.—F. A. M.

[62501.] — **Electrical Gas-Lighter.** — If "'Arry" will refer to p. 391, No. 927, and many other places in back numbers, he will find all about what he wants to know. As, however, it appears he has the thing itself, let him add a solution of sulphate of ammonia, or sulphate of soda or potash.—NUN. DOR.

[62501.]—**Electrical Gas-Lighter.**—The cell, from description, is evidently what is known as the chloride of silver. The "stick of black stuff" has nothing to do with Chatterton's compound; it is merely a piece of hard black wood round which the sheet of silver is rolled. Chatterton's compound is a cement which may be used to stop up the ends and prevent leakage. The stick of silver with its chloride goes into a small cylinder of zinc, and the charge is a weak solution of sal ammoniac.—BOBADIL.

[62502.] — **High-speed Electro-Motor.**—Ayrton and Perry's motor is one of the best forms; 100 revs. per second can be obtained, if no very heavy work has to be done; there will be no injurious heating. Accumulators can be used to drive it, with effect and success.—S. BOTTONE.

[62502.]—**High-speed Electro-Motor.**—For such high speed you would have to get a motor specially built. I have heard of a dynamo running at 10,000 a minute, but have never seen it. I have run a 1-man motor at 50 revs. a second; but I should say that a ½H.P. motor should not run at more than 25, as both the wear and tear would be ruinous, and the centrifugal force on the armature would cause it in all probability to come to grief. A ½H.P. motor would weigh 60lb. to 70lb. I should on no account recommend over-running a smaller one. It would run from accumulators. Allowing an efficiency of 60 per cent. would need about 620 watts, or, say, 31 amperes from 10 cells. The fewer cells the less useless weight, if that is any object. A few big cells would be cheaper than more of smaller size.—ELECTRICIAN.

[62503.]—**Cutting Brass Wheels.**—Yes, a fly-cutter is just the thing for small wheels.

n a mandrel if boss is wide enough for be steady, and if not, between a couple of up with a nut.—T. C., Bristol.

.]—**Pulley Blocks.**—I like Weston's est, and then Pickering's; but the latter vell oiling, and the makers provide no oil you have to make them or get it in between of the wheels.—T. C., Bristol.

.]—**Electric Battery.**—Wood may be ontain bichromate solution, and it may be acid proof by a thick coat of paraffin wax. DIL.

]—**Electric Battery.**—This has been by me some weeks ago. Try paraffin ked in with hot iron, or line box with ing joints burned, not soldered.—ELEC- I.

.]—**Electric Battery.**—You can make l acid-proof by applying to the inside a f paraffin wax, worked in the wood with n, then, after allowing to cool, apply a me. But the best method would be to marine glue.—J. FLETCHER, Burnley.

.]—**Electric Battery.**—I think your best coat the box with marine glue, which is by dissolving 1lb. of caoutchouc in four f naphtha and allowing this to stand for velve days. Two parts of shellac are then one part of this mixture, and the comhus obtained is cooled on marble slabs. pitch might answer the same purpose. ner plan is invariably adopted in the Post r the troughs of Daniell batteries.—F. H.

.]—**Violin Repairing.**—Yes, you can paired by an expert, and possibly the tone better than ever. I got mine done in the y in Strasburg, and the price was 10s.— Plymouth.

.]—**Violin Repairing.**—I once got an aged violin in exchange for a pair of The violin belly was literally in shreds, w by the grain of the wood it was not a thing. I got this violin repaired for £3, worth £10, though the tone is not as loud anticipated. If your violin is a good one o a regular maker, and he will make it und instrument. Cost will vary with the f repairs necessary.—HENDON.

.] — **Systematic Exposure.** — Don't with U.S. numbers or units of aperture, ulate Table III. for yourself by measuring s of your lens and the aperture of each n page 5 you will get an example worked it is very simple.—B.SC., Plymouth.

.] — **Systematic Exposure.** — If ." will mark the reverse side of his stops , 5, with the figures 1, 1¼, 2½, 5, 10, and ese numbers in one of the columns in I., he will be able to work out his exposure s in the example on page 11. Try it. If, will multiply the figures I gave by 6¼, he he has the U.S. numbers—viz., 6·25, 8, 16, cording to the standard of the Photographic and if he will multiply the figures in V. by 6¼, he will obtain the same result on he example on p. 11. "A. D. B." would do liscard the U.S. numbers altogether, and th the first series of figures I gave—viz., , 5, 10, especially as his lens works at $\frac{f}{10}$ exactly in accordance with Platt's tables. e result is arrived at either way, as multioth sides of the equation by 6¼ only comthe working.—C. WENTWORTH.

ANSWERED QUERIES.

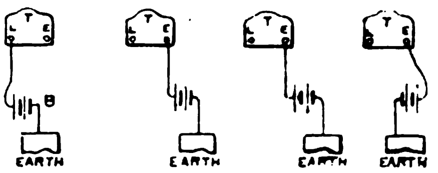
mbers and titles of queries which remain unanr five weeks are inserted in this list, and if still ed are repeated four weeks afterwards. We trust rs will look over the list, and send what information r the benefit of their fellow contributors.

orque, p. 90.
.R. Engines, 90.
.W.R. Engines, 91.
.W.R. Broad-Gauge Goods Engines, 91.
ynamo, 91.
rattice Cloth, 91.
ynamics, 91.
old Ores, 91.
ocust Bean, 91.
epper, 91.
orking in Sheet Lead, 91.
oisting Crab, 92.

.W. Locos, p. 185.
. and N.W. Goods Engines, 185.
oft Colours, 185.
eed of Planer, 185.
mall Accumulator, 185.

QUERIES.

[62513.]—**Telephonic.**—Would some of our electrical correspondents kindly tell me if four telephones would work well, if connected up as shown in diagram. T, telephone; L. line terminal; E, earth terminal; B, battery —W. JACKSON.



[62514.]—I have made a small pair of engines, cylinders 2⅜in. by 5in., inlet to each ⅜in. running into ⅝in. steam pipe, exhaust ⅜in. from each cylinder. Will "T. C., Bristol" kindly say what horse-power they ought to develop at 60lb. pressure? They are at present driving a dynamo, and only lighting four 10c.p. lamps, though the machine is an excellent one, and will light five 20's. Would a larger steam pipe improve matters?—ORMOND.

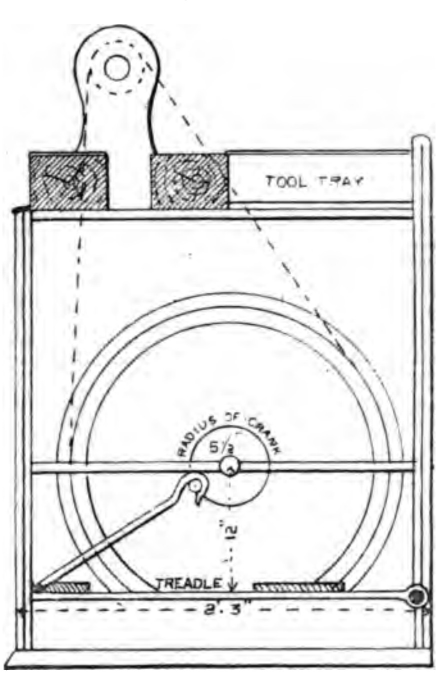
[62515.]—**Squaring Holes.**—I bore wooden boles from 2ft. to 7ft. long, from 1ft. to 2½ft. diameter; size of hole from 2⅜in. to 3⅜in. After boring they have to be taken out of lathe and squared out by hand? Could any of your numerous correspondents inform me of any other method of squaring them out without taking them out of lathe?—A READER OF "E.M."

[62516.]—**Tangent Galvanometer.**—To "SIGMA" OR OTHERS.—I wish to alter my galvanometer, which has but one circuit, to one with two, for large or small currents. Would one massive strip of brass, and about 20 turns of 16 do for the two circuits? Needle 3cm., ring 36cm. Is this large enough for accurate work, or should needle be smaller? How is R. measured, the mean of inside and outside coils?—STUDENT.

[62517.] — **Reflecting Galvanometer.** — What would be best arrangement of coils for general work, and of what R. and how many?—STUDENT.

[62518.]—**Electric Motors.**—I am anxious to ascertain what is the efficiency of the modern electric motors. I am told that they give off power equal to about 90 per cent. of the electricity passed into them. If this is so, there is not much room for improvement; they must be very near perfection. Will any of our electrical readers kindly throw a little light on the subject?—LANKA.

[62519.]—**Length of Throw for 5in. Lathe.**—Having some castings of a 5in. lathe, I resolved to fit it up. In giving working drawings to the smith, I gave the cranks too much throw—5½in. I saw the mistake when too late—the cranks being then nicely turned, and ends of shaft drilled and hardened for centres. To make the best of a bad job, I placed the connecting rods at extreme face of treadle to shorten its rise as much as possible; but I am of opinion that I cannot obtain good results from lathe with connections in this position. Though an old reader of "E.M.," I never saw length of throw given best suited for a 5in. lathe. "F.A.M." could tell us, I know, and maybe, help me out of this difficulty. Perhaps sketch will make my query clearer.—SILVER GREY.



[62520.] — **Problem for "Vladimir."** — What "Vladimir" says on p. 253, about solving with compasses a problem first solved algebraically, suggests this, that Gauss proved soluble by algebra about the end of last century. I once constructed it with ruler and compasses, but not with compasses alone, which must be possible as it involves no equation beyond quadratic. And by the way, as Mascheroni's "Geometria del Compasso" is not Englished, our people know not, as they should, the great advantages of dispensing with the ruler; it being impossible to make straight edges a tithe so accurate as every arc is that they strike. The problem is by compasses alone, and fewer than nine openings, to mark off a seventeenth of a circumference. More than nine openings cannot be needed, because only three are needed for any quadratic equation, and this involves but three such equations. But observe that the division of the circumference into three or four involves a quadratic equation, and yet we divide it into three or six by one opening, and into 4, 8, 12, or 24 by only two. Also the division into five requires two quadratic equations, and yet is made (and even into 120) by only four openings.—E. L. G.

[62521.]—**The Bansoolah.** — To "EOS."—On one point I am not quite clear. Is there a bevel edge same as ordinary adze, or is cutting edge formed by the meeting of back and front of wedge-shaped blade?—ANGLO-CELTIC.

[62522.]—**Bitumen of Judea.**—Can anyone give a list of all the liquids that will dissolve the above? Also a list of those that will dissolve indiarubber.—LUNAR RADIANCE.

[62523.]—**Harmoniums.**—Will some correspondent kindly tell me how to make the vibrators of a harmonium?—MUSICAL.

[62524.]—**Gas Cooking Range.**—Can any of our gas experts tell me what is the composition of the white enamel or paint used to reflect the heat in the inside of the ovens? My range was made before this was thought of, and I want to improve it.—B.SC., Plymouth.

[62525.]—**Piston Rings Blowing.**—I have heard it remarked by experienced locomotive engine-drivers, when a piston is blowing they can tell which ring it is, either back, front, or both. Will some of your readers kindly say if this can be done; if so, how?—T. C. K.

[62526.]—**Organ Making.**—Will any of our musical friends oblige by answering the following?—(1) Are the whole 56 pipes in Stopped Diapason and Flute wood, (2) and would oak or hard wood be better for treble? (3) Should the mouth of flute be cut inside? If I can manage, I mean to have a speaking front (metal). My instructions are all from the "E. M." sixteen years ago; but I have lost the part that treats on the soundboard.—FRASER.

[62527.]—**Daniell's Battery.**—Will any of your readers inform me how to coat above battery with marine glue, as after melting, it becomes hard before I have the job done? Also, can copper be prevented from forming on the porous plate?—J. B.

[62528.]—**Electro-Magnet.**—What no. of wire, and how much, should I put on a core ¾in. thick (horseshoe form), each leg being 3½in. long?—H. CALL.

[62529.]—**Signal Light.** — I want to make the strongest possible light for the least money, where there is no gas. What is best—barrels of mineral oil, or huge Bengal lights? If the latter, state materials, and approximate cost per lb. or cwt. Would it do to mix the materials and ignite the heap, or must they be put into cases? Prompt suggestions invited.—S. S. G.

[62530.]—**Green Holly.**—I have some 2½in. and 3in. plank. Shall I sacrifice colour in drying this for fretwork, or must it be sawn thin while green? If so, will someone among your many subscribers say what plan is best to secure it without cracking open? I conclude it must be a gradual drying. Must it be kept free from rain?—JOSEPHUS.

[62531.]—**Photographic.**—I find that nearly all my negatives developed with pyro and ammonia are stained a dark yellow colour, so that they take a most abnormal time to print, and, from the shadows being rendered so nonactinic, give a rather flat picture. Is it from using too much pyro? (I use about 4gr. to one negative, which only seems enough to develop.) Or if not, what can be the cause of it? Treating with clearing solution of citric acid and alum does not seem to remove it much. I use Chapman's Manchester plates, and Schering's pyrogallic acid. Any hints will greatly oblige.—LUNAR RADIANCE.

[62532.]—**Cane-Sugar in Beer.**—Will some qualified reader—perhaps Mr. Allen will—kindly say how cane-sugar can be detected in beer? I can find no method of detection or estimation in any work I have looked up. If glucose and dextrine were absent (and these, I believe, are always present in beer), cane-sugar might be found by reducing by boiling with sulphuric acid, and then applying the copper test. What method do the Excise use?—they detect it. How do they estimate the water added to beer, as they have done in recent cases in which prosecutions have ensued?—CHEMICAL STUDENT.

[62533.]—**Romsey Observatory.**—Will some one of your readers experienced in such matters kindly tell me what is the best paint to use for the roof of a Romsey observatory? Mine was built three years ago. The roof is covered with stout canvas, which was saturated with boiled oil and painted with three coats of zinc white, mixed with boiled oil and terebine for driers. I have been told that white-lead rots the canvas. Is that the case? The roof now requires to be repainted, and if white-lead does not injure the canvas I should prefer to use it, as it has more body than zinc white.—A. B.

[62534.]—**Machine for Slicing Fat Bacon.**—I am told that there is a machine for slicing fat bacon or pork; but can anyone suggest a means of cutting up pieces into slices about a sixteenth of an inch thick? The pieces are about 7in. by 6in., or 14in. by 6in., and from 1in. to 4in. thick. Will some of your readers give their ideas of how such a machine or apparatus should be constructed; or if one is already in existence, perhaps they will describe that?—J. BETTERIDGE.

[62535.]—**Petroleum or Benzoline Engines.**—Can any of your correspondents who have had experience with this class of engine give any information regarding their reliability in actual service, from personal observation and actual practical experience? So much has been said, in later times, of the merits of this class of motor, and the advantages of such, as compared with steam and gas, from an economical point of view, that a comparison based upon actual experience cannot fail to be exceedingly interesting. In the opinion of your correspondents, would it be possible for benzoline to be adapted to high-speed engines, and what known speed has been obtained from such engines? Are they dangerous in confined spaces, and has practice developed any safe formulæ for comparison betwixt these explosive motors and steam? It is evident that if but one-half asserted regarding the power developed by these explosive engines be true, there is a wide field for their introduction in those places where petroleum and benzoline have little commercial value.—NAWS.

[62536.]—**Fiddle Ribs.**—Can any of my brother-fiddlers tell me a good way to bend fiddle ribs? I have made one fiddle which is a tolerably good one for my first; but it is not quite up to my mind, so I mean to try and make a better. I bent the ribs round a hot tallying iron, but I cannot make a good job of them. I would like to know if there is a better way. Are the ribs thinned down at the corners, so as to make them bend better, and are they faired up to the right breadth before bending.—SOUNDPOST.

[62537.]—**Cement for Rubber.**—Would any of "ours" publish a better way of making cement for sticking rubbers to cycle wheels. The present cement is made—or should be—of equal parts of indiarubber and guttapercha, but it is not quite satisfactory. There is a better material, I believe; but the holder of the recipe keeps it a secret. A really good cement would prevent many accidents by rubbers coming loose from cycles. Any cement to be of use, must be capable of being softened by heat, and cost not over 1s. 6d. per pound.—C. L.

[62538.]—**Rebrazing Lumps of D.B. Breechloaders.**—When at home, I live in an out-of-the-way part of Queensland, and occasionally have brought to me for repair, double breechloaders, the lumps of which, from imperfect brazing, have parted from the barrels. This is a very troublesome job, the barrels becoming unsoldered at the breech ends, and the brass not running properly over the whole joint. I should be obliged for some hints on the subject.—TUKANG BESI.

[62539.]—**Inlaying Iron with Silver.**—In "Shifts and Expedients of Travel," by Lord and Bains, p. 181, the authors say, after describing a method of platinising iron, by a Professor Church:—"In the same article, the professor describes a new and very simple plan of inlaying iron with silver, and also for enamelling metals with different colours." Does any reader of the "E.M." know what article is referred to, and where it could be procured? The authors are, I believe, both deceased.—TUKANG BESI.

[62540.]—**Photographic.**—I have a 2in. achromatic o.g., 30in. focus, part of an old telescope. I have an extended front to camera, and get a fairly defined picture on focussing screen of camera, with ¾in. stop in front of lens. I cannot get a decent negative on dry plate of sufficient density to print; have given time from 1 to 20 seconds; all the plates are poor and thin. Can any fellow-reader give me a hint how to succeed? The object I wish to photograph is about 1·6 mile distant.—MORE LIGHT.

[62541.]—**Sight-feed Lubricators.**—Will some correspondent kindly explain the action of the sight-feed lubricators which are now becoming so general?—W. B. THOMPSON.

[62542.]—**Astronomy.**—Will "F.R.A.S." kindly give the dates when the sun and moon were visible during an eclipse of the moon? Could he also oblige with number of degrees of the celestial sphere an observer can see from north to south, observer's eyes being 6ft. above the sea.—G. B. B.

[62543.]—**Beer Affected by Thunder.**—Can anyone please explain what is the recognised theory of the effect of thunder on beer in casks. Notwithstanding the cask being air-tight, it is said to affect it. Is there any malt beer it does not affect?—MAGNET.

[62544.]—**Half-Round Bits.**—How are the large half-round boring bits made? I have made them up to ⅜in., turning up a boss and filing down the half, but am not equal to the filing of a 1½in. bit? Which is the regular way of turning out the large sizes?—H.

[62545.]—**Moths.**—What is the best thing for keeping moths out of drawers and clothing?—H.

[62546.]—**Lunar Drawing.**—Will Mr. Gaudibert, Mr. Elger, Mr. Sadler, or others please describe how they produce the very excellent drawings of lunar detail which appear in "Ours"? The kind of paper and pencil and crayon used, and of what dimensions the originals are made? Are they reproduced in "E.M." by some phototype process or engraved by hand? Are the finished drawings made at the telescope or worked up from sketches?—LUNA.

[62547.]—**Coins of the Present Reign.**—I wish to make a collection of British coins issued during the present reign, and should be grateful for a complete list of them. I have the following:—Gold sovereign and half-sovereign, silver crown, half-crown, florin, shilling, sixpence, fourpence (two kinds), threepence, twopence, threehalfpence, penny; bronze penny, halfpenny, farthing, half-farthing, third of a farthing. Also a Jersey penny and halfpenny. Are there any other coins issued for the Channel Islands or the Isle of Man? Are there more than one kind of any of the coins named above? I see mention in the recent Queen's proclamation of five-pound and two-pound pieces. Have such been in circulation?—D.G.

[62548.]—**Side Lever Valves.**—Can any reader kindly give a description of the valves of side-lever engine, like paddle tugs? Are there separate valves for top and bottom of cylinder or separate expansion? If so, how do they work?—STEAM TRAWLER.

[62549.]—**Electric Kite.**—Will anyone kindly help me in the following?—I have made a kite from a silk handkerchief (for conducting electricity from the clouds), stretched by two thin pieces of bamboo crossing each other, and turning freely on its axis, so that it could be folded up like a stick; but it would not fly up: it could only be made to fly horizontally—that is, in the same straight line with the person holding the string. What is the cause of this? My kite is well balanced. Will anyone kindly show me another method for making a portable kite for the purpose, or show me an improvement on the former one? Also, how to make the string of the kite a good conductor of electricity? Will it be a sufficiently good conductor if I soak the string for an hour or two in a saturated solution of salt before flying? —*J. S., Bombay.*

ANSWERS TO CORRESPONDENTS.

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⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,025.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: Nos. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 1, and unacknowledged elsewhere:—

LIVERPOOL ASTRO. SOCIETY.—J. S. Stock.—J. Boggis.—Induction.—R. R. N.—Rev. C. Gape.—Black Kettle.—W. J. F.—Enameller.—W. G. B.—W. S. Mitchell.—S. Bottone.—G. W.—Eos.—L. and Y.

R. LORD. (Not misunderstood at all. You want to do something of which you have no apparent knowledge, and you pen queries which are vague, to say the least, and expect that someone will help you out of a difficulty which does not exist. We have given the required information over and over again, and you will find all necessary directions in Watt's "Electro-Deposition," published by Crosby Lockwood and Co., Stationers' Hall-court, E.C. As you do not give details it is impossible to say why you have not succeeded. Perhaps you have not connected the wire to the plumbagoed surface—perhaps you have not done some other simple thing: it is impossible to say, and useless to guess. If you will send a definite query we will endeavour to answer it.)—UNSTUCK. (We should suggest a visit to a jeweller's shop; at any rate, a jeweller would be able to offer a professional opinion, and would no doubt also supply the articles.)—A. H. J. (We are afraid that the only advice would be to try the clarionet or the oboe. 2. The query is indefinite. In what form are the designs? They can be photographed or traced or redrawn; but see indices for several methods.)—THOMAS NAYLOR. (There is no work on the subject. The method has been frequently described in back numbers. See p. 1082, p. 322, and read Hints No. 5 above. The free end is filed to sharpen, the riveted end to flatten; and it is usual to have a standard set to tune by when finishing the reeds in quantity.)—ONLY A BLACKSMITH. (We can only refer you to the indices of back volumes, as we have no idea which articles you mean. At any rate, you will find much useful information on the subject even in the last volume. According to your statement, that is four threads to the inch; but surely you could measure with a rule and count; and as to the wheels, you must procure new ones—it would be folly to attempt to repair the others.)—E. A. B. (If it absorbed the saliva in any way it would no doubt be attacked by rabies. Watch it carefully for any symptoms, but do not destroy while there is any doubt.)—W. A. W. (We are not certain, but think it is published by Ward and Lock.)—AUTOGRAPH. (See indices. We have described them all. The trypograph, the electric or pneumatic pen, or the cyclostyle will do what you require—that is, either will enable you to do it.)—J. E. GORE. (Yes, it is used as a basis, at any rate, by at least 90 per cent. of professional stenographers.)—E. GOBERT. (Yes, but please send it again, or indicate the page where it is to be found. The articles referred to ended in Vol. XXIX., by reason of the untimely death of the author.)—DRAUGHTSMAN. (Get the best Indian ink, and rub it up with a solution of alum.)—W. B. (The question has been frequently answered. There is nothing better than a mixture of guttapercha and pitch; but you want something to resist heat, and in that case we think the rubber must be vulcanised on to the metal. Ask for pale steel lacquer at any of the dealers in varnishes.)—SAFETY VALVE. (The boiler and fittings for the "home-made" engine appeared in No. 1097.)—J. O. C. (There is no further information to give, or at least, we gave all the inventor published, and he says that is all there is to say about it. He does not work the process commercially. What points are obscure?)—WORKING MAN BOTANIST. (See indices, or No. 896, p. 252. The objectives mentioned will do for work of the kind.)—J. S. (Consult a surgeon. How can anyone say without examining the tumour?)—W. B. (You had much better take the advice of a medical man, who can examine you.)—E. M. (Any bookseller will supply you with the works you require, and we have no doubt you will find them at any large shop in your town.)—EDWARD TURNER. (A letter addressed to the secretary would no doubt find him, but we think you will find the advertisement in most of the weekly newspapers.)—W. H. MURCH. (See Hint No. 4. We have no idea, but suppose that Dr. Cornelius Herz, Paris, would find him. Refer to recent back numbers for a description.)—J. PLAYER. (There are several works which describe how to take indicator diagrams, and a great deal of information in back vols. See pp. 130, 244, 272, Vol. XXXVII., for an explanation of indicator diagrams with illustrations.)—PHILIP. (Any textbook of physiology contains what you require; but the other part of the matter is doubtful, though you can, no doubt, find a good deal about it in some books, which, however, are scarcely scientific. Look through the indices, and you will find frequent reference to such matters.)—H. R. B. G. (If it appears to be an excellent instrument, perhaps it is, and if so it would be advisable to send it to a skilled optician. It is very special work, and a novice would most likely spoil the o.g.)—M.SC. (We do not think there is any textbook on that special branch; but you will find chapters on it in any work on the metallurgy of iron.)—W. SUMMERHAYES. (The straight pipe; but the difference would not be great, as it is only the increased friction caused by the bend that affects the question.)—J. D. (Some are coated with an amalgam of mercury and tin, others have a deposit of pure silver. Which process do you want? The latter is now known as patent silvering.)—W. B. THOMPSON. (It is narcotic and sedative; but has little effect apparently on some.)—LUNAR RADIANCE. (Lay a wet cloth over it, keeping damp for several days, then wipe over with a soft sponge. If of any value, and it becomes necessary to use a varnish solvent, better let a professional cleaner do the work. 2. Indiarubber mixed with a little fine grit and vulcanised.)—J. S. R. (What is it you mean? If it will print one, it will print all. Do you refer to a 'graph process?)—G. B. B. (The amount of curvature is given in any of the engineering pocket-books. It is curvature in feet = 2-3rds of D^2 approximately, or curvature less refraction = 4-7ths of D^2 approximately, D being distance in statute miles. 2. As to the other question, watch the discussion now going on. Other queries inserted.)—W. J. JOHNSON. (We think you are bound to complete the lessons or pay.)—HOPELESS MECHANIC. (All such men are quacks. Why don't you go and see Dr. Allinson, the medical adviser of the *Weekly Times and Echo*, or seek his advice through that paper?)

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he English Mechanic
WORLD OF SCIENCE AND ART.
FRIDAY, JUNE 10, 1887.

ROSCOPICAL ADVANCES.—XVIII.

Dr. Royston-Pigott, M.A. Cantab., R.S., F.R.A.S., Memb. Roy. Coll. Phyians; Fell. Cambridge Phil. Society; rmerly Fellow of St. Peter's College, mbridge.

Diffraction, Ancient and Modern.

LESCOPIC and microscopic diffractions are so closely allied, it will be conent to combine both. Sir John Herschel, s article on "Light," makes a brilliant ion to the extraordinary labours of nhofer. But no proper account has yet given in English of his enormous rches on *diffraction* spectra, nor of his umentation. The German memoir re me is a splendid monument of nan energy in thought and action (78 s, quarto).

sing a theodolite reading to 10 seconds, a telescope of 20 lines (= 1¾in.) aper-, and 16·9 focus. "The whole instrut is isolated from the base. The heliois placed 463½ zoll* away. . . . The ture placed before the heliostat is ically 2 zoll long, and its breadth, varied screw, is generally from one-hundredth wo-hundredth of a zoll (inch) broad. A oscope furnished with a micrometer the breadth of the slit (under a power 10) accurately to the 1-50,000th and the 0,000th of an inch.

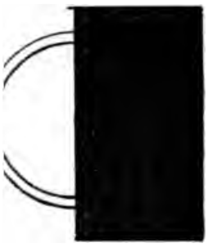
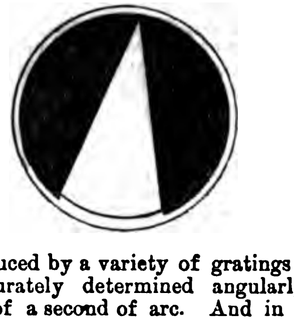


FIG 1

FIG 2

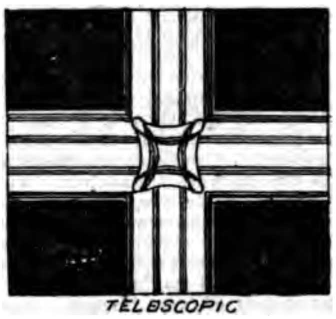
raunhofer also used minute circular apers, producing circular diffraction rings. se rings cannot, however, be examined erly with the low magnifying power of Fraunhofer telescope, 30 to 50 diameters. ordingly, some of the very finest and t *recherché* phenomena were entirely ed by him. But thousands of observas and measurements of the diffraction s produced by a variety of gratings were t accurately determined angularly to imals of a second of arc. And in these ndant details his memory has been imtalised. Sir John Herschel is profuse in encomiums; no such scientific work had r been revealed before.

FIG 3.



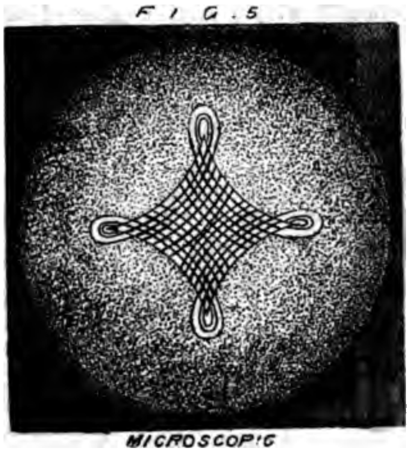
he round aperture was used from 0·04 to zoll (·004in. to ·0085, 1·0085in.) and e apertures at 41ft. with the heliostatic r beam exhibited magnificent effects.

FIG. 4



TELESCOPIC

FIG. 5



MICROSCOPIC

In investigating the subject of circular solar spectra, not having read Fraunhofer, I found that I was obliged to diminish exceedingly the solar beam before I could develop the gorgeous forms displayed by the microscope with a power of one thousand diameters, in bright open daylight without shutter or darkened room. Fraunhofer established the interesting fact that the minuter the transmitted solar ray, the more brilliant and beautiful were the optical effects. But then the sky must be free from haze or scirri, or thin clouds.

That marvellously happy thought of Fraunhofer to obtain diffraction spectra by interposing a variety of apertures between the object-glass and the distant luminous point, has led to some of the most important phenomena in optics. The whole theory of diffraction may be summed up in one word, *grazing*. Rays of light graze the edges of the apertures and become bent out of their course. The more complicated apertures impart their own special beauties to the diffraction imagery, and this happens equally well either with telescopic or microscopic experiments.

A simple experiment can be made with a triangular aperture. Most unexpected results are obtained from the heliostatic beam —varying greatly with its size and the focal plane selected—six-rayed spectra appear, changing into hyperbolic curves when out of focus.

A slit, 1-50th broad, elongates the central image, whilst the diffracted light produces coloured spectra. Curiously enough, as the slit is made wider these spectra become closer; two slits, crossed at right angles, produce a luminous central square arrayed with a cross of spectral stars. The central square shows rounded corners when a broad, square aperture is used, and also four barred rays. Out of focus nine spots are developed, with many smaller ones outside squarely arranged.

If the aperture be ⅛in. square a four-rayed star appears with four very close radiating bars, with minute, long spectra, diminishing, with wonderful gradations of size and brightness; by changing the focus a complete transformation scene is superinduced. The figure attempted has been seen both telescopically and microscopically.

I have found perforated zinc and wire gauze made with the finest meshes develop very singular and exquisitely beautiful spectra in different focal planes. Everyone knows that the spurious diffraction disc of a star is enlarged by contracting the aperture of the telescope.

In studying the fundamental laws of diffraction, the first conclusion is that it always assumes the position of a normal to the grazed edge of the aperture.

Experiment 1. Cut off exactly half the aperture of a telescope; admit the standard solar illuminant, emitting a minute beam of light 40ft. away. The primary diffraction line now takes the form of a brilliant horizontal ray of light, with a bright dot in the centre.

2. If two sides of a triangle are employed, two delicate rays will be seen inclined at the same angle as the sides of the triangle—that is, as normals or perpendiculars to each side. A bright dot appears in the centre, supplemented by a series of short lines, the diffractions of the lower edge of the optical aperture.

3. Place a diaphragm perforated centrally with a very small equal-sided triangle (of about ¾ths of an inch). The diffraction now takes the form of a brightly-dotted six-rayed star, with a brilliant central spurious disc. These rays are separated from the disc by a black ring. They are very narrow, and perfectly straight; all diffused light is totally destroyed.

4. A small square aperture produces a minute bright central square spot and four symmetrical bars exquisitely dotted, but still normal—i.e., perpendicular—to the sides of the aperture.

5. Fine lines, 1,000 to the inch, ruled with a diamond on glass, develop lines and colours of exceeding beauty and accuracy, as well as the celebrated dark lines of the Fraunhofer spectrum*, forming indeed a most perfect comparison standard for spectroscopic research, and named diffraction gratings.†

Similarity of Diffraction Spectra in the Microscope and Telescope.—Here are two figures (Figs. 4 and 5) of a very similar order.

The telescopic diffraction can be obtained from a small square aperture inserted within the perforated cap of a telescope. The microscopic one was obtained with the heliostat of the author's invention placed at a distance of 100 inches in strong sunshine.

Fig. 1 is after Potter, and magnified only a few times by the telescope. Fig. 2 is from the *Proceedings* Roy. Soc. under a power of 1,000 diameters by the writer. It is very difficult to adopt a high power on a near object like Fig. 1; the cusps of the central figure would otherwise display spurious discs and rings identical with those of Fig. 2.

As an object is viewed nearer, telescopic power diminishes, the exact reverse of microscopical magnifying power. I have found 180ft. a very effective telescopic distance for the artificial star; but the air, say at 8.30 a.m. a few days in the spring, was then only capable of displaying these diffraction glories. The beauty of these diffractions depends much upon the focussing of the distant luminous point. Out of the focus this elegant star changes into a close series of six hyperbolas with their apices at the central part, whilst the spurious round disc changes into a small black central equilateral triangle. Very surprising loveliness of form is established by using a diaphragm in front of the object-ere

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* he zoll = 1 Paris inch = 1·06578 English inch, there-63½ zoll = 41ft. nearly. The French foot = 12·78933 sh inches.

* Mr. Rutherford's gratings are much closer than this, 4,000 to the inch.

† In this case, Fraunhofer used a very narrow slit in metal plate placed before the heliostatic rays.

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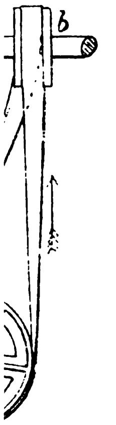
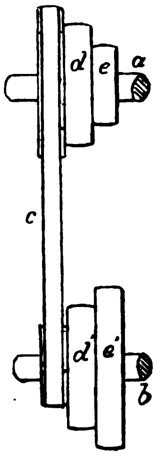
G.44



F I G 47



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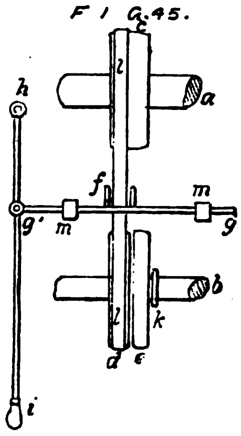
'ig. 44 are two pulleys, connected by a belt as shown, their axes being at right-angles to each other. In such cases the delivery side of the driver must be in plane with the driven pulley, the belt running as shown by the arrows, otherwise it would run off the pulleys; hence it is evident that in this arrangement the pulleys can only run in one direction.

In some instances where sufficient initial tension on the belts cannot be obtained in the ordinary way, friction rollers have been employed; they are rollers in fixed frames which, by means of a screw, are caused to press upon the band at some point between the two working pulleys, and thus to tighten the band upon them; this, however, is a cumbersome arrangement, and should not be adopted if it can be done without.

F I G.45.

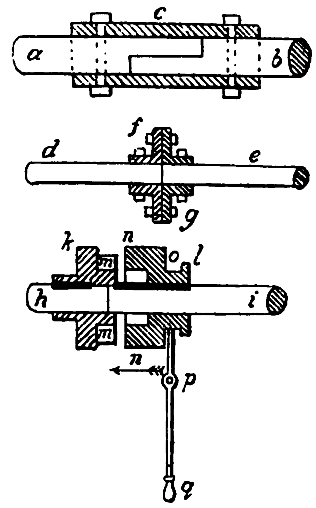


Means must evidently be provided throughout a mill or works to start or stop any individual machine without interfering with the rest; there are several ways of doing this, one of which is shown in Fig. 45. *a* is a part of the general running-shafting of the shop, and *b* the driving-shaft of any single machine.

Upon *a* is securely keyed a pulley *c*, which is made double the width of an ordinary single pulley. Upon the shaft *b* are mounted two pulleys *d* and *e*, the former keyed to the shaft, the latter running loose upon it, being retained in position close to the pulley by the collar *k*, these pulleys *d* and *e* are technically termed the fast and loose pulleys respectively.

On the pulley *c* is a band *l l*, which may run on either *d* or *e*, its position being controlled by the fork *f*. This fork is mounted on a square bar *g g'* carried in guides *m m*, and it has stops upon it which by coming in contact with the guides *m m* prevents the strap from being thrown too far in either direction. The bar *g g'* is moved by a hanging lever *h i*, to which it is connected ay a pin at *g'*, *i* being a handle. Instead of having stops on the bar *g g'*, there may be placed behind the hanging lever a transverse bar with a couple of notches in it, into which it will spring when moved into either position—for running the machine or stopping it.

F I G.46



In great lengths of shafting, it will be necessary to have means of coupling or joining up the short lengths in which it is made.

In Figure 46 are illustrated two forms of permanent couplings, both of which are very satisfactory in practice. The first is the neater of the two in appearance; but the second has the advantage of allowing the shafts to be disconnected if required for a time.

There is also a third kind of coupling shown, which is properly termed a clutch, and which is employed where it is frequently desirable to disconnect certain shafts. For instance, if all the machines in one department of a mill or factory are occasionally standing, it is no use to have the shafting running there absorbing power by its friction, wearing itself out for nothing, and wasting oil in the bearings. *a* and *b* are the ends of two pieces of shafting required to be coupled together. The ends are cut half away so as to fit together as shown, truly bearing against each other. These are held together by a cast steel cylinder *c*, which is retained in position by small bolts and nuts, as shown. Sometimes cast-iron couplings are used; but it is much better to have them of steel, which is more reliable.

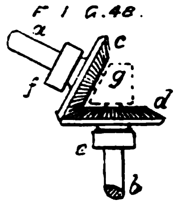
In the second example, *d* and *e* are the ends of the shafts to be connected, which are brought so close together as almost to touch at the ends. On each end is fixed a disc, as shown at *f* and *g*. These discs are secured to the shafts by bolts and nuts as shown, and are also bolted to each other, so that the motion of one shaft is communicated to the other.

If the shafts are required to be temporarily disconnected from each other, the bolts connecting *f* and *g* are withdrawn, and they are thus left free.

h and *i*, in the third view, show the ends of two shafts carrying the reciprocal parts of a clutch, by which they can be instantaneously connected or disconnected.

k is a thick disc of cast iron or steel, secured to the shaft by the key*r*. In the face of this disc are sunk two recesses, *m m*. *l* is a disc keyed at *s* to the shaft *i*. Upon its face are two projections, which fit into the recesses on the face of the disc *k*. At the back is a circular prolongation, with a groove *o*, into which the forked end of a lever working on the dead centre *p* takes. *q* is a handle to work the lever. By pushing this handle to the right, the disc *l* is moved in the direction of the arrow, the clutch is closed, and the two shafts revolve together. By moving the handle *q* to the left the clutch is again thrown out, and the shafts disconnected. In some machine tools, such as lathes, the speed is required to be varied according to the size of the work being operated on and the material of which it is composed, so as the shafting is assumed to be always running at a uniform speed, there must be some intermediate arrangement between it and the machine, to allow of the speed of the latter being varied as occasion may require.

F I G.48.



In Fig. 47 is shown an arrangement of speed pulleys, as they are termed. *a* and *b* each consists of a number of pulleys of different diameters made in one piece, one being keyed to the intermediate driving shaft, and the other to the first driving shaft of the machine; *c* is a strap connecting the two sets of pulleys, which are turned of such diameters that the strap is the right length for any pair of them.

If *a* be the intermediate driving shaft, then, as the strap is shown, the lower shaft and machine to which it is attached will have the highest velocity; if the strap he shifted on to the pulleys *d d'*, the machine speed will be reduced, and still further if the strap is on *e e*. This arrangement is also sometimes used for continuous "feeds," such, for instance, as are required in drilling and boring machines.

When two shafts lie in the same plane at an angle to one another, as shown by *a* and *b* in Fig. 48, motion may be most conveniently transmitted from one to the other by means of bevelled toothed wheels, as shown at *c* and *d*. The ends of the shafts are supported by bearings *f e* placed immediately behind the bevel wheels, or when the latter are very heavy the shafts may be prolonged through them, and their ends supported in socket bearings—in the block shown by dotted lines at *g*.

In the case shown at Fig. 144, it was pointed out that when the strap is used the shafts can only be run in one direction; if, then, it is required to have them capable of running in either direction, the strap must be dispensed with, and a vertical shaft interposed, having a bevel wheel top and bottom to gear into other bevel wheels on the shafts *a* and *b*.

Another kind of reversing gear, consisting of plain-toothed or spur wheels, is shown in Fig. 49. *a* is the driving wheel fixed upon a shaft *b*, upon which is also placed a rocking frame carrying dead centres *h* and *f*, which serve as bearings for the two spur wheels, *g* and *e*, which are in gear with each other, *e* being also in gear with the driving wheel *a*.

FIG. 49

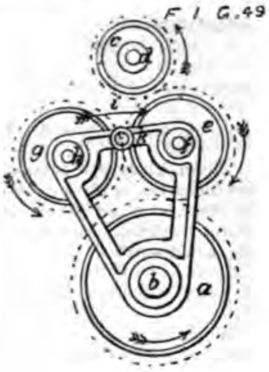
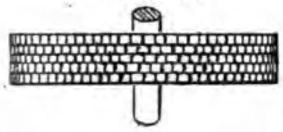


FIG. 50.



As shown, the wheel *e* is in gear with the machine wheel *c*, keyed on the shaft *d*, and the wheels will be revolving in the directions shown by the arrows marked near their pitch circles.

If now the frame *h f b* be moved about its centre of oscillation *b* in the direction of the arrow *i*, the wheel *e* will be thrown out of gear with the wheel *c*, and the wheel *g* will fall into gear with it, whereby the motion of the wheel *c* will be reversed.

It should be noticed that the wheels *e g*, turn in such directions that whichever is in gear with *c* has a tendency to remain so, so there is no danger of their working out of gear, and all that is necessary is to place two stops in the frame of the machine to limit the travel of the frame *h f b*, which may be conveniently manipulated for reversing by means of a handle at *k*.

By varying the sizes of the wheels *g* and *e*, different velocities may be given for the different directions of motion.

For some classes of heavy mill work, mortise wheels are run in gear with iron-toothed wheels. The mortise wheels are of cast iron; but instead of having teeth on their peripheries, there are slots, and into these slots are fitted teeth made of some hard, tough wood, such as hornbeam. These wheels work very smoothly with iron-toothed pinions, and it has been found that in some cases the wooden teeth will outlast the iron.

Where very heavy gearing is used, it is sometimes thought advisable not to make the wheels with teeth extending right across the face, but to divide them up as shown in Fig. 50. This would certainly tend to give a more continuous hold than when the single teeth come consecutively into action. Oblique teeth would have a somewhat similar action, but with the disadvantage of putting an end strain on the bearings.

(*To be continued.*)

PORTABLE BICYCLE AND TRICYCLE SHELTERS.

MESSRS. CROMPTON and FAWKES, of Chelmsford, send us particulars of their new portable bicycle and tricycle shelters, which may be interesting to many readers. The shelters are equally as useful as tool-houses, tennis sheds, &c. These are made of best seasoned timber framework, put together with bolts, so that any amateur can easily erect them or take them to pieces in a few minutes. A wood door, painted chocolate, is provided at one end with a galvanised padlock and key. The exterior is covered with best galvanised corrugated sheets, all cut to proper sizes, and galvanised screws, washers, fastenings, bolts, &c., are included.

FIG. 1.

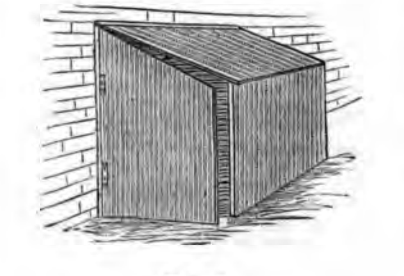


FIG. 2.

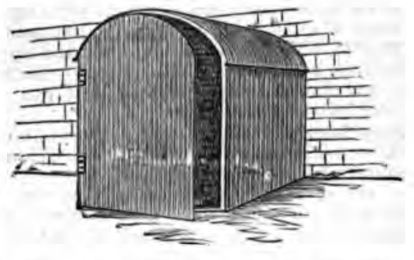


Fig. 1 is specially adapted for bicycles, and is 6ft. high to eaves (the lowest part). Fig. 2 is 5ft. high to eaves. The door can be at either end, but will be sent as in sketch, at left-hand end, unless otherwise ordered.

PHOTOGRAPHY IN NATURAL COLOURS.

THE above heading has recently appeared in the columns of the daily Press, and under it some extraordinary statements have been made by writers who are obviously unacquainted with the rudiments of optics and chemistry. We have before us a card inviting someone to an inspection of samples produced by "a new process of photography in natural colours," and to witness the "method of production." The colouring of the photographs was excellent —it could not be better; but it was not what the scientist understands by photography in "natural colours." The process is based on a patented invention of M. L. J. H. Cellérier, of Paris, and consists in the following operations:—(1) The coloration in uniform tints without any modelling or imitation of forms and without any shades, either by hand, with a brush, or by chromolithographic printing, of a paper specially prepared; this coloration being guided by the aid of transparency on an ordinary photographic positive of the object to be reproduced in colours or by reflection. (2) The formation, independently, of an image in the form of a transparent pellicle obtained by photographic impression without colours, and producing exclusively all the forms, mezzotints, and shades of the object to be reproduced. (3) The juxtaposition, superposition, or intimate union of the products of the above two processes or operations. First there is prepared on glass or paper an ordinary photographic positive of the object or person to be reproduced. Opposite this positive, so as to get the image of it by transparency or by reflection with the aid of suitable mirrors arranged for the purpose, is placed a sheet of paper prepared with arrowroot, or salted or albumenised paper, or cetrarine paper or other analogous paper after having moistened it. Upon the image thus obtained by transparency or by reflection there is applied with a brush honey and aniline or other colours, the colours indicated by the model to be reproduced, and this in simple uniform tints without any imitation of forms or any shades. These colours can be vegetable or mineral; the latter, which cannot be employed in any salts of silver process, give in certain tints a greater vivacity and more diversity in each tint. This work is effected without difficulty, as the operator has only to follow the contours indicated by the transparent or reflected image without troubling himself with shades or imitation of forms. By this method of distributing the colours there is the advantage of operating upon immaculate paper—that is to say, paper free from preliminary work for obtaining the visible forms or designs. On this point depend the vivacity of the colours in the proofs and exactitude in the details. When all the colours in uniform tints have been thus applied, they are fixed in a bath formed of about 200 parts of alcohol at 40° Baumé and 50 parts of acetic acid. When it is required to produce a large number of copies of the same subject, instead of applying the uniform tints on the paper as above described, the usual chromolithographic processes are utilised.

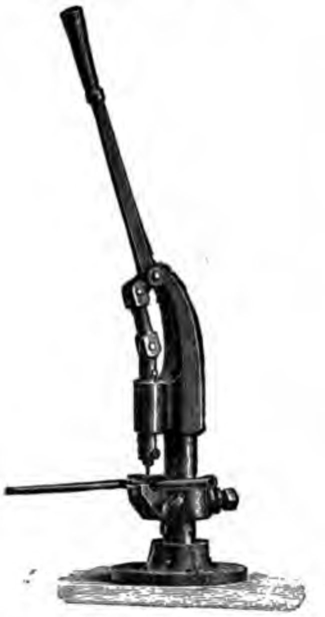
The second operation can be performed at the same time as the first—that is to say, independently. The negative which has served for the production of the positive employed in the first operation is, by means of the ordinary photographic apparatus, used to obtain a positive proof without salt of silver on a carbon paper prepared specially in view of its employment in carrying out this invention, with half the colouring matter usually employed for printing from strong negatives, or with one-third of the colouring matter for feeble negatives. This paper is previously sensitised by means of bichromate of potash or of ammonia at from 2 to 4 per cent. The image is developed against or upon a fine glass previously waxed or collodionised, and submitted to hot water without intermission at from 40° to 50° centigrade. This development of the image against the glass thus prepared has for its object to allow of the ulterior transfer of this image in the form of a thin pellicle above the coloured silhouette obtained by the first operation. The glass bearing the developed image is afterwards submitted to a bath composed of about 10 parts of rectified alcohol and 6 parts of water to hasten the desiccation; on the glass—that is to say, on the image—is applied a layer of gelatine at 10 per cent., after which a complete desiccation is allowed. This coat of gelatine is indispensable, in order that in the subsequent or third operation the image which is to be intimately united to the paper product of the first operation may leave the glass with its smallest mezzotints, which would be impossible without this precaution.

The product of the second operation is applied with mathematical exactness upon the product of the first operation, so that the photographic image of the second shall strictly coincide with the coloured silhouette of the first. It may be here remarked that it is the chemical pellicle, borne provisionally on the glass, that makes the third operation possible—that is to say, that the pellicle and the coloured silhouette coinciding mathematically are arranged in their true sense. These two proofs being well in contact, the glass bearing the result of the second operation is left to complete desiccation. After several hours dessication a reproduction of the object is obtained full of life with all its varied colours. The proof or picture thus produced is very artistic and of great lustre or freshness, which is specially due to the small amount of colouring matters in the carbon paper employed in the second operation to obtain the transparent photographic pellicle. The proofs or pictures are afterwards fixed and rendered unalterable by a bath of alum at 5 per cent. After washing they can be applied to cardboard and finished in the usual way. Sometimes there is interposed between the chemical pellicle and the coloured paper a layer of albumen coagulated by rectified alcohol or a layer of gelatine. This separating layer gives a certain depth of appearance and a very artistic effect.

Since the original patent was obtained this process has been improved and simplified by Mr. E. W. Parkes, and the results produced can be seen at the Pall Mall Gallery, where the Cellérier Syndicate have on view a number of photographic portraits, which, so far as colouring goes, leaves nothing to be desired, except the real photography in natural colours. The principal improvement effected by Mr. Parkes relates to the method of colouring, which process he has greatly simplified without impairing the effectiveness of the picture. Instead of employing the sketching, colouring, and transferring processes of M. Cellérier, which occupy considerable time, Mr. Parkes simply colours the back of the positive film direct with ordinary colours, laid on in a kind of dabbing manner with the finger. After having been coloured, the film is transferred to the final support, which may be either paper or cardboard.

FLINT'S PUNCHING MACHINE FOR GAS PIPES.

In the annexed engraving is illustrated a simple but useful form of punching machine for perforating gas tubing in the manufacture of devices for illuminations. The tool will obviously be useful for other purposes, but it has been brought out by Mr. Flint, of Balance-street Ironworks, Bath, expressly for punching gas tubing. The trouble and loss of time caused by punches breaking are avoided by the use of this machine, which drives the punch cleanly in fine holes through copper and brass tubes, and also through iron pipe if it is nicked previously with a file. The maker says he has punched over one hundred holes in a minute in copper tube; but that is not so much a recommendation of the tool as the fact that it drives the punch through the metal without much risk of breaking it, and the holes are necessarily of the same size, a feature of importance in gas tubing for illuminations.



MURCHEY'S IMPROVED TAPS FOR CUTTING SCREWS.

FIG 1

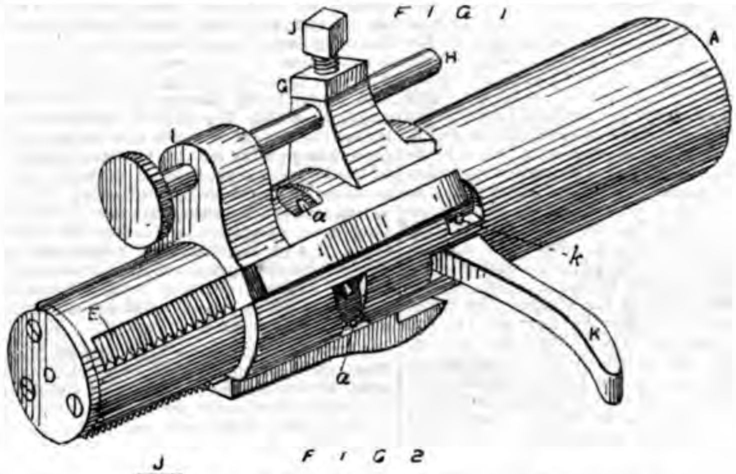
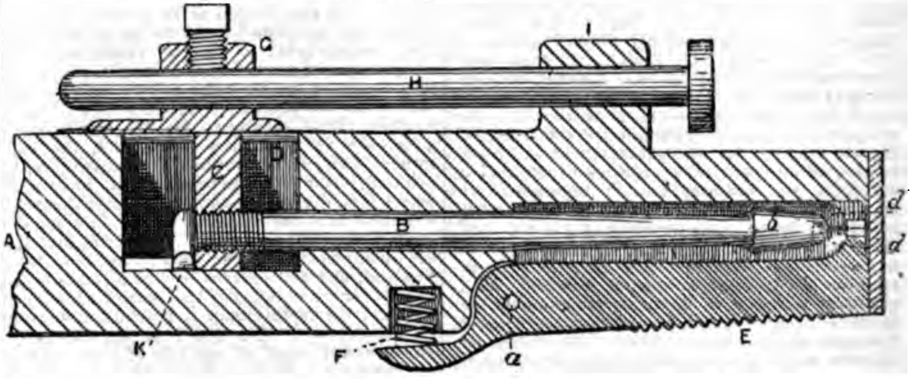


FIG 2



The improvements in taps for cutting screw-threads, recently patented in this country on behalf of Mr. W. Murchey, of Toronto, Canada, are shown in the annexed engravings, Fig. 1 being a perspective view of an improved tap, and Fig. 2 a longitudinal section of the same. The object of the invention is to design a tap which can be readily set to cut any given number of threads, and having done so to be automatically thrown out of action so that the tap may be withdrawn straight from the hole without the necessity of unscrewing it. The device consists essentially of screw-cutters fitted into and pivoted in slots made in a mandrel having a hole in its centre to receive a spindle arranged to expand the cutters, and adjustably connected to a cotter extending outside of the mandrel, and having an adjustable gauge which can be readily set to come in contact with the surface of the article, being screwed to gauge the depth at which the screw-cutting shall cease, and by pushing the internal spindle clear of the pivoted cutters permit their springs to throw them out of action. A represents a mandrel made any required size, and designed to fit into a machine, or it may be made to be operated by an ordinary hand-wrench. B is a spindle inserted into a hole made in the centre of the mandrel A. One end of the spindle has a thread cut on it to screw into the cotter C, which passes through the slot D made in the mandrel A, immediately behind the hole into which the spindle B is placed. E represents the screw-cutters which are fitted into slots made in the mandrel A, and are each pivoted at *a* to the mandrel. F represents a spring which is placed below each cutter E behind its pivot *a*, the expansion of the springs causing the ends of the cutters E to fall in towards the centre of the mandrel, so that when the springs F are permitted to act the cutters will be carried clear of the thread being cut, thereby enabling the ready withdrawal of the tap without the necessity of unscrewing it. G is a head formed on top of the cotter C, and fitting the outside of the mandrel A. This head G has a hole through it to permit the passage of the gauge-rod H, which also passes through a hole in the guide I, formed upon or attached to the mandrel A as indicated. A set-screw J, screwed into the head G, provides means for holding the gauge-rod H in any desired position. A tapered head *b* is formed on the end of the spindle B, and inward projections *d* are formed on the end of each cutter E. When the head *b* is inserted between the ends of the cutters E, the cutters are held out, as indicated in Fig. 1, and when so held will cut the thread they are intended for.

In operating this improved tap the patentee first adjusts the gauge-rod H so that its end shall come against the surface of the article being tapped, about the time that it is wished to stop the cutting of the thread. The gauge-rod is thus pushed back, and as it is connected to the cotter C, the latter is pushed back with it, and the head *b* of the spindle B is thereby withdrawn from between the inward projections *d* on the cutter E, thereby leaving the cutters free to be acted upon by the springs F, which cause the cutters to spring inwardly towards the centre of the spindle, thereby carrying them free of the thread just cut and enabling the tap to be pulled out without the necessity of unscrewing it. When the mandrel A is connected to a drilling-machine, or other spindle, weighted or otherwise arranged to spring back when it has reached the end of its stroke, an arrangement is provided for re-expanding the cutters E so as to be ready to tap the next hole. This may be accomplished by pivoting at *k* a lever K or its equivalent to some stationary part of the machine, and against which the head G strikes when the mandrel is brought back. In this way the cotter C is pushed forward, and as the spindle B is attached to it the latter's head *b* is pushed between the cutters E, thereby causing them to expand. By screwing the spindle B into the cotter C it can be readily adjusted so that the head *b* will not be pushed forward further than is necessary to expand the cutters.

OXYGEN AS AN ANTIPYRETIC.

At the last session of the Royal Academy of Medicine of Madrid, the President introduced an innovation by allowing Senor Don Dr. Francisco Valenzuela, a non-member, to read a paper. The subject was "The Effect of Oxygen of High Tension upon the Animal Organism," and the amount of original investigation reported in it may well serve to justify the president of the Academy in departing from the time-honoured custom of confining the papers and speeches to academicians. Don Valenzuela began his researches by submitting rabbits to pure oxygen at various pressures. No effect on the temperature was produced at a lower pressure than 760mm., or five times the ordinary tension of the oxygen in the atmosphere. Under this, however, a rabbit whose initial temperature was 38·7° C. after an hour's sojourn in the chamber presented a temperature of 37·9° C. At still higher pressures of pure oxygen greater falls of temperature occurred. The highest tension at which experiments were made was 1,520mm.; this reduced a rabbit's temperature in an hour from 38·4° to 32·2°. The general effect on the animals of oxygen at the higher tensions was to produce a temporary torpor, and they came out of the chamber covered with moisture; in a very short time, however, they entirely recovered their ordinary condition. Some experiments were also made on the effect of oxygen of high tension on the febrile state, by inducing septicæmia in rabbits and comparing the course of the disease in those which were subjected to the action of oxygen with that in others kept under ordinary atmospheric conditions, with the general result that pyrexia appeared to be reduced by the sojourn in the oxygen chamber. In one case two rabbits were each inoculated with a cubic centimètre of serous fluid with a putrid smell from a dead body. One of them was then subjected for two hours to the action of oxygen of a tension seven times higher than that which it has in the air. Four hours subsequently the temperature showed a reduction of 1·7° C., the temperature of the other rabbit at the same time being 3° C. higher than the normal. The next day the body heat of the first rabbit was 1·5° C. and the second 3·1 C. above the normal. The first was replaced in the oxygen chamber under the same pressure, and for the same length of time as before, which reduced the temperature 2·2°—that is to say, to 0·7° below the normal. On the third day it was only 1° C. above the normal, while the second rabbit died. No further treatment was resorted to, and on the fourth day the first rabbit had regained its normal physiological condition. It was found in the various experiments made that when a small quantity of septic matter only was introduced, a single session in the oxygen chamber was sufficient to destroy the effect of the virus; but that if a high degree of sepsis was induced, the poison was only partially destroyed by a single session. Dr. Valenzuela then made some observations on patients. A young man was attacked by pneumonia, affecting both lungs, on April 26th. On the morning of the 27th the temperature was 39·5° C., and in the evening 40·4°. He was then put into the pneumatic chamber containing pure oxygen at a pressure of 950mm., or six times the ordinary tension of atmospheric oxygen, for an hour, after which his temperature was 1·7° C. lower. The next morning it was 39·2°. A second session in the chamber produced no immediate reduction, but four hours later the temperature was 39·0°. That evening it was 39·5°, and it gradually returned to normal, though no further sessions in the oxygen chamber were ordered. The man made a rapid recovery. Dr. Valenzuela likewise mentioned some other cases of pneumonia and tuberculosis on which the oxygen treatment appeared to have a beneficial action.—*Lancet.*

TRANSMISSION OF POWER AT THE MANCHESTER EXHIBITION.

ALTHOUGH much attention has been given to the transmission of power by electricity, and its application to electrical tramways and railways and the utilisation of water-power at a distance, the distribution of power by this means in workshops, factories, shipyards, and similar places has received comparatively little attention. At the same time there is no doubt that there is in this direction a very wide field for the use of electrical motors. This is especially so in those works where for various reasons the principal machines and tools are not driven from one common system of shafting, but have each an independent engine. Such is the case in printing works, where each printing machine is driven by its own engines; also in paper-mills, in rolling-mills, and in many shipbuilding yards, and other large engineering shops, where the heavier tools are necessarily distributed over a large area, and where it is important to have complete control over each individual tool. It is with the special intention of showing the applicability of the electrical driving in these cases and its advantages that Messrs. Mather and Platt have designed their exhibit at the Manchester Exhibition. As a typical case, and one in which the conditions to be met are most stringent, they have chosen one of their ten-colour calico printing machines, for printing calico with ten colours simultaneously. If electrical driving can be proved to be advantageous and economical for complex machinery of this class, where a slow speed under the most perfect control and at the same time high efficiency are essential, there is no doubt about its applicability in other cases where the conditions are less exacting.

A large printing machine, similar to the one exhibited, would be driven under ordinary circumstances by a double cylinder diagonal engine, with cylinder 10in. diameter, 12in. stroke, running at about 180 revolutions per minute. The star wheel of the printing machine when printing at full speed runs at 12 or 13 revolutions only, it is therefore necessary to reduce the speed by gearing. But where a dynamo-motor is used in place of the steam-engine, the speed of the motor must be much higher in order to obtain good efficiency without unduly increasing the size and cost of the motor. The motor employed at the Exhibition runs at 700 revolutions; hence the speed must be reduced in the ratio of 56·1. This is accomplished by a combination of belt and spur gearing. The dynamo shaft is fitted with a pulley 16½in. diameter, driving by means of a short belt on to a pulley 5¼in. diameter. In order to increase the grip of the small driving pulley on the belt Messrs. Mather *and Platt's system* of a loose "jockey" pulley is employed. The jockey pulley runs on a stud fixed on an arm projecting from the dynamo bed, and bears against the slack side of the belt. By an arrangement of worm and wheel the arm can be raised or lowered, moving the loose pulley with it, and consequently increasing or diminishing the angle at which the belt is bent over. By this means the surface of contact between the belt and the driving pulley can be increased, and the slack of the belt taken up, thus at the same time giving an adhesion equal to that of a long belt, and providing means for taking up the slack as the belt stretches. The speed is further diminished by a train of two internal spur wheels and pinions. The combination gives a most effective drive, perfectly noiseless, occupying no more space than the gear for reducing the speed of a steam engine, and under perfect control.

The printing machine is of Messrs. Mather and Platt's latest design for printing cloth up to 34in. wide, with from one to ten colours simultaneously, at a speed of 30 yards per minute. The machine is fitted with transverse motion for the doctors, long rollers, and steam drying. To work it at full speed from 15 to 20 horse-power is required. In order to set the pattern it is essential that the speed of the machine should be so under control that it can be made to "creep" round, and can be stopped in a fraction of a revolution, so as to enable the printer to see that the rollers, each printing one colour, are properly adjusted relatively to one another. With a steam-engine this is effected by a throttle valve on the steam inlet, the valve spindle being fixed conveniently accessible to the printing. But a steam-engine must have a flywheel, and the valves cannot be instantaneously closed, so that the machine cannot be stopped as quickly as might be desired. A dynamo motor, on the other hand, having no dead points, requires no flywheel, and the current can be instantaneously shut off, and consequently the machine brought to a stand more rapidly than is possible with steam-engine driving. The speed is regulated by a switch-board placed at one side of the machine at the printer's right hand, arranged to insert resistance in the circuit, and so lowering the speed of the motor to any desired extent. The whole floor space covered by the motor, driving gear, and resistance is somewhat less than that which a steam-engine would take, a point of much importance in print works.

The current is conveyed to the motor from a generating dynamo by an insulated copper cable carried under the floor of the Exhibition buildings. The generating dynamo is fixed in the dynamo house immediately adjacent to Messrs. Mather and Platt's pair of vertical engines and dynamos for lighting the fine art section. The distance from generator to motor is forty-five yards, but this might be greatly increased with very slight increase in the proportion of power lost in transmissions. The generating dynamo is also of the Manchester type, and is a similar machine to the motor, capable of generating 25 to 30 electrical horse-power at a speed of 950 revolutions per minute. It is driven by a double-cylinder diagonal engine with cylinders 8in. diameter, 10in. stroke, and running at 180 revolutions per minute, with a short belt driving on the same principle as that used with the motor. Although a separate engine and generating dynamo are provided this is not necessary, and the current could be obtained from any dynamo of sufficient power used for lighting or for working other motors. Arrangements have been made for connecting the motor cables to any of the four dynamos working the incandescent lamps in the art galleries. The whole loss in conversion from mechanical to electrical power in transmitting the electrical power and reconverting into mechanical power does not exceed 25 per cent. This is far more than compensated for by the fact that the engine driving the generating dynamo can be worked under the most economical conditions, which is impossible with an engine driving direct. No better illustration of this could be afforded than the fact that actually a smaller engine is employed for driving the generating dynamo than would have been employed had the printing machine been driven direct. In a large print works, where there are a considerable number of independent machines, the advantage will be still more conspicuous, for, in place of a separate small engine to each machine, working necessarily with low steam pressure, often with considerable back pressure, and generating under conditions where high efficiency is impossible, a single high-class engine can be used, working under the most favourable conditions with high pressure steam, high expansion proper automatic cut-off valves giving the highest efficiency. This engine would be employed to drive one or more generating dynamos, which might also be employed for lighting purposes, and from these cables would be taken to each independent machine worked by its own motor. Such a system has, moreover, the advantage of avoiding the necessity of steam and exhaust pipes and drain pipes for the engines running throughout the building—a point of considerable importance when the operations carried on require great cleanliness. Briefly, the advantages of the system of electrical motors for the distribution of power may be summarised: 1. Greater economy in consumption of fuel. 2. More perfect control over each individual machine. 3. Greater cleanliness. 4. The availability of the plant used for the distribution of power for electric lighting and other purposes.—*The Electrician.*

INSTANTANEOUS PHOTOGRAPHY WITH MAGNESIUM LIGHT.*

By Dr. H. W. Vogel.

INSTANTANEOUS photographs are now constantly being produced by every amateur, so that when taken in the ordinary way by daylight there is nothing in them to excite special attention. Instantaneous photography by artificial light, however, is quite a new departure; and, as shown at the last meeting of the Berlin Society for the Advancement of Photography, by Messrs. Gädicke and Miethe, the process excited much interest among the fraternity.

Mr. Gädicke stated that the inventors of the process had been for the last six months engaged in working it out, but had only now arrived at the point where it might be considered as practical. They used magnesium, but had abandoned the slow burning wire for the metal in a powdered state, and this in mixture with salts containing oxygen—*i.e.*, chlorate and nitrate of potassium. This had been done by many previously, but hitherto without complete success. The essence of the process is the employment of a mixture producing such a brilliant light and burning so rapidly as to permit the photographing instantaneously of living objects. Instantaneous pictures produced by this process had been shown by Mr. Gädicke at the meeting held on March 11th, but no one had guessed the means by which they had been produced, although a lively interest was displayed by the members. The method employed was first experimentally shown by Mr. Gädicke at the meeting of the 15th of April, since when others have followed in the same path, the first to do so being E. Vogel, jun.

The discovery of Gädicke and Miethe is, in fact, like the egg that Columbus stood on end. We, ourselves, four years since, experimented with magnesium flash-burning, but did not meet with success. At times the mixture burnt too slowly, and smoked too much. Sometimes the sitters were so much startled by the sudden blaze that we looked upon a successful photograph as out of the question, since the violent movements of the model excluded all hope of a sharp picture. Gädicke and Miethe have, however, shown us that instantaneous portraiture is quite practicable by the means indicated.

Still-life subjects, engravings, &c., have been photographed years since by the light from burning magnesium powder, but for portraits a fresh device was necessary, and this was hit upon by Gädicke and Miethe by the composition of the mixture for extremely rapid combustion, which they have brought to such perfection that the burning is accomplished in from the $\frac{1}{10}$th to the $\frac{1}{30}$th of a second. With powder thus prepared they have produced their results. My son also has on a first trial succeeded in taking a photograph of a group of six persons in a drawing-room at 11 o'clock p.m., using two grammes of magnesium powder. The exposure was made with a Steinheil's aplanatic lens, using full aperture at a distance of about three yards from the subject. The sitters were all startled by the sudden glare; nevertheless, the group on development came out perfectly sharp and properly exposed, proving that the movement of the sitters caused by the shock was subsequent to the action of the light upon the plate. On account of the want of a proper reflector, the shadow side of the figures was somewhat dark, but by no means hard. The inventors have introduced a very complete arrangement for making artistic portraits and for avoiding fumes, as they showed at the recent meeting of the society.

The powder was exploded in a lantern consisting of a strong flat case with a glass front. The can was impervious to the fumes, so that not a trace of them escaped. The lighting up of the shadows was accomplished by tinfoil reflectors, and the softening of the light was achieved by tissue paper interposed between the blaze and the sitter. In addition to this the speaker indicated another method, for use especially when interiors or large groups have to be photographed. This second method was also experimentally proved by the photographing of a group. The magnesium mixture was burned in a long trough of sheet iron, and, as a protection from direct light, sheets of tissue paper were hung in a line in front of the apparatus. A further toning down of the light may be obtained by using a second or third thickness of tissue paper, and this is so arranged in ront of a portion of the line of flame as to diminish its power upon those parts of the subject that are nearest to the light, and so by comparison to better lluminate the part of the subject farthest from the ight.

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* From the *Photographic News.*

The inventors and I have taken in this manner a great many instantaneous groups at night time; and they have described their method in a work llustrated by two collo-types from negatives taken n a drawing room with instantaneous magnesium ight.

The advantages of the method the authors describe as follows:—

"The portrait photographer is enabled by the means described to solve problems that have hitherto been either insoluble, or only overcome with the greatest difficulty.

"(1) To take portraits either by day or night.

"(2) To obtain during dull, heavy weather, especially in dark winter days, a bright, charmingly-ighted picture, by strengthening the light with a flash of magnesium light, and so giving piquancy o the illumination.

"(3) To take portraits without difficulty in the private houses of their customers.

"(4) To take sharp photographs, with certainty, of children and dogs, even in a state of the greatest unrest.

"A point of great importance is that magnesium ight may now also be used for photographing nteriors, since the whole illumination being concentrated in a moment, the fumes of the magnesium are harmless. They only form and spread when the exposure is over. Dark places may be lit up, and moving persons and things therein found be instantaneously photographed.

"Amateurs who have no studio erected need now no longer fear to take portrait photographs.

"The importance of instantaneous magnesium photography for all photo-chemical and physical purposes is very evident. We are now in a position, by the addition of sodium, lithium, barium, strontium, and lime salts to our light, to adapt it to the purposes for which colour-sensitive plates are used, as copying paintings, and the reproduction of coloured objects.

"It also becomes possible to produce instantaneous pictures with the highest magnifying power of our microscopes, and so to carry on researches on physiological actions, on the life of micro-organisms, on the formation of crystals, on molecular movements, &c., which have hitherto not been practicable.

"Various other applications to research, and in he arts, will be found; improvements will result herefrom, and that which is useless discarded. We, therefore, hope that our labours will not have been in vain. Our mixture, as well as the principle of our method of burning, we have protected by patent."

ON THE THEORY OF THE TELEPHONE: THE MONO-TELEPHONE OR ELECTRO-MAGNETIC RESONATOR.

By M. E. Mercadier.

IN a former paper (*Comptes Rendus* CI. pp. 744, 1,001) on the theory of the telephone, I think I showed that the magnetic diaphragm of this apparatus is animated by two different kinds of movements which are superposed. One kind consists of the movements of resonance, which are molecular and independent of the outward form; it is these that enable the diaphragm to transmit and reproduce all sounds, a characteristic property that ought to have been expressed in the very name of the telephone by calling it pan-telephone. The others are harmonic movements and are transversal, corresponding to the fundamental sound and the harmonics of the diaphragm, and depending on its elasticity, form, and structure; the former are prejudicial to the clear transmission of music and speech, for they alter the *timbre*, the harmonics only coinciding by the merest chance with those of the voice or instruments now in use. In order to place beyond the existence and superposition of these two kinds of movements, I endeavoured to make the one predominate over the other at will in the same diaphragm. This was effected by means of the following method, which I invented in 1881, and have merely simplified since. 1. The diaphragm of any telephone is placed in conditions favourable to its vibrating transversely freely, and in such a manner as to enable the division into nodal lines corresponding to a determined given sound to be produced. For this purpose, instead of the diaphragm being fixed at its edges, as is generally the case, it is simply placed as near as possible to the pole of the electro-magnet on a sufficient number of points of a nodal line. If it is a rectangular diaphragm, it is placed upon two rectilinear supports coinciding with the two nodal lines of the fundamental sound. If it is a circular diaphragm, three apertures are made, from two to three millimètres in diameter, at the angles of an equilateral triangle inscribed in the circumference which constitutes the nodal line of the first harmonic, and the disc is laid on three points of cork placed in a corresponding manner on a fixed straw and penetrating into the apertures. This being done, let us introduce into the bobbin of the apparatus a series of currents of very low intensity, and gradually decreasing period, for example, proceeding from the emission of musical sounds before any transmitter whatever, either telephonic or radiophonic. Then the telephonic receiver, modified as already described, only vibrates appreciably under the action of the currents whose period is equal to that of the corresponding sound at the nodal line on which the diaphragm rests, a sound which I will term particular or special: it is no longer pan-telephonic, it is mono-telephonic, and may therefore be called a mono-telephone. This result is not absolute. In reality, the diaphragm sounds some sub-harmonics of the special sound corresponding to the fixed nodal line; but their intensity is comparatively very low; and besides, the diaphragm reproduces somewhat lower or higher in period than the special sound, but the extreme interval between these sounds is very small, and does not generally exceed one or two commas.

These reservations are similar to those that have to be made in connection with resonators in acoustics. Likewise the kind of analysis that a mono-telephone makes of what we may term the electro-magnetic waves is analogous to that made of the sound waves by a resonator. In fact, if we communicate to them a series of successive or simultaneous waves of different periods, each of them selects in a certain degree that of the particular sound that corresponds to its geometrical form, and to the conditions in which it is placed, and greatly strengthens it. The mono-telephone might thus be termed an electro-magnetic resonator.

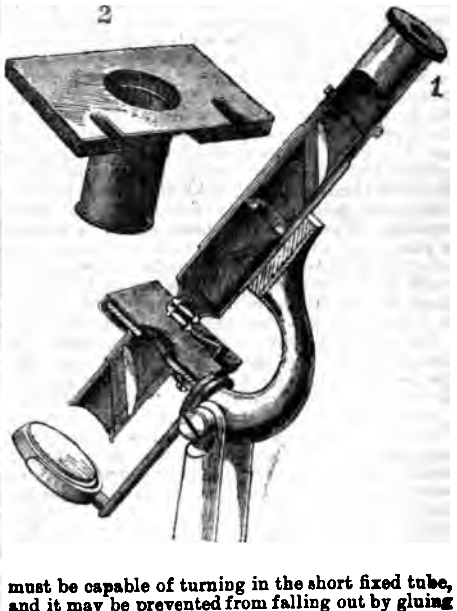
2. In the arrangement we have just described the transverse movements predominate, and it is easy to see the effect that they would have in an ordinary telephone; for if we try to reproduce by means of a mono-telephone articulate speech spoken into a transmitter, either we hear scarcely anything if the particular sound of the apparatus is not within the scale of the human voice (from the 2nd to the 4th C.), or else, in the contrary case, we only hear sounds modified in quality and muffled articulations, the whole being drowned, as it were, in the sonorousness of the special sound every time it occurs. But it is very easy to produce the opposite effect—viz., to make the molecular movements of resonance predominate over the transverse ones, and thus render the mono-telephone pan-telephonic, and make it reproduce all sounds with the same intensity and articulate speech with clearness. To do this it is sufficient to place obstacles in the way of the transverse harmonic vibrations by lightly fixing the edges or several points of the diaphragm; for example, by placing the finger on it in a certain manner. The most simple way of performing the experiment is as follows:—We receive into the mono-telephone various successive or simultaneous sounds, among which is the special sound or articulate speech at about the pitch of this sound. We place our ear to the diaphragm; while it is a certain distance away, or at the most just brushing it, we hear only the special sound; but as we apply the ear to the diaphragm more closely, the special sound becomes weaker and weaker, and at last we hear all sounds with equal intensity and articulate speech without any appreciable alteration of quality. By this very simple method we cause the movements of resonance to predominate over the transverse ones, and give to the apparatus the pan-telephonic property possessed by the ordinary telephone with fixed diaphragm.

STRONG DAMP-PROOF GLUE.

THE books are full of directions for making waterproof glues which do not "pan out" to be as waterproof as could be desired, so says an American paper. Many of the recipes have been designed by men who have but little knowledge of chemistry, and who misunderstand the terms which are sometimes used. Many of the best recipes for the glue are neglected, because people do not understand the reason for adding some of the strange ingredients which are recommended. Some of the best recipes have been omitted from the later books, because the authors have not taken pains to test what they rejected or recommended. Chemical experience does not always enable one to decide on the goodness of a given recipe or the usefulness of an ingredient in a mixture. For a strong glue which will hold in a damp place the following recipe works well. Glue prepared in this way will hold leather belts in deep cellars, wheel pits, and similar situations. Take of the best and strongest glue enough to make a pint when melted. Soak this until soft. Pour off the water as in ordinary glue making, and add a little water if the glue is likely to be too thick. When melted, add three tablespoonfuls of boiled linseed oil. Stir frequently, and keep up the heat till the oil disappears, which may take the whole day, and perhaps more. If necessary, add water to make up for that loss by evaporation. When no more oil is seen, a tablespoonful of whiting is added and thoroughly incorporated with the glue. Prepared in this way the glue is stronger than that made in the ordinary way, and resists dampness far better. It does not exactly come under the head of waterproof glue, though it is not affected by moisture. Glue of this kind has been used with success in fastening belts in wheel pits where the joint was constantly exposed to damp. The whiting cannot be omitted without injuring the glue very much. It contributes materially to the strength. Though a long time is required for the preparation, the value of the results is sufficient to amply repay the labour expended.

SIMPLE POLARISCOPE FOR THE TOY MICROSCOPE.*

THE possessor of an inexpensive microscope, or, in fact, of any other microscope not provided with a polariscope, will feel well repaid for his labour if he will construct and apply to his instrument a polariscope like that shown in the annexed engraving. The cash outlay for the material is 25 or 30 cents, and only an hour or so of time is required to complete the attachment. To the draw-tube of the microscope is fitted a paper tube, which is readily made by gumming writing paper and winding it around a cylindrical stick of the proper size. To the paper tube is fitted a second tube, and this last tube is cut diagonally through the centre at an angle of 35° 25′. One of these pieces is inserted in the first tube, and sixteen or eighteen elliptical glass covers, such as are used for covering mounted microscopic objects, are placed on the diagonally cut end of the inner tube. The glasses should be thoroughly cleaned, and when in position in the tube they are held by the remainder of the diagonally cut tube. The sectional view of the instrument clearly shows the position of these glasses in the draw-tube. The tube which goes under the stage is made in precisely the same way, and is supported in position for use by a short paper tube secured to a cardboard casing adapted to slide over the stage of the microscope, as shown in the engraving. Notches are formed in the rear edge of the upper part of the casing (Fig. 2) to allow it to slip by the slide-holding clips, as shown in Fig. 1. The lower tube must be capable of turning in the short fixed tube, and it may be prevented from falling out by gluing a cardboard band or a piece of small cord around its upper end, forming a sort of flange. The hole in the upper part of the casing is made larger than the movable tube, to admit of inserting the tube from the top of the casing. The part of the attachment below the stage is the polariser. The part in the draw-tube is the analyser. By turning the polariser, the light being thrown directly up the tube by the mirror, the field of the microscope will appear alternately light and dark, showing the partial extinguishment of the polarised beam twice during each revolution of the polariser. When the field is darkest, a piece of mica of the



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* From the Scientific American.

proper thickness inserted between the stage and objective renders the field light, and it may produce a colour effect, in addition to its depolarising effect. The colours depend on the thickness of the film or upon its position in the instrument. There are various chemical salts and animal and vegetable substances which produce brilliant colour effects in the polarised beam. Salicine is a favourite. Santonine is good. Tartaric acid, boracic acid, and cane sugar are easily prepared by allowing their solution to crystallise on the glass slip. Some of these substances, salicine for example, may be fused upon the slip and recrystallised. The colours may be heightened by placing a film of mica behind the object during examination. Different colours will be produced by different thicknesses of mica. Among animal substances to be examined in this way are fish scales, parings of the finger-nails and of horses' hoofs, parings of corns and of horn. Among vegetable substances, the sections of some woods, the cuticle of plants, the rush for example, form good polariscope objects. Many minerals show well in polarised light; but they are generally difficult of preparation. Selenite is an exception; it may be readily reduced to the proper thickness to secure brilliant effects. The polariscope above described, although not as desirable as one provided with a pair of Nicol prisms, is nevertheless worth having, and will give its possessor a great deal of satisfaction.

CENTRES FOR WOOD - TURNING.*

IN the closing paragraph of his article (see p. 341, Vol. XLIV.) Mr. Barrows says a centre might be devised for live spindle that would safely hold small light work, and would be a desirable tool; and as laziness and necessity, the father and mother of invention, led me to make such a tool some five years ago, which I have used more or less ever since, I will describe it for the benefit of the trade, first stating that I am a machinist, but make some patterns because I have to. Fig. 1 is a longitudinal section of the live centre, and Fig. 2 of the dead centre, while Figs. 3 and 4 are end views of the same, respectively. It will be seen that the dead centre is nearly the same as Mr. Barrows's Fig. 6 (loc. cit.), or the common point and ring centre, which is very old, while the live centre is of the same shape, although larger, but with four notches cut in the ring, which produces, or rather leaves, four teeth for holding and driving the work. There is, however, a radical difference between these centres and Mr. Barrows's Fig. 6, in that they are straight on the outside, instead of tapering, which latter form has a tendency to force the work apart, while mine do not. The dimensions of this pair of centres, which are the only ones I ever made, are as follows: Live centres, ¾in. diameter; dead centre, ½in. diameter; diameter of point, nearly 3/32in., and the points project beyond the edge of the ring 3/16in. The angle of the taper inside of the ring with the outside of the centre, or with its axis, is 30° in both centres. The teeth on the live centre are ¼in. long, and the circular groove in the dead centre is about 3/16in. deep. The teeth on the live centres are produced by cutting four notches, the side lines of which should be radial, in order to leave the teeth strong and not cut away the bevel inside the teeth too much, as this is what draws and holds the two halves of the work together. The teeth and spaces should be as near as possible of the same size, each tooth and each notch being one-eighth of the circle. These spaces could be cut with a milling cutter of the right shape, letting the cutter into the body of the centre in such a way as to clear the point of the centre.

These centres can be made of any size, and large sizes for live centres might be made of cast-iron, and to screw on the spindle, with a steel ring on the outside, in which to cut the teeth, and with the centre point inserted, as Mr. Barrows suggests. The two centres may be of the same diameter for large work; but a small dead centre is better for small work, as it does not tend to twist the work so much as a larger one, and on small work, having small core prints, this is important. I consider ¾in. for the live, and ½in. for the dead centre, as the smallest sizes that are needed; yet, with a little care, I have turned a split pattern, 12in. long and 3in. diameter, and small patterns, from 2in. to 8in. long, with 3/16in. core prints on each end.

These centres are as good for solid work as any, and patterns can be turned in four pieces, equally as well as in two pieces; and a half-round piece can be turned as well as a full round. The live centre drives very strong—I think as strong as any other—and the work never gets loose sideways. I have turned patterns for cored work of irregular shape in halves, and obtained the proper shape and size by trying one-half of the core pattern on one-half of the pattern, as the work can be taken out of the lathe and put back as often as necessary, the same as if solid. I also sometimes turn the round parts of solid patterns in halves, as it is often easier to make a pattern in that way. When a job is long and springy, of course it will need one or more screws in it, to prevent the centrifugal force from throwing it apart in the middle; but if these centres are of a size in proportion to the work, dogs and centre plates on the ends of the work can be entirely dispensed with.

In using these centres, after getting out the two pieces for a split pattern, put a hand-clamp on each end, if it is long enough; if not, then put on one, and make an awl hole in each end of the pattern, as near as possible in the joint. Then put the job in the lathe, and turn up the tail spindle, until both centres are far enough into the wood, and then take off the clamps, oil the dead centre, and go ahead. These centres should be tempered a low blue, about like a screw-driver. I do not claim that a half pattern can be turned with these centres, which shall be found, after turning, to have the joint exactly in the centre every time; but it will come very near, probably as near as any, for none of them are perfect.

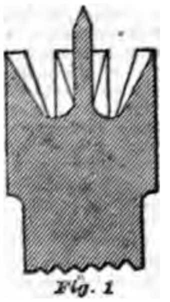
Fig. 1

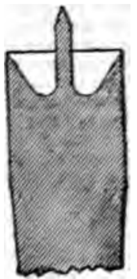
Fig. 2

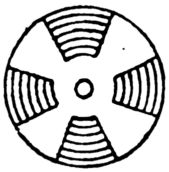
Fig. 3

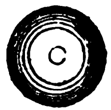
Fig. 4

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* By H. K. Porter, Boston, Mass., in the *American Machinist*.

MULTIPLEX PERSONALITY.*

By Frederic W. H. Myers.

I PURPOSE in this paper briefly to suggest certain topics for reflection—topics which will need to be more fully worked out elsewhere. My theme is the multiplex and mutable character of that which we know as the personality of man, and the practical advantage which we may gain by discerning and working upon this as yet unrecognised modifiability. I shall begin by citing a few examples of hysterical transfer, of morbid disintegration; I shall then show that these spontaneous readjustments of man's being are not all of them pathological or retrogressive; nay, that the familiar changes of sleep and waking contain the hint of further alternations which may be beneficially acquired. And, lastly, I shall point out that we can already by artificial means induce and regulate some central nervous changes which effect physical and moral good; changes which may be more restorative than sleep, more rapid than education. Here, I shall urge, is an avenue open at once to scientific and to philanthropic endeavour, a hope which hangs neither on fable nor on fancy, but is based on actual experience and consists with rational conceptions of the genesis and evolution of man.

I begin, then, with one or two examples of the pitch to which the disassociation of memories, faculties, sensibilities may be carried, without resulting in mere insane chaos, mere demented oblivion. These cases as yet are few in number. It is only of late years—and it is mainly in France—that *savants* have recorded with due care those psychical lessons, deeper than any art of our own can teach us, which natural anomalies and aberrant instances afford.

Pre-eminent among the priceless living documents which nature thus offers to our study stand the singular personages known as Louis V. and Félida X. Félida's name at least is probably familiar to most of my readers; but Louis V.'s case is little known, and although some account of it has already been given in English, it will be needful to recall certain particulars in order to introduce the speculations which follow.

Louis V. began life (in 1863) as the neglected child of a turbulent mother. He was sent to a reformatory at ten years old, and there showed himself, as he has always done when his organisation has given him a chance, quiet, well-behaved, and obedient. Then at fourteen years old he had a great fright from a viper—a fright which threw him off his balance and started the series of psychical oscillations on which he has been tossed ever since. At first the symptoms were only physical, epilepsy and hysterical paralysis of the legs; and at the asylum of Bonneval, whither he was next sent, he worked at tailoring steadily for a couple of months. Then suddenly he had a hystero-epileptic attack—fifty hours of convulsions and ecstasy—and when he awoke from it he was no longer paralysed, no longer acquainted with tailoring, and no longer virtuous. His memory was set back, so to say, to the moment of the viper's appearance, and he could remember nothing since. His character had become violent, greedy, and quarrelsome, and his tastes were radically changed. For instance, though he had before the attack been a total abstainer, he now not only drank his own wine, but stole the wine of the other patients. He escaped from Bonneval, and after a few turbulent years, tracked by his occasional relapses into hospital or madhouse, he turned up once more at the Rochefort asylum in the character of a private of marines, convicted of theft but considered to be of unsound mind. And at Rochefort and La Rochelle, by great good fortune, he fell into the hands of three physicians—Professors Bourru and Burot, and Dr. Mabille—able and willing to continue and extend the observations which Dr. Camuset at Bonneval, and Dr. Jules Voisin at Bicêtre, had already made on this most precious of *mauvais sujets* at earlier points in his chequered career.

He is now no longer at Rochefort, and Dr. Burot informs me that his health has much improved, and that his peculiarities have in great part disappeared. I must, however, for clearness sake, use the present tense in briefly describing his condition at the time when the long series of experiments were made.

The state into which he has gravitated is a very unpleasing one. There is paralysis and insensibility of the right side, and (as is often the case in right hemiplegia) the speech is indistinct and difficult. Nevertheless, he is constantly haranguing anyone who will listen to him, abusing his physicians, or preaching, with a monkey-like impudence rather than with reasoned clearness, radicalism in politics, and atheism in religion. He makes bad jokes, and if anyone pleases him he endeavours to caress him. He remembers recent events during his residence at the Rochefort asylum, but only two scraps of his life before that date—viz., his vicious period at Bonneval and a part of his stay at Bicêtre.

Except this strangely fragmentary memory there is nothing very unusual in this condition, and in many asylums no experiments on it would have been attempted. Fortunately, the physicians of Rochefort were familiar with the efficacy of the contact of metals in provoking transfer of hysterical hemiplegia from one side to the other. They tried various metals in turn on Louis V. Lead, silver, and zinc had no effect. Copper produced a slight return of sensibility in the paralysed arm; but steel, applied to the right arm, transferred the whole insensibility to the left side of the body.

Inexplicable as such a phenomenon certainly is, it is sufficiently common (as French physicians hold) in hysterical cases to excite little surprise. What puzzled the doctors was the change of character which accompanied the change of sensibility. When Louis V. issued from the crisis of transfer, with its minute of anxious expression and panting breath, he was what might fairly be called a new man. The restless insolence, the savage impulsiveness, have wholly disappeared. The patient is now gentle, respectful, and modest. He can speak clearly now, but he only speaks when he is spoken to. If he is asked his views on religion and politics, he prefers to leave such matters to wiser heads than his own. It might seem that morally and intellectually the patient's cure had been complete.

But now ask him what he thinks of Rochefort; how he liked his regiment of marines. He will blankly answer that he knows nothing of Rochefort, and was never a soldier in his life. "Where are you, then, and what is the date of to-day?" "I am at Bicêtre; it is January 2nd, 1884; and I hope to see M. Voisin to-day, as I did yesterday."

It is found, in fact, that he has now the memory of two short periods of life (different from those which he remembers when his *right* side is paralysed), periods during which, so far as can now be ascertained, his character was of this same decorous type and his paralysis was on the left side.

These two conditions are what are now termed his first and his second, out of a series of six or more through which he can be made to pass. For brevity's sake I will further describe his fifth state only.

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* From the *Proceedings* of the Society for Psychical Research.

If he is placed in an electric bath, or if a magnet e placed on his head, it looks at first sight as rough a complete physical cure had been effected. ll paralysis, all defect of sensibility, has disppeared. His movements are light and active, is expression gentle and timid. But ask him here he is, and you find that he has gone back to boy of 14, that he is at St. Urbain, his first reormatory, and that his memory embraces his years childhood, and stops short on the very day when e had the fright with the viper. If he is pressed recollect the incident of the viper, a violent ileptiform crisis puts a sudden end to this phase his personality.

Is there, then, the reader may ask, any assignable w which governs these strange revolutions? Any ason why Louis V. should at one moment seem a ere lunatic or savage, at another moment should se into decorous manhood, at another should rever his physical soundness, but sink backward in ind into the child? Briefly, and with many serves and technicalities perforce omitted, the ew of the doctors who have watched him is somehat as follows: A sudden shock, falling on an nstable organisation, has effected in this boy a rofounder severance between the functions of e right and left hemispheres of the brain an has perhaps ever been observed before. e are accustomed, of course, to see the ght side of the body paralysed and insensible in consequence of injury to the left emisphere, which governs it, and *vice-versâ*. And e are accustomed in hysterical cases—cases where here is no actual traceable injury to either hemiphere—to see the defects in sensation and motility hift rapidly—shift, as I may say, at a touch—rom one side of the body to the other. But we annot usually trace any corresponding change in he mode of functioning of what we assume as the highest centres," the centres which determine hose manifestations of intelligence, character, nemory, on which our identity mainly depends. et in some cases of aphasia and of other forms of semia (the loss of power over signs, spoken or vritten words, and the like) phenomena have occurred which have somewhat prepared us to find hat the loss of power to use the left—which certainly is in some ways the more developed—hemisphere may bring with it a retrogression in the higher characteristics of human life. And the singular phenomenon of automatic writing (as I have previously tried to show) seems often to depend on an obscure action of the less-used hemisphere. Those who have followed these lines of observation may be somewhat prepared to think it possible that in Louis V.'s case the alternate predominance of right or left hemisphere affects memory and character as well as motor and sensory innervation. Inhibit his left brain (and right side) and he becomes, as one may say, not only left-handed but *sinister*; he manifests himself through nervous arrangements which have reached a lower degree of evolution. And he can represent in memory those periods only when his personality had assumed the same attitude, when he had crystallised about the same point.

Inhibit his right brain, and the higher qualities of character remain, like the power of speech, intact. There is self-control; there is modesty; there is the sense of duty—the qualities which man has developed as he has risen from the savage level. But, nevertheless, he is only half himself. Besides the hemiplegia, which is a matter of course, memory is truncated too, and he can summon up only such fragments of the past as chance to have been linked with this one abnormal state, leaving unrecalled not only the period of sinister inward ascendency, but the normal period of childhood, before his *Wesen* was thus cloven in twain. And now if by some art we can restore the equipoise of the two hemispheres again, if we can throw him into a state in which no physical trace is left of the severance which has become for him a second nature, what may we expect to find as the psychical concomitant of this restored integrity? What we *do* find is a change in the patient which, in the glimpse of psychical possibilities which it offer us, is among the most interesting of all. He is, if I may so say, born again; he becomes as a little child; he is set back in memory, character, knowledge, powers to the days before this trouble came upon him or his worse self assumed its sway.

I have begun with the description of an extreme case, a case which, to many of my readers may seem incredible in its bizarrerie. But though it is extreme it is not really isolated; it is approached from different sides by cases already known. The mere resumption of life at an earlier moment, for instance, is, of course, only an exaggeration of a phenomenon which frequently appears after cerebral injury. The trainer, stunned by the kick of a horse, completes his order to loosen the girths the moment that trepanning has been successfully performed. The old lady struck down at a card party, and restored to consciousness after a long insensibility, surprises her weeping family by the inquiry, "What are trumps?" But in these common cases there is but a morsel cut out of life; the personality reawakens as from sleep, and is the same as of old. With Louis V. it is not thus; the memories of the successive stages are not lost, but juxtaposed, as it were, in separate compartments; nor can one say what epochs are in truth intercalary, or in what central channel the stream of his being flows.

Self-severances profound as Louis V.'s are naturally to be sought mainly in the lunatic asylum. There, indeed, we find duplicated individuality in its grotesquer forms. We have the man who has always lost himself, and insists on looking for himself under the bed. We have the man who maintains that there are two of him, and sends his plate a second time, remarking, "I have had plenty, but the other fellow has not." We have the man who maintains that he is himself and his brother too, and when asked how he can possibly be both at one, replies, "Oh, by a different mother."

Or sometimes the personality oscillates from one focus to another, and the rival impulses, which in us merely sway different moods, objectify themselves each in a *persona* of its own. An hysterical penitent believes herself one week to be "Sœur Marthe des Cinq Plaies," and the next week relapses into an imaginary "Madame Poulmaire," with tastes recalling a quite other than conventual model. Another patient seems usually sane enough, but at intervals he lets his beard grow, and is transformed into a swaggering lieutenant of artillery. The excess over, he shaves his beard and becomes once more a lucid though melancholy student of the Early Fathers. Such changes of character, indeed, may be rapid and varied to any extent which the patient's experience of life will allow. In one well-known case a poor lady varied her history, her character, even her sex, from day to day. One day she would be an emperor's bride, the next an imprisoned statesman—

> Juvenis quondam, nunc femina, Cæneus,
> Rursus et in veterem fato revoluta figuram.

Yet more instructive, though often sadder still, are the cases where the disintegration of personality has not reached the pitch of insanity, but has ended in a bewildered impotence, in the horror of a lifelong dream. Speaking generally, such cases fall under two main heads—those where the loss of control is mainly over *motor* centres, and the patient can feel but cannot act; and those where the loss of control is mainly over *sensory* centres, and the patient acts but cannot feel.

Inability to act just as we would wish to act is a trouble in which we most of us share. We probably have moods in which we can even sympathise with that provoking patient of Esquirol's, who, after an attack of monomania, recovered all those social gifts which made him the delight of his friends, but could no longer be induced to give five minutes' attention to the most urgent business. "Your advice," he said cordially to Esquirol, "is thoroughly good. I should ask nothing better than to follow it, if you could further oblige me with the power to *will* what I please." Sometimes the whole life is spent in the endeavour to perform trifling acts—as when a patient of M. Billod's spent nearly an hour in attempting to make the flourish under his signature to a power of attorney; or tried in vain for three hours, with hat and gloves on, to leave his room and go out to a pageant which he much wished to see. Such cases need heroic treatment, and this gentleman had the luck to be caught and cured by the Revolution of 1848.

Still more mournful are the cases where it is mainly the sensory centres which lie, as it were, outside the personality; where thought and will remain intact, but the world around no longer stirs the wonted feelings, nor can reach the solitary soul. "In all my acts one thing is lacking—the sense of effort that should accompany them, the sense of pleasure that they should yield." "All things," said another sufferer, "are immeasurably distant from me; they are covered with a heavy air." "Men seem to move round me," said another, "like moving shadows." And gradually this sense of ghostly vacancy extends to the patient's own person. "Each of my senses, each part of me, is separate from myself." "J'existe, mais en dehors de la vie réelle." It is as though Teiresias, who alone kept his true life in unsubstantial Hades, should at last feel himself dream into a shade.

Sometimes the regretful longing turns into a bitter sense of exile, of banishment, of fall from high estate. There are words that remind us of the passionate protestations of Empedocles, refusing to accept the earth as his veritable home. Κλαῦσά τε καὶ κώκυσα, said the Sicilian of Sicily, ἰδὼν ἀσυνήθεα χῶρον ("I wept and lamented, looking on a land to me unwonted and unknown"). "Lorsque je me trouvais seul," said a patient of Krishaber's, "dans un endroit nouveau, j'étais comme un enfant nouveau-né, ne reconnaissant plus rien. J'avais un ardent désir de revoir mon ancien monde, de redevenir l'ancien moi; c'est ce désir qui m'a empêché de me tuer."

These instances have shown us the *retrogressive* change of personality, the dissolution into incoordinate elements of the polity of our being. We have seen the state of man like a city blockaded, like a great empire dying at the core. And of course a spontaneous, unguided disturbance in a machinery so complex is likely to alter it more often for the worse than for the better. Yet here we reach the very point which I most desire to urge in this paper. I mean that even these spontaneous, these unguided disturbances, do sometimes effect a change which is a marked improvement. Apart from all direct experiment, they show us that we are, in fact, capable of being reconstituted after an improved pattern, that we may be fused and recrystallised into greater clarity; or, let us say more modestly, that the shifting sand-heap of our being will sometimes suddenly settle itself into a new attitude of more assured equilibrium.

Among cases of this kind which have thus far been recorded, none is more striking than that of Dr. Azam's often-quoted patient, Félida X.

Many of my readers will remember that in her case the somnambulic life has become the normal life; the "second state," which appeared at first only in short, dream-like accesses, has gradually replaced the "first state," which now recurs but for a few hours at long intervals. But the point on which I wish to dwell is this: that Félida's second state is altogether *superior* to the first—physically superior, since the nervous pains which had troubled her from childhood have disappeared; and morally superior, inasmuch as her morose, self-centred disposition is exchanged for a cheerful activity which enables her to attend to her children and her shop much more effectively than when she was in the "état bête," as she now calls what was once the only personality that she knew. In this case, then, which is now of nearly 30 years' standing, the spontaneous readjustment of nervous activities—the second state, no memory of which remains in the first state—has resulted in an improvement profounder than could have been anticipated from any moral or medical treatment that we know. The case shows us how often the word "normal" means nothing more than "what happens to exist." For Félida's *normal* state was in fact her *morbid* state; and the new condition, which seemed at first a mere hysterical abnormality, has brought her to a life of bodily and mental sanity which makes her fully the equal of average women of her class.

Now, before we go further, let us ask ourselves whether this result, which sounds so odd and paradoxical, ought in reality to surprise us? Had we any reason for supposing that changes as profound as Félida's need always be for the worse, that the phase of personality in which we happen to find ourselves is the phase in which, given our innate capacities, it is always best for us to be?

To make this question more intelligible, I must have recourse to a metaphor. Let us picture the human brain as a vast manufactory, in which thousands of looms, of complex and differing patterns, are habitually at work. These looms are used in varying combinations; but the main driving-bands, which connect them severally or collectively with the motive power, remain for the most part unaltered.

Now, how do I come to have my looms and driving-gear arranged in this particular way? Not, certainly, through any deliberate choice of my own. My ancestor the ascidian, in fact, inherited the business when it consisted of little more than a single spindle. Since his day my nearer ancestors have added loom after loom. Some of their looms have fallen to pieces unheeded; others have been kept in repair because they suited the style of order which the firm had at that time to meet. But the class of orders received has changed very rapidly during the last few hundred years. I have now to try to turn out altruistic emotions and intelligent reasoning with machinery adapted to self-preserving fierceness or manual toil. And in my efforts to readjust and reorganise I am hindered not only by the old-fashioned type of the looms, but by the inconvenient disposition of the driving gear. I cannot start one useful loom without starting a dozen others that are merely in the way. And I cannot shift the driving gear to suit myself, for I cannot get at much of it without stopping the engines, and if I stopped my engines I should not know how to set them going again. In this perplexity I watch what happens in certain factories—Félida's, for instance—where the hidden part of the machinery is subject to certain dangerous jerks or dislocations, after which the gearings shift of themselves, and whole groups of looms are connected and disconnected in a novel manner. From hence I get at least a hint as to the concealed attachments; and if I see that new arrangement working well I have an object to aim at; I can try to produce a similar change, though a smaller one, among my own looms and by my own manipulation.

For even if these profoundest spontaneous changes are beyond the reach of imitation, there are smaller changes, long familiar to us, which we now see in a new light, as imitable in a manner which shall reproduce their advantages without their drawbacks. There is the painless trance which sometimes supervenes in hysteria; there is the action of alcohol; there is especially the action of opium, which from the first commended itself by its *physical* effect, by the emotional tranquillity which it induces. Such at least seems to be the inference from the well-known passage where the wifely Helen determines to gives her husband and his friends the chance of talking comfortably, without interrupting themselves by perpetual tears and lamentations.

Then heaven-born Helen in their cups would throw
Nepenthes, woeless banisher of woe:
This whoso drank daylong no tear should shed—
No, though he gazed on sire and mother dead;
No, though his own son on that dreamy day
Before his own eyes raging foes should slay.

The successive discoveries of intoxicants, narcotics proper, and anæsthetics formed three important stages in our growing control over the nervous system. Mesmer's discovery, or rather his rediscovery of a process probably at least as old as Solon, marked an epoch of quite equal significance. And the refinements on Mesmer's process which this country has seen, the discoveries linked with the names of Puységur, Esdaile, Braid, Charcot, &c., though often set forth with an air of controversy rather than of co-operation, will gradually be recognised as mutually concordant elements in a new branch of moral as well as physical therapeutics. Nay, it is a nascent art of self-modification; a system of pulleys (to return to our previous metaphor), by which we can disjoin and reconnect portions of our machinery which admit of no directer access.

(*To be continued.*)

John Bright on Kindness to Animals.—In connection with his speech last week at Rochdale on the desirability of teaching children in Sunday schools lessons of kindness to animals and to each other, the conductor of the "Children's Corner" in the *Weekly Times and Echo* has received a very kind letter from Mr. John Bright. The Children's Society in question, which numbers many thousands of members, pledges its adherents "to defend the weak against the strong, to be kind to all dumb creatures, to avoid all cruelty to human being, bird, or beast, to be guilty of no rudeness to the poor, and to be friendly to one another." All children can join, and it is hoped that many Sunday-school teachers, mindful of Mr. Bright's remarks, may be induced to assist. In his letter Mr. Bright says: "'The Children's Corner' in the *Weekly Times and Echo* will, I believe, be very interesting and instructive to young people. I hope very many of them may gather information and much good from your labours in their behalf. It is pleasant to me to know that my speech has given you satisfaction."

The Temperature of the Skin.—The experiments of Davy long ago demonstrated irrefutably that the temperature of the interior of the body varied little in man with race, climate, or season; yet it is familiar to all that the temperature of the skin varies considerably in different parts—the extremities, for example, and those parts of the skin in which the circulation is feeble being cooler than other parts. Quite recently some interesting experiment to determine these variations of the surface have been made by Prof Kunkel at Wurzburg. Taking the skin of the face in the first instance, he finds that in men from twenty to thirty years of age it varies from 85° to 89° F., with an approximate average of 88°. The skin of the more exposed parts of the body, as the tip of the nose and the lobules of the ear, in which the circulation is slow and feeble, exhibited a lower temperature, not exceeding in many instances 75°, or even descending as low as 71·5°. The skin covering the muscular portion of the body is warmer than that over the bones and tendons. Contraction of the muscles caused the temperature of the superjacent portion of skin to rise one degree or more. The decrease of temperature from the skin to the outer covering in a room at a temperature of 63° was as follows: on the skin 88°, on the linen shirt 82°, on the vest 75°, and on the coat 72°. The highest temperature was found to occur in men in the full vigour of life. As a singular fact, Dr. Kunkel states that children otherwise in perfect health showed a much lower degree of surface temperature—from 77° to 84°—than adults. He does not appear to have followed out Prof Lombard's observations on the temperature of the head.—*Lancet.*

A NEW use for the tobacco plant has been discovered. Its stems and waste, it is claimed, are equal to linen rags in the manufacture of paper. Tobacco waste costs less than £2 a ton, linen rags £11. There is no expense in assorting the former and very little shrinkage, as against a loss of one-third of rags. The yearly tobacco waste is estimated by the census reports at from 3,000,000 to *to 4,000,000 pounds.*

SCIENTIFIC NEWS.

AMENDED elements of Barnard's new comet have been computed by Dr. H. Oppenheim, and they have been published in the Dun Echt Circular No. 147. The period of perihelion passage is now computed at June 17·2209 Berlin M.T.; π — ☊ 15° 40′ 19″; ☊ 245° 13′ 1″; i 17° 31′ 52″; log. q 0·14288. The position for Berlin midnight is—

	R.A.	S. Dec.
June 11	16h. 9m. 11s.	9° 22·7′
13	16 13 43	7 50·3
15	16 18 17	6 20·5
17	16 22 51	4 53·9

After the last date the brightness decreases.

The *Rapport Annuel sur l'état de l'Observatoire de Paris*, for 1886, by Contre-Amiral Mouchez, contains some interesting notes and an illustration of the macro-micrometer, constructed by M. Gautier under the direction of MM. Henry, for the measurement of the relative distances of stars on their photographs. Admiral Mouchez, referring to M. Loewy's proposed methods of determining the constants of refraction and aberration, hopes to be able to attack during the present year the problems indicated, with the aid of an instrument constructed on M. Loewy's plan. The general work of the observatory has been carried on with assiduity, no fewer than 16,505 meridian observations having been made during the year.

According to the *Athenæum*, although no Government expedition is to be sent out to observe the solar eclipse of August 19, several parties are being organised to take up positions at advantageous points. The nearest of these is, it appears, in the neighbourhood of Moscow. That city is itself a little to the south of the line of totality; but three railways radiating from it will afford easy access to places on this line. One of these is Kineshma (a small town on the Volga, a few miles to the east of Kostroma), near which Prof. Bredichin, the Director of the Moscow Observatory, has a house containing a private observatory, to which he has invited two English astronomers through the Royal Astronomical Society—an offer which has been accepted on behalf of Dr. Copeland and the Rev. S. J. Perry. Prof. C. A. Young, of the Princeton Observatory, New Jersey, also proposes to observe the eclipse at Kineshma; whilst two English (Mr. Common, of Ealing, and Mr. Turner, of the Royal Observatory, Greenwich), and two Italian (Profs. Tacchini and Riccò) astronomers are to be located somewhat nearer Moscow, in the government of Vladimir. Three parties, two German and one French, will, moreover, take up stations in the government of Tver, to the north of Moscow. The duration of totality will be longest in the south-eastern part of Siberia, which will possess the additional advantage of having the sun at the time of the eclipse much higher than it will be in Europe. At no great distance to the east of Irkutsk the totality will last nearly four minutes, while at Kineshma it will be only about two minutes and a half, and in Japan little more than three minutes. It is to be hoped, therefore, that the Russian astronomers will not fail to occupy positions at some of the most convenient Siberian localities. Near Perm, to proceed to which Col. Tupman has organised an English party, the totality will last 156 seconds, and the sun will be about 28° high at mid-eclipse. In England, it may be remarked, the sun will rise partially eclipsed, but the eclipse will be over a few minutes after sunrise. The westernmost point at which the eclipse can be seen total (just after sunrise) is in Prussia, and in Poland the sun will be very low at the time of totality.

In reference to the coming eclipse of the sun, we may mention that in connection with the Liverpool Astronomical Society special arrangements have been made with Messrs. Thomas Cook and Son for a trip to Jaroslav to view the total eclipse. The tour will occupy 16 days, and various places of interest will be visited *en route.* Total cost, £45, but full particulars can be obtained from the Rev. S. J. Johnson, who has kindly consented to organise the expedition. Members who would like to combine for a cheaper and quicker route are invited to send in their names to the secretary, who will do his best to make satisfactory arrangements. Advice and information from members acquainted with the country will be highly esteemed.

The annual general meeting of the Liverpool Astronomical Society will be held in the rooms of the R.A.S., at Burlington House on Friday, July 8, the chair to be taken at 3 p.m.

Another minor planet, No. 267, has been discovered—this time by M. Charlois, of M. Bischoffsheim's Observatory at Nice, on May 28.

The Council of the Royal Meteorological Society are desirous of obtaining a collection of photographs of lightning flashes, and they would esteem it a favour if anyone who can assist will send them copies of any photographs of flashes already taken, or will endeavour to take photographs. The Council say that the photography of lightning does not present any particular difficulties. If a rapid plate and an ordinary rapid doublet with full aperture be left uncovered at night during a thunderstorm for a short time, flashes of lightning will after the development be found in some cases to have impressed themselves upon the plate. The only difficulty is the uncertainty whether any particular flash will happen to have been in the field of view. The Council hope that now the thunderstorm season is approaching, many photographers may be found willing to take up this interesting branch of their art.

The fifty-fifth annual exhibition of the Royal Cornwall Polytechnic Society will be held at Falmouth in September next, opening on the 6th. The prize list has been issued, and can be had on application to Mr. E. Kitto, F.R.Met.Soc., Polytechnic Hall, Falmouth.

We have received a copy of the *Tansactions* and Annual Report of the Manchester Microscopical Society, which contains some interesting papers and is an encouraging sign of the interest now taken in scientific matters—though for that matter Lancashire has always been noted as the home of many distinguished workers, both well known and humble.

At a recent meeting of the Anthropological Institute, Dr. G. Harley read a paper on the recuperative powers of man living in a rude and in a highly-civilised state, in which he brought forward a number of hitherto unpublished, though mostly well-known, facts, demonstrating that the refining influence of civilisation had not been altogether the unalloyed boon we imagine it to have been; for the cases cited went far to demonstrate the fact that while man's physique as well as his mental power had increased during his evolution from a barbaric state into a condition of *bienséance*, his recuperative capacity, on the other hand, has materially deteriorated. In fact, it appeared from the examples cited that every appliance adding to man's bodily comfort, as well as every contrivance either stimulating or developing his mental faculties, while increasing his personal enjoyment, materially diminishes his animal vitality—rendering him less able to resist the effects of lethal bodily injuries, or recover from them as well and as quickly as his barbaric ancestors or his less favoured brethren.

A scientific exhibition, connected with the sixtieth congress of German naturalists and physicians, will be held in Wiesbaden from the 15th to the 24th of September next. It will be strictly scientific, not mercantile, and its purpose will be to show at a glance the latest and most perfected instruments and apparatus, which have been placed at the disposal of science and medicine in the last few years. The following groups will form part of it:—Surgery, physical diagnosis and therapeutics; ophthalmology, gynæcology; laryngology, rhinology, and otiatry; orthopædia, dentistry, chemistry, instruments of precision, with subdivision for microscopy; instruments and apparatus aiding instruction in natural history, geography, equipment for scientific travel, photography, anthropology, biology and physiology, hygiene, electro-therapeutics and neurology, and pharmacology. Applications are to be addressed to the Ausstellungs Committee der 60 Versammlung Deutscher Naturforscher und Aerzte, 44, Frankfürterstrasse, Wiesbaden.

The Orient liner *Ormuz* recently [illegible] lished a remarkably quick [illegible] ustralia (see p. 241); but it appears that her ster vessel, the *Oroya* has the record now, aving run from Adelaide to Plymouth, 0,664 miles, in the unprecedentedly short apparent time of 32 days 12 hours, including ransit of the Suez Canal and all stoppages. hese delays having amounted to 2 days, ½ hours, the actual steaming time allowing r difference of longitude, was 30 days 15 ours.

The Cunard liner, *Umbria*, has lowered the ecord for the passage between Queenstown nd New York, having reached the latter port ast Saturday in 6 days 2 hours 37 min. from ueenstown.

The twenty-fourth annual general meeting f the members of the Gas Institute will be eld at the Corporation Galleries, Glasgow, on uesday, Wednesday, and Thursday, June 28, 9, and 30. The Glasgow Corporation Gas Vorks will be visited on the Wednesday.

The Accademia dei Lincei at Rome has publshed in its *Atti* the results of a careful study, y Messrs. Taramelli and Mercalli, of the series f earthquakes in Andalusia, which commenced in 1884, and have continued more or less interruptedly up to the present time. It appears that earthquakes are more frequent in the littoral regions of Spain than in the interior, and more common in the south than in the north. The Andalusian shocks proceeded from a focus of ellipsoidal form situated at a depth of 12 or 13 kilometres. From this centre the waves were propagated in all directions; but most freely and with relatively less destructive effects in the hard crystalline rocks of the archæan and palæozoic series. The greater number of earthquakes in Spain occur in the autumn and winter.

According to Prof. Woodward, of Washington, in about 2,200 years the rock over which the falls flow at Niagara will be all worn away. The area of the rock worn away at the Horseshoe Falls, between the years 1842 and 1875 was 18,500 square feet, equal to 0·425 acres; between 1875 and 1886, 60,000 square feet, or 1·37 acre. The main length of the contour of the falls is 2,300ft. The time required to recede one mile, if the rate is 2·4ft. yer year, is 2,200 years.

In a pamphlet issued lately by the United States Hydrographic Office, Lieut. Underwood says that mineral oils are not so effective for use at sea as vegetable or animal. A comparatively small amount of the right kind of oil—say two quarts per hour, properly used—is sufficient, he asserts, to prevent much damage, both to vessels and to small boats, in heavy seas. The greatest result from oil is obtained in deep water. In a surf, or where water is breaking on a bar, the effect is not so certain; but, even in this case, oil may be of benefit, and its use is recommended by Lieut. Underwood. He advises that, when an attempt is about to be made to board a wreck, the approaching vessel should use the oil after running as close as possible under the lee of the wreck. The wreck will soon drift into the oil, and then a boat may be sent alongside of her.

It is the present intention of the United States Fish Commission to send the steamer *Albatross* to the Pacific shores next year to conduct there investigations similar to those which have been carried on for the past fifteen years along the Atlantic coast of the United States. The Commission is now engaged in preparing, in connection with the Signal Service and Light-House Board, temperature charts of the Atlantic from Maine to Florida. These are to have isothermals of ten-day means, and it is hoped that they will throw considerable light upon the migrations of the more important of the economic fishes.

The fifty-seventh annual meeting of the British Association for the Advancement or Science will commence at Manchester on Wednesday, August 31, the president being Sir H. E. Roscoe, M.P., LL.D., Ph.D., F.R.S., V.P.C.S. Tickets for the meeting may be obtained of the local secretaries at Manchester on and after August 17, and from that date to August 25, at the office of the Association, 22, Albemarle-street, London, W., or on application by letter to the General Treasurer, Professor A. W. Williamson, British Association, University College, London, W.C. The Reception Room at Manchester, will be opened on Monday, August 29, at 1 p.m., and on the following days at 8 a.m., for the issue of tickets to members, Associates, and ladies, according to the statement given above, and for supplying lists and prices of lodgings, and other information, to strangers on their arrival. No tickets will be issued after 6 p.m. The first general meeting will be held on Wednesday, August 31, at 8 p.m. precisely, when Principal Sir William Dawson, C.M.G., M.A., LL.D., F.R.S., F.G.S., will resign the chair, and Sir H. E. Roscoe, B.A., Ph.D., LL.D., M.P., F.R.S., F.C.S., president elect, will assume the presidency, and deliver an address. On Thursday evening, September 1, at 8 p.m., a soirée; on Friday evening, September 2, at 8.30 p.m., a discourse on "The Rate of Explosion in Gases," by Professor H. B. Dixon, M.A., F.R.S., F.C.S.; on Monday evening, September 5, at 8.30 p.m., a discourse on "Explorations in Central Africa," by Colonel Sir Francis de Winton, K.C.M.G., R.A., F.R.G.S.; on Tuesday evening, September 6, at 8 p.m., a soirée; on Wednesday, September 7, the concluding general meeting will be held at 2.30 p.m. The sections are:—A. Mathematical and Physical Science; B. Chemical Science; C. Geology; D. Biology; E. Geography; F. Economic Science and Statistics; G. Mechanical Science; H. Anthropology. Excursions to places of interest in the neighbourhood of Manchester will be made on the afternoon of Saturday, September 3, and on Thursday, September 8. The Presidents of the sections are:—Mathematical and Physical Science: President, Professor Sir R. S. Ball, M.A., LL.D., F.R.S., F.R.A.S., M.R.I.A., Astronomer Royal for Ireland. Chemical Science: President, Edward Schunck, Ph.D. F.R.S., F.C.S. Geology: President, Henry Woodward, LL.D., F.R.S., F.G.S. Biology: President: Professor A. Newton, M.A., F.R.S., F.L.S., V.P.Z.S. Geography: President, Major-General Sir Charles Warren, R.E., G.C.M.G., F.R.S., F.R.G.S. Economic Science and Statistics: President, Robert Giffen, LL.D., V.P.S.S. Mechanical Science: President, Professor Osborne Reynolds, M.A., LL.D., F.R.S., M.Inst.C.E. Anthropology: President, Professor A. H. Sayce, M.A.

Electroplating Flowers, Insects, &c.—Improvements in the preparation of organic matter for metallisation by galvanic deposit have been recently introduced by La Société Anonyme de Metallisation Artistique des Animaux, Végétaux, ou autre Corps, of Paris, which consists in the employment of an albuminous liquid, with which the different substances in question are treated to prepare them for metallisation. A quantity of snails or slugs are first washed in ordinary water, to free them from all earthy or calcareous matter; they are then placed in a vessel containing distilled water, and are left here sufficient time to give off slowly their albuminous matter. The albumen thus obtained is filtered and boiled for about an hour. After the boiling there is added a quantity of distilled water sufficient to replace that lost by the boiling, and about 3 per cent. of nitrate of silver. This liquid is then placed in bottles, hermetically closed, and kept in the dark; it will thus keep without any alteration. To use this liquid for the preparation of the objects, about 30 grammes of it are dissolved in about 100 grammes of distilled water. In this solution the objects are submerged for a few moments; they are then placed in a bath consisting of distilled water with about 20 per cent. of nitrate of silver in solution and afterwards submitted to the action of hydrosulphuric gas, to reduce the nitrate of silver adhering to the albumen-covered surface of the object. Thus treated, all organic matter is rendered fit to receive a galvanic deposit; and the galvanic products obtained by this process are far superior in fineness and neatness to those obtained by any other known process. Even the finest and most minute fibres and veins, the smallest unevenness of surfaces, and hairs scarcely visible to the naked eye are clearly discernible, and come out with striking neatness, the metallic deposit being of perfectly uniform thickness and adherence.

A Remarkable Motor.—We have been favoured with the following description of an electromotor, which we reproduce as received:—"It is of recent type, double-armoured armature, working on 30 ampères and 100 volts, and containing compensation cylinders and elaborate cut-outs for the very varying pressure required. The nicety of finish remarkable in this machine enables it to produce at least 15,000 ohms, and being driven at 150lb. to the square inch gives out 95 per cent. of the initial energy. A very difficult problem is evidently nearer solution, as our electricians will see."—*Electrician.*

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

ZETA BOOTIS.

[27382.]—The following are some of the more recent measurements of ζ Boötis, which I have entered in my "Gledhill, Wilson, and Seabroke." They are, I think, almost the last measures published; but I have no time at this moment to look for others.

Schiaparelli 296·8° : 0·833″ : 1881·48.
„ 297·2 : 0·725 : 1882·48.
„ 296·4 : 0·701 : 1883·47.
Perrotin ... 295·3 : 0·600 : 1884·37.
Engelmann. 297·5 : 0·640 : 1885·56.
Tarrant...... 296·5 : 0·65 : 1885·40.

Mr. Tarrant mentions that the stars were never fairly separated with his 10¼in., and his distance is probably a little too large. It certainly does not exceed 0·55″ at present. This is a star resembling 42 Coronæ. The distance, probably, never much exceeds 1·2″. Herschel and South's measures in 1823 and 1830 are much too large, as is usual with the micrometer employed by Herschel and South, and by Herschel himself on the 5ft. Tulley. Amici gives 1·00″ in 1815 and 1817.

H. Sadler.

SATURN—STRUVE'S DIVISION.

[27383.]—WITH reference to the division between rings B and C, alluded to by Dr. Ferguson (letter 27349, p. 315), and described by Dr. Terby as Struve's division, I have searched in vain for such division being called after his name.

Webb says, "Celestial Objects," p. 180, "Struve considered ring C divided by a dark line, but this has not been seen since." Again, in *Intellectual Observer*, issue 66, p. 374, he writes, "A division was seen on each ansa of ring C, in 1851, by Struve, *which he could not find in* 1852. Neither Secchi nor Lassell, with exquisite definition, could glimpse this division of Struve." Struve never saw any division *between rings B and C*, or Secchi or Lassell, and Bond and Coolidge especially looked for this on the nights of the finest definition with power of 688 on the 26in. The crape ring is apparently now undergoing great changes, or else it has of late been subject to closer scrutiny, so a division may exist, although undetected by the 12·2in. Grubb at Oxford, and other telescopes of equal power, and only seen by Dr. Terby at present. Should the principal division of Saturn's ring be called Cassini's or Ball's? Did not the Bros. Ball discover the division a decade before it was detected by Cassini? We can understand foreigners liking to call it Cassini's; but to whom is the credit of the discovery really due?

June 3rd. **H. Watson.**

INSOMNIA AND NOISES IN THE EARS.

[27384.]—I HAVE derived such incalculable benefit from the perusal, during the past seven or eight years, of the scientific letters and articles appearing in the ENGLISH MECHANIC, that I wish, if possible in my small way, to repay the debt by communicating a fact or discovery from which I have personally derived results equally inestimable to those of your readers interested in the matter.

Partial deafness, of which "noises in the ears" are said to be the sign, is no doubt an unpleasant qualification of one's senses; as though, if one may judge from the generality of the remarks one *does* hear in ordinary conversation, this peculiar modification of the tympanum, and the resulting slight deafness would seem to be of no great consequence to anyone accustomed to "converse chiefly" with sensible books; but continued "insomnia," or inability to sleep, is one of the most dreadful diseases which can affect humanity: it is the almost certain precursor of madness and death.

I will therefore attempt to show (and I hope, convince) your readers who may suffer from either or both of these complaints, how the first mentioned may be turned into a certain cure for the last one, which the ordinary chemical remedies, as morphia chloral, &c., only aggravate; and to do this, I will quote from a pamphlet I lately purchased, by Dr. Litton Forbes. "There is perhaps no more distressing symptom of deafness than what is known as *Tinnitus aurium* or 'noises in the ears.' These may vary a good deal in intensity; sometimes they are loud, sometimes low. Some persons hear a sound of bells continuously ringing, others of rushing waters, others of singing, whistling, buzzing, blowing, or the rush of steam, or notes of music." (I would here remark that there seems to be nothing so very disagreeable in all this.) "In many cases, these sounds continue day and night. Writers on aural diseases mention not a few cases of extraordinary depression of spirits, ending even in suicide, produced by those continual noises. As to the cause of these noises, in many cases they are due to certain diseased conditions of the ear, or to a bad state of the general health." I may add to this that Sir Walter Scott (see Lockhart's Life") complained of what he called "a continual whizzing in the ears"; and that this "tinnitus" is said to have been—partly, at all events—the cause that Mr. Swift became "a driveller and a show" also that your talented correspondent, "Eos," will doubtless remember the constant "whizzing noise" of crickets and other insects during a summer's day and night in India. This latter exactly resembles the "tinnitus" with which I am affected, and which is not the slightest inconvenience to me during the day, whilst it is an inestimable advantage to me at night by sending me to sleep whenever I like in about ten minutes, proximate. In nine cases out of ten, thought—unpleasant thought—is the cause of insomnia, and this is such a well-recognised fact, that all kinds of devices—such as (mentally) watching or counting sheep jump over a stile one by one—are suggested to insomnists "to prevent thinking." These all fail, because they are all methods, if humble methods, of brain-exercise, and the brain is, above all others, the organ which must be put to sleep.

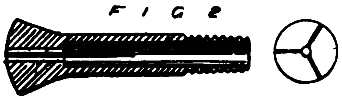
Now, I find that while it is by no means necessary to listen to this "tinnitus" (which can easily be shown to be located in the inner ear next the brain, for you can hear it if you like, in spite of, and during the most tremendous noises — as thunder, the rattling of carts on stony streets, &c.), if you do listen to it, and imagine its probable cause, thought of any kind is absolutely impossible; and the brain being at rest, you go to sleep at once. I have tried this plan for more than a year now, and it has never once failed me. If you wish I will give you (in another letter) my idea of the real cause of "tinnitus," which is certainly none of those above mentioned.

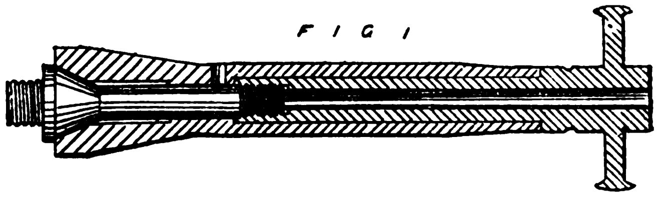
Brussels, June 3. **R. W.**

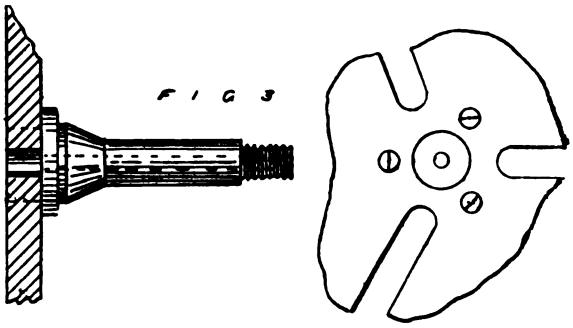
THE INDIAN TURNER.

[27385.]—SOME years ago I described the rude appliances of this trade. Except in large cities, at the railway workshops, and Government manufactories, you will not find any form of European lathe. Poverty, and a superstitious dislike of innovation (encouraged by subtle priestcraft), are the two chief causes of this primitive rudeness; yet the works in ivory and wood are very cleverly and neatly executed. The workman's canvas bag contains his lathe and tools—the first being two stout pointed pegs (like tent-pegs), in each of which is inserted near the head, at right angles, a projecting pin of taper iron (exactly like the end of a pegtop); a length of twisted raw hide, with a cross stick at ends for holding it firmly when pulling by reciprocating motion; a long, clumsy village-made chisel, a ditto gouge, a piece of ½in. board, in the centre of which a square hole is cut, and a narrow piece of wood inserted when the height of centre has been measured (not till then). This nondescript lot of turner's outfit constitutes the whole workshop of most artisans; yet in years gone by I have seen beautiful and wonderful work accomplished by such tools. An apprentice or hired boy performs the irksome task of puller for hours together. Most of my requirements were manufactured under a shady tree, where I even became a pupil in the art, and eventually turned out many neat articles in wood and metal, having altered the rude appliances to a sliding fixture on a table, the coolie who pulled the cord being squatted, *vis-à-vis*, on a seat at the same level. The brass-founders, too, finish and polish their water vessels, of every size, by cementing the base to a block of wood, and attaching a cylinder to the mouth. The cutlers and lapidaries employ the same means of rotation for their works.

Fifty years ago the quality of all native wares was far superior to the present day. Gradually they have deteriorated, while the prices charged to Europeans have increased. The "mild Hindoo" has availed himself of a growing demand for his goods, and, under cover of gaudy lacquers and varnishes, uses inferior kinds of wood, fresh and unseasoned. Only can a resident on the spot insure seasoned timber—hence, the cracking and splitting of most turnery from the East. This remark applies to many other materials and manufactures sold to travellers.







Patna, in Lower Bengal, was once the emporium of turnery decorated with gaudy lacquers; but the trade has slowly spread to Benares and N. India. For many long years these harmless toys were much valued as infantile presents in Europe. Numerous children had been poisoned by the metallic oxides employed by British toy-makers, and their parents fully appreciated the hard, insoluble sealing-wax coating of Hindostan. The Anglo-Indian, returning home after his long sojourn in the East, usually carried the additional baggage of these favourite trifles. Tea sets in baskets, ninepins, rattles, balls, boxes of all sizes, swings for nursery, and a vast assortment of parti-coloured playthings of all kinds and shapes—the large humming-tops being the boys' favourite; for older persons, napkin rings, cylindrical cases for pencils and knitting needles, vases, and such-like household ornaments; the bell-shaped feet of native bedsteads, very gaudily embellished with circles of every colour, are the chief articles in local demand, generally of sound, hard wood, and well finished. The slabs of lacquer, made by stirring in dry colours into the melted gum, and heating it continually on a sheet of warm metal, are prepared by the turners; this coating is applied to the wood as it revolves in the lathe, frictional heat causing the lac to melt and adhere to the article, the coating being uniformly distributed, and acquiring the glassy polish of sealing-wax. For making spirit varnish, I found nothing equal to these slabs, of which I possess nearly all the colours used by the turners. I have, also, a lot of inside tools, all copied from our modern hooks; these were made by a young native blacksmith near Calcutta, where he probably saw and imitated these patterns. On my table before me are two ingenious specimens of boxes from N. India; multiple curiosities of turnery. No. 1, on removing the lid, is found to be a solid disc, or cylindrical block; six holes of various diameters, arranged concentrically, each contain six boxes, dwindling down one within the other, lids and all, to a wee size, which might hold a mustard seed! No. 2 is a handsomely-coloured affair, spotted with gold; it contains a nest of 12 boxes. all of different colours! The workman's toes have as much play as his fingers; he employs them as much as possible in every handicraft, as he only wears loose shoes, and takes them off when following his calling. In fact, his feet are always in use whenever he needs an elastic vice! Some of the once renowed occupations are dying out—that of making the sets of ivory chessmen, costing to order £25 to £30 sterling, kings and queens on elephants, knights on horseback, pawns as spearmen, &c. Twenty years ago the aged artist in these gems was going blind; his pupils and successors are all unworthy of their instructor, the modern imitations being coarse and ill-executed, though expensive.

The last article the patriarch constructed for me to my pattern was a bracelet, carrying a miniature portrait-frame in spotless ivory; the pieces when put together on elastic cord closed up on the wrist. I possess it still. Billiard balls and such-like articles he executed well. The cement used by Indian turners is a compound of shellac and brick-dust, a very tenacious compound, especially for metal. **Eos.**

LATHE MATTERS.

[27386.]—IN answer to "F. A. M.'s" q
garding split chucks for lathe, I send sketc
size, taken from watchmaker's lathe, showi
struction; also method of fixing split an
chucks.

The spindle, Fig. 1, is drilled throug
chuck binding screw is inserted at back
mandrel. It is hollow, with internal screw
at one end, which fits screw on end of chuc

Fig. 2 shows construction of spring c
chucks. They are hardened and tempere
being slit. Besides being slit, there is a
way, cut as shown in Fig. 3, to prevent the
turning; feather is fixed inside of mandrel.
small range necessitates a good assortment of
Wheel or plate chucks are made and act
same way as wire chucks; these chucks ta
very true.

Fig. 3 shows part of large face-plate ch
diameter. It is fixed into mandrel in th
way as the other chucks, the cone and c
fitting giving perfect truth in running. Th
screw (Fig. 1) is fitted to spindle as shown;
may be screwed on in the ordinary way, i
easily removed when required for receptio
other chucks.

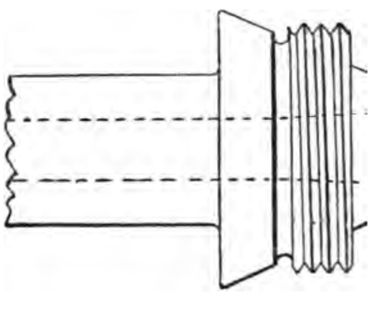
I think this method of fixing chucks has
tages over the present (nose screw), bein
independent of any inaccuracy in the b
screw, with all the advantages of easy fitti
interchangeability.

Any other particulars I will be happy to

G

LATHE MANDREL.

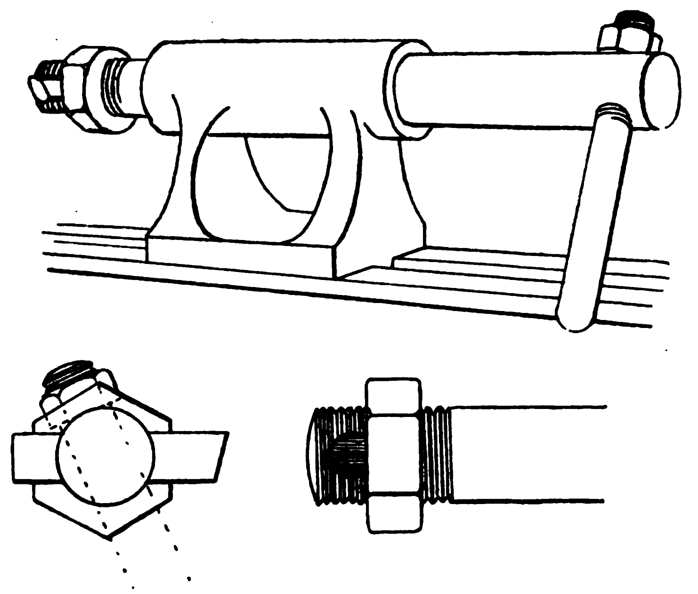
[27387.]—HOW would this suit Mr.
(27296), or Mr. Newall (27325)? I think th
would not be so liable to injury. It gives



base, and chucks could be easily fitted t
bottoms of thread being larger in diame
taper of cone. **Black H**

BORING IN THE LATHE WITH
SLIDE-REST.

[27388.]—SEEING the woodcut of the la
by "F. A. M." last week, May 27th, has r
me of a plan I used for boring in the lath
possessing a slide-rest. As it might be o
some of your readers I send sketch. A rod



up to fit back-poppet nicely. In this rod bored across at each end, one to take a bit steel ground flat on one side; the other insertion of a steadying pin, placed as between shears. The end holding the er is screwed to take a nut which locks at the size required to be bored. The anced and withdrawn by hand, and bores ooth, cylindrical hole. If required to bore ttom of a plugged hole, the cutter would ccordingly. Of course it is only applicable certain size, owing to the spring of the any great distance from the bar.

Silke.

TT'S SCREWING APPARATUS.

]—ALTHOUGH I had determined to argue on the merits of the above, I cannot oting a sentence in a letter by "Bow":—'s device is highly ingenious, and in its ovince will do good work. It will enable led amateur to strike a short screw of any sily and correctly." This is all that designed it for, as I think I stated in my r. It is simply for application to lathes o traversing mandrel, and what the latter ed to accomplish—just that, and no more ned for this unique invention. Absolute tical accuracy should hardly be expected pparatus made for workshop use, and is lt of attainment that it must always be a ocess. Moreover, it is not needed in a workshop. I have often stated that I nathematician, and cannot work on the Pocklington or "Bow"; but the mathe-objection was made, and I at once wrote t, who told me that he had noticed and d the error, and very much I admired his method of correction, which, at any rate ington, appears sufficient. If it is *not*, and, as anyone would naturally expect, shop appliance is only *fairly* true—true we here need truth—Mr. Niblett's inven-quite satisfactory. As to the cases of inclination of the disc, Mr. Niblett told it would only work satisfactorily from o 40 pitches. If it will work from 8 to 30 more than a traversing mandrel is usually to do, in which we are content with six screw nd cannot with these get any intermediate This device may apparently be advertised e of giving a quite correct lead for any etween 8 and 30, with occasional exten-a rather less truth from 6 to 40. What irly demanded beyond this? As to long screws in metal, we never use a traversing for such work; we go at once to the only d efficient tool—the self acting lathe.

her Novice" speaks of the hand-chasing tives at the Crystal Palace and opticians. uite true; but let me also tell a tale *de screwibus*. Many years ago, when one as alive, whose business it was to give on at H. and Co.'s to amateurs, I asked ach me screw-chasing. He prepared a bit unded off the arris, and remarking on the ty of hand work, *missed the lead.* Now, a man who could turn, acknowledging st persons allow, that hand-chasing was tain process; that, in fact, to those who onstantly engaged in that work a miss is as likely as a hit. But again it is not so o chase a thread. The real difficulty is to ood fit of a screwed box-cover. For this, es certain one of the two things requisite some screwing apparatus will always be found desirable. I have not for some years been at the Crystal Palace. When last there there was, I think, but one turner down below stairs who was generally engaged turning billiard balls (Fenton's, I think, was the name). Is there now a large turnery?

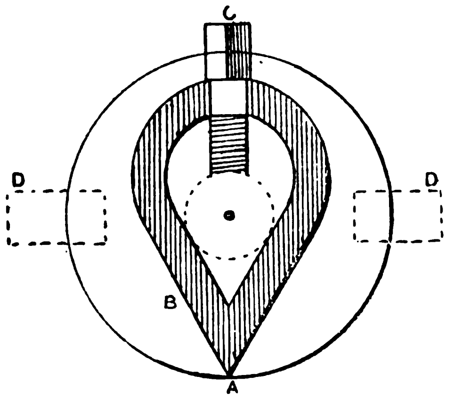
O. J. L.

[27390.]—MANY thanks to "Orderic Vital" (letter 27319, p. 293) and "Bow" (letter 27355, p. 317) for indicating the false assumption upon which my reasoning (letter 27138, p. 178) was based. So far as I can see, their argument is conclusive; but could not the mechanical arrangements of the apparatus be so altered as to make my reasoning accord with the facts? I throw out this hint for the consideration of the inventor and mechanicians generally.

H. C. Pocklington.

USEFUL CHUCK.

[27391.]—THIS is the specimen I alluded to lately as having appeared in the pages of "E. M." many years ago. I made two sizes: the larger, which must not exceed ⅔rds diameter of any face plate; the smaller, about 3in. across. A is a disc, of ½in. boiler-plate, with the pointed holder B, attached to it firmly. I constructed mine by the tedious method of fastening together by back screws, countersunk in the plate, but recommend a casting in one piece. C shows the tightening bolt, screwed in through the head of holder on a cylinder mounted for work, as per dotted circle. You should have two or three of these screws in different lengths, to suit thickness of the pieces to be turned. Square bars or nuts are just as easily held in this chuck, which seems to have been copied from the principal of the "carrier." D D are sheet-metal clamps, to fasten down the disc. They are held by bolts passing through apertures of face plate. At first the true centring of work so fixed bothered me; but I have overcome this obstacle by having a centre line engraved on the face-plate, diametrically exact. With a T square and chalk pencil, mark off centre line on your cylinder; prolong this on the discs while clamping. Set these till all the lines meet—faceplate, disc, and work.



Eos.

COUNTERBALANCING LATHE FLY-WHEEL.

[27392.]—MANY thanks to A. F. Shakespear for his reply (27359) to my query (27299); but my object in counterbalancing wheel would be not so much to bring it to a convenient position for starting as to give it an impetus during upward movement of crank. The former would, to me, be only of secondary importance.

In the device illustrated by "A. F. S.," there seems to be a useless amount of extra friction, for some arrangement for fixing different weights on to rim of wheel would seem to be the most simple plan; but I should still like to know the views of some of your readers on this question. Suppose mandrel set to run ten times to once of flywheel, and a piece of wood, say, 6in. diameter, to be turned, an ordinary pressure on the work must considerably decrease the speed before power is again brought to bear on treadle. Surely in such a case it would be advantageous to counterbalance more or less, according to the nature of the work.

Loxley.

MECHANICAL MATTERS.

[27393.] — ASIATICS have deeply-rooted prejudices against bones, horns, hoofs, and discarded animal matters. An outcry of the populace that British ground sugar was refined by burnt bones, and bone-dust mixed at the mills with the flour sold, were among the warning notes heralding the great Mutiny. Beyond burning some leather at the forge fire occasionally, I never saw any attempt at "case hardening"; but was frequently interrogated by the juvenile artisans on the subject. I have no doubt the schoolmaster and the steam-engine combined have changed their creed immensely for the better. All those young Hindoos persisted that we tempered the springs of our firearms with the juice of a plant, which I knew very well, but withheld from their knowledge! As to "glass polishing," except in two or three large cities where Europeans employ black workmen, no native has ever attempted the art of an optician, though they are skilful lapidaries and seal-cutters, only cognisant of corundum and diamond dust. I used to buy the sweepings of a man in that line, and cleansed them by elutriation. I know of no other polishing powder so abrasive.

Eos.

PITCH STRIKER.

[27394.]—A FEW weeks ago an explanation of the construction of Greenwood's "pitch striker" was given by a subscriber signing himself "Goolwa," but who added the remark that the article was not worth making. Now, I naturally inferred, from the able manner in which "Goolwa" had described the tool and the decisive remark above quoted, that he either had something much better by him or could design something. I wrote to the MECHANIC expressing a desire that he would, if possible, forward some better arrangement, but have seen no reply. I should be glad to see the subject taken up.

The various plans that have been described and illustrated during the last few weeks for striking a true thread, acceptable and useful though they may be to the "amateur" turner, are valueless to the professional, for the simple reason that such apparatus, if not already in existence in the workshop, would almost to a certainty not be placed there. A proper screw-cutting lathe would be preferred where such was necessary.

What is wanted is a tool that can be taken up with the same facility as any other hand tool, and a true thread struck at once, deep enough to make a drunken thread almost impossible. Surely amongst the thousands of readers of the MECHANIC there are some who either have such a tool or could describe one they may have seen; or is it to be taken for granted that Greenwood's is the best tool that can be designed for the purpose?

One Deeply Interested.

THE CUSHMAN CENTRE PUNCH.

[27395.]—THE arrangement engraved on p. 310 cannot be considered new. It is a common tool in engineer's shops, and is identical with a number we have had in use for years in our own workshops, some of which we have bought in the regular tool shops; others we have made. That it is a useful tool for centring rods is undoubted; but it cannot by any stretch of imagination be considered any more a novelty than a common centre punch or a screwdriver.

Thos. Fletcher.

[27396.]—THE Cushman centre-punch, figured on page 310, is practically identical with one made by R. R. Jones, of Birkenhead, and figured in your columns a year or two since. Mr. Jones has informed me that he has sold some hundreds of these convenient little tools.

Oa.

CONTINUOUS BRAKES.

[27397.]—I FAIL to understand the alacrity displayed by Mr. Samuel Davies in his last letter (27377); nor do I think in place the somewhat sarcastical tone which prevails in it.

No doubt Mr. Samuel Davies thinks he has been making a great discovery. However, it took him a roundabout way to come to the knowledge of a fact which any supporter of the automatic air-brake will own with me. I do not, therefore, understand his insistence in wanting me to inform him on the point in question. I do not see, either, what he is aiming at, for I see nothing therein which is against the Westinghouse brake. If it should be too hard on, we release and put it on again, and that is done in less time that it takes to write it. Certainly, you have not to do that with the Carpenter, Wenger air brakes, or with the automatic vacuum brake; but this is such a trifling advantage that the inconvenience inherent to the latter systems do more than counterbalance it. Such brakes as have pressure or vacuum on both sides of the piston, require stuffing-boxes, and this is a continual source of leakages and increased friction.

It requires no more than 25 seconds to release the Westinghouse brake and put it on again. As a rule, the necessity of releasing it arises from the fact that the speed is falling below the mean speed which is timed. A skilled driver—and every driver can acquire this skill in a short time—can always seize the proper moment to release the brakes so that the variations of speed are scarcely felt. Mr. Davies has lost out of sight the fact that there is on the engine a main reservoir, the function of which is to refill the auxiliary ones as well as release the brakes. Whilst the brakes are on, the pump is not standing idle, and the pressure can be easily maintained, as will be seen afterwards. This storing of power does not exist in the automatic vacuum brakes; that is, no doubt, the cause why they are so slow in their action. I was, of course, justified in saying that the driver concerned in the Crook accident lacked the necessary dexterity; for, according to Mr. Davies's account, he reduced his pressure by 25lb. at a time. Now, if the main reservoir of the engine had not been undoing the braking of the driver on the first, I would call this a foolish waste of air.

I found by experience that a reduction of 5 to 8lb. in the main pipe will take you down the steepest inclines without having to release the brake for several miles. I have worked an incline nine miles long and one in 70 without moving the handle a single time after having put the brake on. As the speed is not to exceed 25 miles an hour, there is not the least fear that the pressure should not rise again to the normal figure.

Wherever there has been any difficulty, it was simply due to unsuitable proportions. On grades 1 in 40, as are worked day after day in the Hungarian chain of the Carpathian mountains, there have been no complaints. The drivers prefer the Westinghouse brake to the Carpenter, which does not require releasing to alter the power.

The letter published by Mr. Albert Kapten in the *Engineer* for 26th May is a fine illustration of the capacities of the Westinghouse brake. Now, Mr. Davies, reply to this letter. In presence of such feats the best thing which the supporters of the automatic vacuum brake have thought wise to do is to keep quiet; and I praise them for that. As for the accident near Leeds, I never heard anything of it, although it took place at a time when the Penistone accident was still fresh in the memories of all, and had caused long polemics in these columns. Would Mr. Davies kindly tell us where we could find an account of it, and the report of the Government Inspector on the same?

In the Crook accident the result would have been the same if the automatic vacuum had been used, as the ejector on the second engine would recreate the vacuum which the driver of the first engine attempted to destroy. **E. Gobert.**

[27398.] — YOUR correspondent, Mr. Samuel Davies, having entirely failed to substantiate his statements with reference to the Crook accident, now (page 321) makes another incorrect assertion that a collision which occurred at the Leeds Junction on the 15th of August, 1884, was caused "because the Westinghouse brake could not be graduated." I well remember the circumstances, and the Board of Trade report is now before me. Major-General Hutchinson reported that: "This junction collision was entirely due to want of judgment on the part of the driver of the North-Eastern train, an experienced man of 22 years' service as a driver."

The Westinghouse brake did not fail, nor had graduation anything to do with the accident. It is distinctly stated that the *wheels skidded.* Surely that alone furnishes ample proof that the brake was "on," and in proper working order.

If correspondents would furnish details of cases *where brakes have either* prevented or caused *accidents, they would greatly* assist *in* the discus*sion; but the production of* cases such as Crook and Leeds Junction is perfectly useless, as they have no bearing upon the subject in question.

The result of the discussion in your columns confirms the opinion that there is nothing which a vacuum brake can do with regard to the safe and efficient working of a train that a pressure brake cannot do; but that, on the other hand, a pressure brake complies with requirements, and is able to provide for cases which the vacuum does not even attempt to do. For instance, the pressure system retains its power for use when shunting; a defective carriage can be shut off without cutting off the brake power upon those in the rear; the engine can be detached without putting on the brakes; a pressure brake is also quicker in its action, and it works efficiently upon slip-portions of trains—this latter advantage is, however, I believe, now claimed for the vacuum brake by the introduction of two taps in the brake coupling upon the Great Western Railway.

It should be clearly understood that an automatic air-pressure brake can easily be constructed without triple-valves, taps, or valves; it would be perfectly simple, and do as much as the automatic vacuum system; but it would not, of course, be as efficient as the pressure brake having those parts as employed in the Westinghouse system.

It has recently been stated in letters by some of your correspondents that the Westinghouse brake cannot be graduated or employed upon long and steep inclines, it is therefore satisfactory to find that official information is published in *Iron* and other engineering journals, showing that the brake is working as follows upon the—

"Union Pacific Railroad.	
30 miles	1 in 25
19 miles	1 in 25
"Atchison, Topeka, and Santa Fé Railroad.	
5 miles	1 in 28½
11 miles	1 in 50
"Denver and Rio Grande Railroad.	
21 miles	1 in 25
"Northern Pacific Railroad.	
10 miles	1 in 38½
10 miles	1 in 38½
10 miles	1 in 38½
"To be shortly operated	1 in 18"

These facts prove beyond doubt that the Westinghouse brake *can* be, and is, used upon long inclines. On the other hand, we have before us the fact that the Midland Railway Company does not trust to the automatic vacuum brake upon the Lickey Incline of 1 in 37 for only two miles.

Clement E. Stretton, C.E.,
Consulting Engineer Amalgamated Society of Railway Servants.
306, City-road, London, E.C., June 3.

RAILWAY BRAKES.

[27399.]—I DON'T know whether Sam Davies (27377) is a driver or not; but if he is, I am bound to say he works upon a principle of his own in regard to inclines. He surely must know that drivers when running down inclines 1 in 90 or 1 in 100 don't use the brakes all the way down. I have many times gone from Settle to Carlisle, and vice versâ, with the Scotch expresses, but never found the blocks continually applied down the inclines; the brake, I admit, is put on occasionally to slacken over certain curves. I find the same rule applying on the L. and N.W. between Lancaster and Carlisle with vacuum trains over the Shap summit. Now, about the great point made as to taking brake off. The holes through which air passes from brake cylinder are made small; from the driver turning his handle to release the brake till the blocks leave the wheels is about four seconds, and in that time a driver can turn his handle to "release," charge his reservoirs, and put brake "on" again without the blocks having ever left the wheels.

Sam "may" defy Mr. Gobert (27335) if he likes; but these are indisputable facts, and there you are! Hundreds of drivers reduce the power without letting the blocks leave the wheels, and when running down 1 in 100, say a driver did for a second or two take off his brake, what then? Gravity does not act with such power or as quickly as Sam and others think. Several seconds are required before the incline begins to cause the speed of a train to increase over two or three miles an hour. Note a train standing on an incline at a station: when driver takes off his brake, gravity does not rush off with him. He has to put on steam to get away with any speed. **Rover.**

[27400.]—I SEE that S. Davies says in your paper last Friday, No. 27377, that you must take off the Westinghouse brake if you want to reduce its force.

How strange it does seem for such things to be written when we all know they are not accurate! With Westinghouse brake you can put over the driver's handle to the left-hand side, and before the brake blocks have left the wheels you can put brake "on" again with any power you desire.

The Crook accident and that one at Leeds are very poor for Mr. S. D. to pin his faith upon. I should have thought he could have made much more capital out of a collision at Coatbridge, 5th August, 1885. Perhaps he will kindly look it up.

Will you allow me to refer again to my letter, 27290, in your issue 20th May. Neither Mr. Kiernan, Mr. Hopkinson, Mr. Davies, or any other reader has ever given one reply to my seven objections to vacuum brakes. **Loco.**

[27401.]—I HAD not noticed "Engineer's" query (62472) until my attention was drawn to it by the replies of Mr. Stretton and Mr. Gobert.

I presume that "Engineer" has my figures before him, and they can be easily checked. If he, however, does not understand them, and will say in what way, I will give him the information he requires. I might say that in making the calculations I included the connecting pipes from train pipe to cylinder or valve, as also the spaces in the latter.

In replying to this question, Mr. Stretton uses one of his stock phrases, and says, "The question is one of fact, not of argument." This phrase follows a statement that the vacuum pipe contains four times the space of the Westinghouse, and by another statement, which he must know perfectly well is *not* a "fact," that I had "expressed a contrary opinion."

To show that I am correct in what I say, I extract the figures referred to, which appear on page 22 of the reprint of my paper.

Westinghouse Brake.—400ft. of piping and connections = 8,952c.in. of air at 75lb. pressure = 19,760c.in. of air at atmospheric pressure.

Vacuum Automatic Brake.—400ft. of piping and connections = 15,150c.in. of air at 21in. of mercury = 10,605c.in. of air at atmospheric pressure.

It will be seen that I show the cubical contents of the 2in. pipe and connections to be nearly four times as great as the 1in. pipe and connections; but owing to the different densities of the air used, it is necessary to bring them, as it were, to a "common denominator," for the purpose of comparison, just in the same way as we compare tons to pounds by first reducing them to pounds.

The "denominator" adopted by myself is that of nature—viz., air at atmospheric pressure, and a comparison shows that the Westinghouse pipes contain 19,760c.in., and the vac. automatic pipes 10,605c.in. of air at this pressure.

Mr. Gobert goes into a very elaborate theoretical calculation, which, however proves nothing, for he does not take into account that the vacuum brake is increased in rapidity by its automatic van valves. I would inform this gentleman that in my calculations given in the paper referred to, in which I showed the amount of air used in applying the brakes fully, I *did* take into account the space below the pistons, and the fact of only releasing from the train-pipe 25lb., and with the following result:—For the Westinghouse, 20,031c.in. of air at atmospheric pressure. For the vacuum, 19,663c.in. of air at atmospheric pressure.

G. W. Kiernan.
166, Duke-street, Brooks' Bar, Manchester,
June 4.

GRADUATING POWERS OF BRAKES.

[27402.]—WILL you kindly allow me to say a word or two respecting the powers of the Westinghouse brake. Some say this graduating can be done. From my own personal experience, I say it cannot be done with simultaneous action, and I will tell you why. Some time ago the L. and Y. Co. used this brake on one of their Bradford and Manchester expresses, which consisted of twelve coaches. I have invariably found that by making a slight reduction of pressure so as to open the graduating valve only, the brake blocks on engine and tender would never touch the wheels, therefore the train pipe pressure had to be reduced considerably more to bring the engine blocks to the wheels, the result of this further reduction of pressure causing the blocks on the train to be set with full power. Again, I have noticed that when the same train has been at rest, and a slight reduction of pressure made, some of the blocks have been set to the wheels and others not; this, in my opinion, being caused by the triple valves not all being sensitive alike. As it is almost an impossibility to make them so, I think that for all practical purposes the Westinghouse is not a graduating brake, but I admit it is an efficient train stopper.

In your issue of May 27th (letter 27335) Mr. Gobert states that had the vacuum brake been used in the Tow Law accident, the result would have been the same. I think it would not. I have been in charge of trains several times when two engines have been coupled together, and have never found any difficulty in applying the vacuum brake, although the ejector of the second engine has been open at the same time.

Many men who, like myself, have had experience of both the Westinghouse and vacuum systems,

h me, that the latter brake is much to be
from a driver's point of view.

Lowmoor Driver.

OME EXPRESS RUNS.—V.

]—THE following smart run was made
's ago, 871 Proserpine (Precedent) and 7½

	h. m. s.	Speed.	Remarks.
ıgby	1 56 10	—	due 1.55
ıst	2 2 6	—	
·,	2 3 10	56·2	
·,	2 8 5	61·0	
ventry	2 10 50	—	" 2.11
dep.	2 13 8		" 2.13
ıst	2 20 0	—	
·,	2 22 22	50·7	
,	2 29 21	60 0	
echford	2 32 6	—	" 2.38

hortly give a few particulars of a very
vith the Leeds express from Nottingham
ing in 56min. 50sec., 51¾ miles, and of a
the down Leeds express, in which we
4 miles in 11min. 53sec. This last was
Luton and Bedford.

Kappa.

RAILWAY COUPLINGS.

]—"SILKE" (letter 27378) says, "Should
irst change be towards establishing a
buffer?" Important as that is, I think
re important matter is the establishing
form height of the buffer-rod from the
ıe Great Northern is 3ft. 6in., the Midland
and the result is that if an empty Great
waggon is coupled to a fully laden Mid-
gon, which, in consequence of the load, is
ı on the springs, we have a difference of
the height of the buffers of the two
and that is too great to be safe.

G. W. M.

]—"SILKE" (p. 322, 27378), I see, sends
ıng, or rather a diagram of it, along with
ıestions he wishes to have answered. Yes,
; a standard buffer or a uniform com-
of buffers is what is wanted, and every
ld work for this end. You must retain
nt hook. Non-automatic couplings are
ın automatic ones.
have a lot of waggons in a siding, and an
ıes to couple to one, you don't want to
ıe lot. Perhaps "Silke" will say, Put
of action. Yes; but if you have to go
hem out of action, you had better go and
em with a non-automatic coupling. I am
ith spring buffers, "Silke's" apparatus,
Roe's, at Nine Elms, would knock a hole
ggon end.

Rover.

CCIDENT NEAR HARRINGAY PARK.

]—I DO not think that Mr. Stretton sees
exactly as I do. It is "clear" enough in one
t Mr. Stretton's explanation (p. 321) reads
e an accusation. I thought probably the
the engine had been on duty for an ex-
umber of hours, which would perhaps
" how he came to run on the wrong line
ıiles. I could understand that being done
ɔ in the open country; but here he must
ıed four platforms and at least nine over-
nd his position with regard to them ought,
d think, not to have escaped his notice.
. what I want to get from your railway
s this: here we have a case of a driver
for two miles on the wrong line without
ıg his error. The fact is "clear": it may
gain. I want to know what suggestions
ffered to prevent its recurrence. I am
iged to Mr. Stretton for his replies. As
he driver had no right to pass the starting
en it stood at danger; but he did. What
is some automatic arrangement to safe-
:h a driver against himself. What would
ers suggest?

Nun. Dor.

DULTERATED OLIVE OIL.

]—IN No. 1136, p. 384, there is a chapter
ıil, in which "An Analytical Chemist"
the methods of testing the purity of com-
ıamples of olive oil, which is now so
y mixed with cotton-seed oil, and, as Mr.
s, with arachis, sesame, poppy, and rape.
fish oil, and even hydro-carbon oils are, it
sometimes used. Now, looking through
e article and Mr. Allen's "Commercial
Analysis," Vol. II. pp. 96-102, I came to
lusion that adulterations of the kind
would not be easily detected, and would
good deal of skill on the part of even a professional chemist. I saw a statement the other day that olive oil could be bought for 6d. or 7d. a flask, and thought that if the writer was satisfied with such oil it would not be worth while to undeceive him; but when I find the *Lancet* saying that "the adulterations of olive oil can be easily detected," I should like to ask if anybody knows how. This is what the *Lancet* says, in its peculiar style:—

"Olive oil is adulterated extensively, and lard is also adulterated. These are among the latest discoveries of the daily papers, and for a day or two they have attracted some feeble indignation in the public mind. 'How fraudulent—how disgraceful!' say a few, and then pass on to some other novelty. Of course, oil and lard are adulterated. No one who knows anything of the trades doubts it. Dishonest vendors are making profits freely by their dishonesty; but nothing noxious is sold to the public, and as for the fraud, who cares? Certainly not the Government, who are too busy to think of such things, and certainly not the public, who are too apathetic to care about anything that does not come before them with a flourish of trumpets. The British Consul at Leghorn has recently made some strong remarks on the barefaced frauds now openly perpetrated in Tuscany and England. Not only is olive oil freely adulterated with the cheaper oil of cotton seed; but the well-known flasks and cases are now sent empty to London to be filled with cotton-seed oil, and sold in England as olive oil of fine quality. It may well be asked, Is there no possible remedy for such audacious swindling? Of course there is: the remedy is simple enough. The adulterations of olive oil can easily be detected, and fraudulent vendors might easily be punished if it were not for the absurd difficulties which are engendered by our English law. Give us a more stringent Adulteration Act, which shall not only confer greater power upon local authorities, but compel them to exercise it, and such frauds would soon become matters of history. At present, however, there seems little chance of such an upheaval of commercial morality."

The simplest test is, I believe, the use of sulphuric acid, which with olive oil forms a clear yellow clot, while cotton-seed oil gives a clot with a violet shade, and colza a green or slaty colour. But how can a mixture be readily tested?

Nun. Dor.

THE UTILITY OF GAS IN THE WORKSHOP.

[27408.]—IT may be of interest to your readers to know that the whole of the apparatus described by Mr. J. F. Hobart (p. 312) is taken from our current lists of workshop appliances, and it is not very satisfactory to find that he has not had the courtesy to acknowledge the source of his information. There is no possible harm in his giving the process of manufacture of any apparatus if he will only do it correctly, so that anyone who is not a specialist can make the appliances for himself; but unfortunately, he omits the most important points of constructive detail, giving only a crude and imperfect description which is practically useless.

Warrington. **Thos. Fletcher and Co.**

KEYLESS WATCHES.

[27409.]—I READ letter 27367 in the ENGLISH MECHANIC of the 3rd inst. with much interest, and, I may say, feelingly, as I had only lost my gold keyless watch the week before. I believe it would not have been stolen but for the very imperfect fastening of the bow (the bow was twisted off the watch and left hanging to the chain, but the watch was gone).

I did not know before how insecure my watch was. It seems to me far from right for a watchmaker to charge a high price for what is supposed to be a good and trustworthy piece of mechanism, and which, at least in respect of the bow, is a mere sham.

I find on inquiry that all keyless watches are as bad as mine, and some worse. I am told that some watch dealers consider that the more watches there are stolen the better it is for trade, as the cases usually go in the "melting-pot" and the movements are thrown away. I, for one, do not agree with improving trade in that way, and shall take good care when I have a watch again to get one without a bow.

John H. Wells.

285, Oxford-street, W., June 6.

FRUIT PICKER.

[27410.]—SEEING the reference to my grape cutter by "Toodles," I beg to state it is not a "fruit picker" at all, but simply a mechanical solution to the problem how to cut a bunch of grapes (any size), without injuring the bloom, in any part of a hothouse and without the use of a ladder. The first thing I made was a simple sliding knife, worked by a bell-crank and rod, the bunch dropping into a net. The sketch I sent was the perfect form I arrived at. I have used a thing similar to that of "Toodles" for getting an apple now and then, mine being a ring fixed at right angles to a pole and carrying a bag, the ring contracted at the farthest end from the pole to form a sharp corner.

Silke.

BURNT AIR.

[27411.]—DURING the somewhat heated discussion of this question that prevailed lately, it was my impression that there was a better explanation of the phenomena than any which was advanced; and, though I could not find authority for it then, I have since done so in Tait's "Properties of Matter," under the head of "Transpiration." It is, that heated cast-iron is extremely pervious to certain gases, especially carbonic oxide. If you compare the effects of an overheated iron stove and of a coke devil upon the atmosphere, you will not doubt that both breathe out the same poison, carbonic oxide, which is many times more poisonous than the dioxide. Hydrogen has neither taste nor smell, and certainly could not account for the effects observed.

W. A. S. B.

BUTTRESS AND V-THREADS.

[27412.]—IN reply to Mr. A. Gray, on page 319, last paragraph, I beg to say that I have been too busy during the last three weeks to pay any attention to screws. Also to say that if Mr. Gray will refer to his own letter on page 247, also last paragraph, he will observe that it is not the buttress thread, but something else, that I object to. I shall soon, I daresay, find time for trying a buttress against an ordinary V-thread.

J. K. P.

CENTRES FOR SOFT WOOD.

[27413.]—I FAIL to see what is "Silke's" idea (letter 27363) on page 319. The dead centre is of an unusual shape, and the double-pronged affair appears to be divided through the middle. The ordinary method is to cut a triangular piece of sheet iron of size suitable for the job, and with a pliers bend down, say, three-sixteenths of each corner to a right angle, drive this into the end of the wood, drill a hole for the centre, and there you are. My plan is to purchase one pennyworth of Blakey's toepieces, drill hole for centre in same, and these will last for an indefinite period.

A., Liverpool.

LAMINATED ARMATURES.

[27414.]—NOTWITHSTANDING the reluctance I feel in occupying the valuable space of the "E. M." in replying to the charge made against me of making untruthful statements in my letter on laminated armatures (letter 27343) by A. Parkington (letter 27375), yet, in justice to myself, I am bound to do so.

I think that when one person questions the truthfulness of another's statements, he ought at least to write truths himself. He says, "I punched all the punchings and fitted them up ready for winding." This statement would lead others to infer that he made the punchings which I made before I knew him: the most he did was to make square holes in web of punchings to fit a square spindle, since I prefer square to round spindles. He also says that "armature is 2¼in. diameter." A small matter for contradiction if it was so, since I was speaking from memory; but I know it is not 2¼in., but may exceed 2in. diameter. He also states that "F.M.'s are 2½in. by 1¼in. by 6in. long." This statement is absurd, since it makes the machine appear an enormous size. I again maintain what I stated, that the F.M.'s are 3½in. long by 2in. by 1¼in. They only measure 6in., including pole-pieces, the bore running parallel with F.M.'s. I stated that the machine had run an 11-volt 10c.p. lamp, and the machine would give 30c.p. We ran the lamp, and forced it so that it lit up a large engine-room, and, as far as I could judge, equal to 30c.p. or more, and this on a shunt, the result being that the carbon filament parted in centre. Electricians know that it is quite possible to force a lamp to give treble its candle-power or more at a risk of its life, and for a much shorter time than if it ran its proper c.p. A. Partington's statement that the machine ran at 3,000 is simply guess-work. I may have stated that these lamps when hot may not exceed 5 volts, since the more incandescent a carbon filament becomes the less resistance it offers—a fact well known to electricians. The wire used on machine I took off an old machine I had been experimenting upon, and I have no doubt it would be found scarcely an ounce, more or less, than what I stated. I was only able to see Mr. Bottone's letter once, so I quoted from memory, and I apologise if, by using the word *great*, I erred. The other part of sentence is correct, I am certain. My only object in writing (letter 27343, p. 299) was to place before my fellow-readers the patterns of armature for their benefit, since they could use any pattern F.M.'s, and I leave them to decide whom they consider has written truthfully, "what they know and as much as they know, and no more."

As to my integrity of character, and my knowledge of electric lighting, I can refer to W. E. Painter, Lion Inn, Woodbridge, whom I lately assisted in constructing an installation on and successfully lighting up his house.

W. Tilley.

BOOT AND SHOEMAKING MACHINERY.

[27415.]—I READ in an American paper that "the development of improvements in shoe machinery runs in grooves." It does, and the grooves unfortunately run downwards. Machinery is a great invention; but in the matter of bootmaking it has resulted in the production of an article which would have given a cobbler of the old school "fits." The old saying has it, that there is "nothing like leather." It strikes me that there is something very much like leather as found in modern boots, and that is brown paper. However, just listen to what the *Shoe and Leather Reporter* says:—

"The development of improvements in shoe machinery runs in grooves. At any particular time the effort seems pretty much all in one direction. Last year there was an epidemic of edge-setters and heel-burnishers. Two and three years ago metallic fastenings and metal button fasteners had the call. Now, seam rubbers, shank burnishers, and, above all, lasting machines, claim the attention of inventors. In Haverhill, a new seam-rubbing machine is announced; in Lynn has recently been devised a machine for corrugating a seam which does away with rubbing. In Boston, a practical shoe manufacturer has discovered a seam stay which can be applied without the use of any rubbing or corrugating machinery. Three or four machinists in as many quarters of the country each have a shank burnisher 'ready for the market.' Among all the new machinery, however, lasting machines now claim the most attention. A good many years ago many thousand dollars were spent in an attempt to solve the problem of lasting by machinery. Out of all the effort and money thus expended came a machine that has been successfully employed on coarse, heavy work. Here the matter rested, and might have continued to rest had not labour agitation offered a motive to manufacturers to try anything that promised them relief. There having come up an urgent demand for a lasting machine, extra effort has been made to produce one. At least, five new machines are ready, or about ready, to appear on the market. Four of these are tack machines, and have not yet been thoroughly tested in the factory. The remaining one is a complete departure from old-time usages. It is, in fact, a crimping or forming machine, which crimps or forms the upper over the edges of the last, holding it in position while the operator hammers it down and draws it close over bottom of last with strings, which he ties. It is an innovation in that but two tacks are used in lasting a shoe. It is known as the string machine, and about one dozen of them are at use in factories."

Who benefits by the introduction of this machinery? I doubt whether the shoe-maker does, and I am sure the public does not, for it is impossible now to get a boot with a decent sole, unless you go to a West-end shop (and ditto price), or to one of the old-fashioned bootmakers, who puts honest labour into the boot as well as good leather. The great majority of boots, women's especially, are now sewn by machine, and to sew the sole leather by machine it is necessary to have it very soft as well as wet. Our old friend, Johnny Crispin, who used to make boots that could stand a tramp on gravelled roads without exhibiting any extraordinary signs of wear, also used his leather soft and wet, but he hammered it afterwards until it became as tough as—well, as tough as English oak-bark tanned leather can be made when hammered by a man who likes to do good work. The worst of it is that the rubbish is foisted on us with the reiterated lie that it is "hand-sewn," as it is in one sense, which you arrive at by suppressing the truth and suggesting the falsehood. However, in a hand-sewn boot the leather, provided it is good to start with, will never curl outwards round the edges, especially in rainy weather, and it will not absorb water as if it were a sponge; the machine-sewn boot will; but you can easily detect the animal by lifting the insole near the waist—the stitches never come down to the heel,—and there you will see the thread driven right through the leather, and can count the stitches and take stock of the amount of wax on the threads. In hand-sewn work you may be able to see where the stitches are; but they do not come through. Look, in future! But bear this in mind, that some makers glue or cement the insole (the lining sole) down so firmly, that it is not easily raised. According to Mr. Leno ("Boot and Shoemaking"), "the success of the sole-sewing machine has been, to say the least, marvellous, and no event that has ever occurred, or is likely to *occur, has or can be expected* to effect so complete a change in the bootmaking industry. There is no doubt about the completeness of the change: but, unfortunately, it is all for the worse, for the machine does not produce lasting work, even in closing uppers. I speak feelingly, for I like an old boot—a pair of boots that one can walk a dozen miles in without pain in the feet: nowadays, you no sooner get boots "shaped" to your feet—that is, comfortable—than they are worn out, and a new pair of the machine-made "improvements" must be endured.

Baudoin.

PRIMITIVE INDUSTRY — INDIAN BLACKSMITHS.

[27416.]—ONLY in late years have screw stocks and dies and screw plates become common in India. A nut dropped from a European carriage or cart was considered a prize. Its threads were roughly copied, then a piece of good tough steel was shaped with the home-made file and the threads accurately and beautifully cut with the same uncouth tool, hardened and tempered in charcoal and leather scraps: thus the village workman could multiply his gauge and supply the wants of his fellow-craftsmen. Between 40 and 50 years ago, being the possessor of a good native gun-barrel bored for me by an English friend to 1in. calibre, I resolved on mounting it as a piece of wild-fowl artillery, and consulted my head workman (a clever Hindoo) on the possibility of being able to turn out a percussion breech in my workshop. He said there was no difficulty, as he had often made them for small guns. We got a pig of the purest iron and soon forged it into shape of a breech: then my friend Janky obtained a thick bar of best sword steel from the bazaar of the little town. He forged and filed this into an immense tap, the threads as regular and symmetrical as an English one. The long barrel was sunk in the ground between two well-secured posts, to which it was lashed by several thongs of raw hide. A capstan bar of stout timber, having a block of iron inserted in the centre, with a square hole in the metal to fit the shank of the tap was next prepared by my carpenter. When everything was put together, Janky, with a bottle of oil in hand, told off several strong men to their posts, and they slowly moved and stopped at his order, when adding oil to the work. In less than an hour the female screw was triumphantly cut, just in time to save the huge bar from a smash, for it was splintered through in the centre. Then the smiling Janky sat down on his mat, measured the threads of his tap, and copied them off on the breech end. His eye and file in due time accomplished the male screw, resulting in a perfect fit. It was unscrewed, and the "cunning craftsman," with his hand-drill, perforated the breech chamber, then the nipple-hole. The proof was to come, and Janky looked grave, and spoke cautiously. I determined it should be of the severest form. We loaded the infant monster with plenty of army powder, ramming clay over the charge, and, lashing it to a stout timber, deposited the interesting article in a deep hole between some outbuildings. Finally, a "devil," or fuse of wet powder, was put on the breech as priming, a bit of cotton-rag serving as slow match. This being ignited, everybody ran away to the workshop, and awaited the explosion. There was a roar like a nine-pounder, and all hands, headed by the anxious Janky, raced towards the cloud of smoke. A hearty shout proclaimed that the village gunsmith had won: but I was not thoroughly satisfied, as the party who was to be the future gunner. I said that the shaking might have done some unseen damage, and insisted on a stronger edition of proof-firing. We doubled the heavy charge, and added a quantity of sand—about the most trying of explosions on any kind of firearm. This time the gun thundered, and the smoke rose up more dense than before. Everybody jumped into the pit together, yelling with delight, and then Janky's face became merry and self-satisfied. Lock, stock, and appurtenances were all added in succession; but before the wild-fowl season arrived I was off on a very long journey, doing a good stroke of business in the gun line by exchanging my heavy metal for a beautiful English double rifle, with case and appliances! In those unsophisticated days of Eastern simplicity, Janky, as my foreman, received thirty-two shillings monthly wages, and found himself in everything—tools, clothes, food, and dwelling. He could turn out everything, from a waggon axle to a fish-hook!

Eos.

THE SEXTANT AND ITS USES.

[27417.]—IN reply to "Edward A. R." (letter 27313, p. 292), I wish in the first place to direct his attention to the fact that the original query under the above heading (letter 27179) related especially to the finding of the latitude of ships at sea. Now I certainly did not know that stars were always preferred for determining the latitude at sea. Theoretically a mean alt. of a star is the simplest and most accurate method; but the difficulty and uncertainty of the observation (for reasons I shall be glad to give "E. A. R." should he so wish) renders this method of far less practical value than that in which the sun is the body observed. In fact, the liability to error is considered to be (with a star at night) double what it is in the case of the sun.

In letter 27237 "Edward A. R." expressly states that allowance is made for the motion of the earth in its orbit by correcting the declination of a heavenly body. Now the only correction applied to the declination is that for diff. of longitude, or what is the same thing, diff. of time, the decl. being taken from the *Nautical Almanac* for noon, and corrected for long. of place of observation. For instance, suppose the declination to be increasing 1' per hour, and place of observation to be, say, 15° west of Greenwich; then it is evident that as 15° = 1 hour, 1' must be added to decl., as taken out for noon at Greenwich. This is the correction applied, and I think that it is pretty plain that it is rendered necessary not by the motion of the earth in its orbit, but rather by the rotation of the earth round its axis; at least, it is the rate of this last which determines its value. As I before stated, this corr. cannot apply to a star the decl. of which is sensibly the same at the same date for places of all longitudes.

Does "E. A. R." wish to convey that the corr. for horizontal parallax is applied to the declination? Because if he does I can inform him that practical men apply this corr. to the obs. alt., and not to the declination.

I am quite aware that seamen avoid as much as possible using the moon for sextant observations of latitude; but "E. A. R." is mistaken in the reasons he gives—i.e., that it is because of the moon's great parallax and sensible diameter. Instead of this, it is because of her rapid change in declination; for whereas the hor. parallax never changes more than 30' in 12 hours, and a change of 30' in hor. par. only entails a change of about 20" in diameter, her change in declination is sometimes as great as 17' in one hour. These figures are, of course, only approximate. Therefore a slight error in time might introduce a serious error in reduced declination, and consequently in latitude.

I have no quarrel with the deductions arrived at in regard to the smaller earth having shorter degrees of latitude or the larger earth longer ditto. "E. A. R." makes that clear enough; but he fails, I think, to prove "that it is because the distance from the earth to the sun is so much greater than the diameter of the earth" (letter 27237, p. 242).

Many thanks to "E. L. G." (letter 27315, p. 293) for his answer to my question regarding hours of daylight per annum. I was rather hazy about the matter, therefore I asked "E. A. R." for his authority. In speaking of sunlight, I had in my mind the actual rising and setting, leaving refraction out of the question, which was, as "E. L. G." shows, an error.

Norwood Junction, S.E. **James Adams.**

PERMANGANATE OF POTASH AS A STAINING MEDIUM FOR MICRO. OBJECTS.

[27418.]—MAY I recommend to the notice of microscopists the use of permanganate of potash as a reagent or staining medium? I have been using it for examining tissues and structures of plants, and find it very useful, as it defines edges of cells, markings on cell walls, &c., more strongly than other dyes. I have made use of a crystal or two dissolved in a little water, and I have not tried its suitability for mounting purposes.

R. E. V.

HOT-AIR ENGINE.—TO "F. A. H."

[27419.] — I PROPOSED the eccentric arrangement in my design for hot-air engine so as to do away with the two joints, which would be required if two ordinary eccentrics were used. More wearing surface could be obtained in my arrangement by inserting a sliding piece on top of eccentrics. I have not tried an engine of the dimensions given; but, from what I have obtained from a cylinder of 11in. capacity, I should expect rather more than half-man power from a cylinder of 70in. capacity. I don't think there would be much grease get into the heater if piston rings fitted properly, or else how does the "Robinson" engine get on? I have tried black-lead in a gas-engine, and find that it is of no use as a lubricant. I have found from experience that the hotter the cylinder the better the result—that is the reason for having a non-conductor at the bottom of cylinder. The reason for inserting the tube P is to stop the air from passing through the centre of displacer when being displaced. I think your arrangement of the fire-chamber would answer very well in a large engine; but I don't think there would be room in my half-man power engine. I should prefer the top casting in your arrangement made in two, so as to have an asbestos joint about midway between hot plate and water: that would stop a lot of the heat from rising to the water, and I should not let the water be in contact with the working cylinder.

J. Seal.

OOSE JOINTS OF RAILS ON RAILWAYS.

420.]—In reply to Mr. Ed. Gobert's letter 5) in which he writes that "the use of a lic permanent way with Vignolle's rails on udinal wood sleepers would be one of the solutions of the question," I quite agree this suggestion; but in the face of the almost rsal adoption of cross sleepers, I do not think ely that railway engineers will return to the udinal sleeper system.

herally, for economic and other reasons, it rs that the cross-sleeper system will be the urite one with railway companies. That being se, I come back to the question of the loose of the rails.

eoretically, the addition of a wood sleeper the fish-plated joint would naturally be the ly for this defect, with perhaps a shallow trough or plate under the ends of the rails. ically, it remains by experiment to prove should be the size and position of the sleeper the adjoining ones, and to arrange them so the deflection at this point (caused by a ig train) is uniform upon every part of the The problem does not seem a difficult one. sidering the long time that railways have ie the chief roads of this country, it is very laing that such a rough and ready method l be the common practice, and that the train d be allowed to jolt along over uneven ways. advantages of a smooth and level running to have been lost sight of.

o not find in the answers to my letters any a why this defect cannot be remedied.

Hy. J. Lanchester.

POWER OF TELESCOPES.

421.]—As I notice this question has cropped n your columns, and vague statements are made in the daily press, you will probably ement the remarks of "F.R.A.S." (p. 315) ie following notes of a paper read by Mr. x before the American Astronomical Society ng ago, and entitled, "Limit of Available r in Great Telescopes."

ording to accredited formulæ, the minimum eter of the optic pencil at its emergence from repiece of a telescope is equal to the dia- of the object-glass divided by the magnify- ower; and by inversion the magnifying power s the diameter of the object-glass divided by iameter of the emergent pencil. As it is desirable to observe nebulæ and clusters, as a search for faint comets under very low s, for the purpose of obtaining a larger and brilliant field, and for bringing out the ir companions of double stars, the fact be- important that in great telescopes an ob- r may only obtain the value of two-thirds, alf, or even one-third of the total light-grasp- ower of the telescope. This failure comes the disparity in the size of the pupil of the nd the emergent pencil of light from low- r eyepieces. The eye aperture in different iduals varies from one-eighth inch to one- h inch in diameter under the same light in- ties; and the pupil of a single individual may in diameter from one-eighth inch to one- h inch with varying light intensities. Hence must be a larger personal equation to account ie discrepancies in the recognition of faint ts in large telescopes. By the rule, a tele- of 12in. aperture will have an emergent l, with a power of 100, equal to 0·12in. or ⅛in. meter; with a power of 50 it will equal one- a inch. An 18in. aperture with power of 100 pencil 0·18in., or about $\frac{3}{16}$in. in diameter.

ower of 150 gives a ⅛in. pencil, so that with hicago telescope, says Mr. Hiscox, a power is the lowest possible, while a power of 50 l shut out more than one-half the light from ordinary pupil. But here the trouble only a. A power of 100 with a field of half a e, or possibly more, is a good working power earching, and for bringing out the configura- of nebulæ by contrast with a dark background. the 23in. Princeton telescope a power of 100 ces a pencil 0·23in., or nearly one-fourth inch ameter, about the largest that can be compassed es with large pupils, when the telescope is ted upon faint objects. The lowest power in ith this telescope is 158, with an emergent l of 0·15in., or about equal to the diameter of rdinary pupil in daylight. Here the equation e eye comes in as a factor, determining what rson can see and another cannot.

the Washington 26in. equatoreal the lowest r in use is 155, giving an emergent pencil of in diameter. This is too large for many to e, and it is only with the pupil of Prof. ess, which is 0·22in. in diameter when look- a distant light, that assurance is had that hole power of the telescope is made available his magnification. With a power of 100 the would be increased to 0·26in., placing its full power beyond the scope of the human eye. So with such a telescope 155 is the lowest power available for the delicate work of studying the fainter wisps and minute stars of the nebulæ.

The 36in. telescope of the Lick Observatory will be somewhat crippled by this difficulty, unless some new form of eyepiece is made to overcome it, for with a power of 100 the pencil will be 0·36in., or nearly ⅜in. in diameter, making it impossible to use the leviathan for all that it is worth with low powers. A power of 200 with a pencil 0·18in. in diameter will be the lowest that will give the full value of its light-grasping power to an ordinary pupil; the measurement of the latter ranging from 0·12 to 0·20in. in diameter when in a normal condition. Now, 200 is an unsatisfactory power with which to view a nebula and comprehend its beauty and delicacy.

When we rise to the sphere of the great reflectors, we meet an insuperable stumbling block. A 48in. reflector cannot use economically a power of less than 250; while the great 72in. reflector of Lord Rosse is restricted with a power lower than 350, which produces a pencil of 0·20in. diameter, the utmost capacity of the average eye, so that but few persons can compass the light-giving power of this great telescope even with this power, which is far too great for nebula work. With a power of 500 the pencil, 0·14in., just comes within the light-grasping power of the average eye.

With such an unwieldy instrument and great magnification, it is no wonder that stars are unsteady and seeing unsatisfactory, as had been often asserted; nor is it a wonder that the great reflector has done so little work, when a power of 200 produces an emergent pencil of 0·36in. in diameter, and with such a power only one-fifth the light-giving power of that monster telescope can be utilised. The part thus shut out would naturally be the marginal cone, which gives the sharpest definition by producing the smallest star disc, leaving for the observer's gratification the poorest offering within the gift of so great and costly an instrument.

In celestial photography this difficulty is avoided, and this may account for the late photographic discoveries of faint objects by some of the large telescopes in France and England, the 48in. reflectors of the Paris Observatory, and of Mr. Common in England, being now used for this purpose. The photographic plate utilises the whole light of the largest emergent pencil, and with the quick process will no doubt realise large and satisfactory results in the near future.

The method of overcoming this optical defect in the low powers of great telescopes is worthy of our best efforts, and its remedy may lie within the scope of mechanical optics; although in a slight correspondence with Professor Young on this subject, he casts some grave doubts on the possibility of its accomplishment, or the *dodgeability* of its geometrical considerations. I do not think that theoretical geometry is at fault for this suggestion, for it has always been found to swing into line in the face of mechanical facts; not that geometry is at fault or untrue, but that the human mind has not always recognised the geometrical bearing until after the discovery of the mechanical relation of its factors.

Some experiments upon the realisation of the full light of wide-angled object-glasses of short focus, as used for comet seekers, seem to point to a solution, and Mr. Hiscox promised at a future time to bring them before the Society.

J. C. H.

THE HERZ TELEPHONE.

[27422.]—What amount of truth is there in the statements which are made about the new Herz telephone? A few weeks ago the *Times*' correspondent in Paris made the absurd statement that it could be had for half a crown; but it turned out that he had merely estimated its cost at his valuation. The *Times* has recently returned to the subject, and seems determined to stick to a part of the statements of M. Blowitz; so perhaps M. C. Detaille or some other correspondent can give us details, or tell us the real facts of the case. This is what the *Times* said the other day:—

"Last March our Paris correspondent gave particulars of some successful experiments in telephoning between Paris and Brussels. The instrument employed was the micro-telephone, an invention of Dr. Cornelius Herz. Other experiments have been made since then in order to show how the forts round Paris and throughout France can be put into communication by telephone, and we understand that the French Government have it in contemplation to connect the 36,000 communes or parishes of France by Dr. Herz's micro-telephone. As yet the new invention is little known in this country, but it will probably be introduced here at no distant day. While Dr. Herz's micro-telephone is well adapted for transmitting messages over long distances, it is still better fitted for use in dwelling-houses, hotels, and all large buildings wherein it is desired that messages should be speedily conveyed from one room to another. The experiments made in this country have fully confirmed those made in France. Sir Charles Bright, a great authority on all subjects relating to electricity, has pronounced Dr. Herz's micro-telephone a practical invention. Mr. W. H. Preece, the highest authority in this country, has spoken as favourably of it after having made a personal trial of the micro-telephone in his own room at the General Post Office. It may be only necessary to effect an arrangement with the existing telephone companies for the new instrument to be extensively used. For a little more than three years the patent rights possessed by these companies may give them the power to hinder the competition of other companies; but in the present case an arrangement should not be difficult, as the use of the micro-telephone might be confined for the present to the interior of buildings, while the connection between buildings at a distance from each other might be made by the ordinary telephones.

The special advantages of Dr. Herz's invention are its compactness and cheapness. The cost of fitting one in a room can be reckoned by shillings, whereas that of the other telephones is reckoned by pounds. Moreover the telephones in use are unsightly, and occupy a certain amount of space. The micro-telephone does not offend the eye, nor does it take up much more room than the shield of an electric bell. To all appearance, indeed, this instrument is an electric bell shield of a slightly larger size. In this case, as in that of the bell, there is a button to be pressed which causes a bell to ring. When the person at the other end touches the button there, the two are prepared to converse. In order to do this the shield, which forms the receiver and is attached to the instrument by a wire of any desired length, is removed from the wall and applied to the ear; the part exposed is a disc of carbon, and any sound uttered at or near it is conveyed to the opposite extremity. There is no need to remain close to the disc; on the contrary, one may remain a yard away from it and speak in an ordinary tone of voice at that distance. The instrument is so sensitive that sounds are conveyed by it which would not be transmitted over the wires by the instruments in use.

The technical details have less interest for the general public than the general character and scope of the invention itself. Like many other meritorious inventions, the novelty in this one consists chiefly in the arrangement and combination of the several parts. The microphone was the invention of Prof. D. E. Hughes, and in adapting it to his invention Dr. Herz has substantially followed in Prof. Hughes's path. In like manner the receiver he employs does not differ materially from others, but the general adaptation of these parts is Dr. Herz's own, while he is also to be credited with the novelty of some of the other details. We are inclined to think that some such instrument as the micro-telephone is needed to give an impetus to the spread of telephony." Other people may be inclined to think that too much has been said about the new telephone, and too little done with it; but can anyone give authentic details and particulars, for the published descriptions are altogether at variance?

J. T. M.

RIBBED BOILER TUBES.

[27423.]—With reference to the ribbed surfaces for increasing the steaming power of boilers, on page 311 of your issue of June 3, mention is made of the "inventor" of these, and of a contract to supply them. It may be well to mention that I was the first to determine the correct proportions and positions of these ribs, and to measure their effective duty both over the fire and in the flues, and that the use of ribs or studs, rolled, cast, or otherwise, produced in perfect metallic contact with the boiler surfaces was patented by me early in 1886. A portion of the details of my experiment was given in a paper read before the Gas Institute at the last June meeting, and the English patents for this system of boiler construction are my property, and remain in my own hands at the present time. Whether the patent referred to in your issue is, or is not, a copy of mine I have no means of finding out; but if it is a copy, it will not be the first attempt of the kind.

Warrington. **Thos. Fletcher.**

ON THE LAWS, REACTIONS, AND CONSTRUCTION OF SOME FORMS OF PRIMARY BATTERIES.

[27424.]—Oxides of copper and lead have also been used as depolarisers in some forms of cell.

The oxide of copper cell, as patented by MM. Lalande and Chaperon, and which has been since greatly improved, is a new departure from any of the cells hitherto described, in that the waste product has a market value, and that the depolariser can be regenerated and used over and over again.

The battery consists of a plate of zinc immersed in a strong solution of caustic potash, which also contains the negative element, consisting of wire

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LOCOMOTIVE REPAIRS

[illegible] wiped and the w[illegible] every machine is ready to [illegible] a full train safely, and with some degree of [illegible] to her crew. That is what they are built for. It should be as much his concern that the engines steam well, and do not run hot, as the engineers' who run them; and if under his care engines stay out of the back shop longer than usual, he should receive some of the credit, as he deserves it. A few years ago I enjoyed the proud distinction of being night round-house foreman. We were located over 10,000ft. above the sea, in the great Rocky Mountain range; we had a small wooden round house, and no machinery; we had seventeen consolidation engines doing extra heavy mountain work, and all the snow you could wish for. These engines ran all day and lay up at night. They used the purest water on earth, and were not washed out from the time they came from the shop till they went back, yet they very seldom leaked. We had flue expanders, &c., but no regular boiler maker. The fires were never drawn unless we had repairs to make that would [illegible] the blowing off of steam pressure. We had [illegible] machinists, three helpers, and a thing (that [illegible]. When one of these engines had worried [illegible] cars up a dozen miles or so of mountain [illegible] to the mile, she backed down the [illegible] for more cars, and was held by the [illegible], and this usage was hard on the [illegible] everywhere, and few were the nights [illegible] reports on most of the engines [illegible] that let us inside: the boiler [illegible] cocks, three way cocks, gauge [illegible] throttles, checks, &c., were leaking [illegible]. Now, as we [illegible] use but [illegible], it kept all hands rushing to [illegible] and steam on. [illegible]

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TO QUERIES.

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To "Backwoodsman."—The
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ists who are seeking to improve the condition of the poor of your large cities would turn their energies in the direction of colonising these immense tracts (some of them 100 miles square, containing millions of acres) by assisting said poor to reach them, and teach them how to earn their own living on them, *and not leave them to shift for themselves*, they would partly and temporarily solve the question of what to do with your surplus population, and earn the blessings of your heavily-burdened taxpayers. Here is a splendid opportunity for some philanthropical millionaire to perpetuate his name and fame to all eternity. If "F. A. M." will send his address to H., 20, Accrington-road, Burnley, England, he will receive a San Francisco paper that will give him a fair idea of his chance of success in California. If he desires to communicate with me direct, he will find my name and address in the Sixpenny Column of this issue.—BACKWOODSMAN, San José, California, U.S.

[61903.]—**Harmonium.**—The reply of G. Fryer to me is rather disappointing. He says the real cause is made obvious to all who understand. I agree with him—those who understand; but to me it is not quite so clear. On p. 278 he says that the only way in which the defect could arise from the reeds is in the wrong setting of the tongues. Now, on p. 299, I believe that to be the seat of the mystery; but on p. 323 he certainly differs from my opinion, if my experiment with borrowed reeds is correct. My experiment is correct, and is a proof that the broad reeds are wrong either in setting or in construction, or the pan is not constructed for them. As a further proof of this I tried the broad reeds in the Hillier, but they would not vibrate at all like the narrow reeds. I could hear the beats, but they seemed choked, as if the apertures were too small to admit sufficient wind to keep up the vibration. It is the same in both instruments. On p. 323 G. Fryer says: "Taking it for granted that the pan, reeds, and pallets are all right, the real cause of the defect remains clear, and any further reply is 'absolutely' unnecessary." If the pan, reeds, and pallets are all right, will G. Fryer say what is the real cause? I shall be pleased to know why the broad reeds do not act properly when fixed in place of narrow reeds on Hillier. If the defect is in setting of the tongues, how shall I proceed to set them to vibrate properly?—QUEEN.

[62078.]—**Gold Ores (U.Q.)**—I have never heard of gold being found as sulphide; but it occurs in pyrites, and when the gold is finely distributed the ordinary process of crushing and amalgamation is ineffective to extract the metal. Under such circumstances the pyrites are exposed in heaps and allowed to oxidise; disintegration ensues, and solution of the ore may now be effected, leaving the gold undissolved.—SM.

[62264.]—**Duodecimals — Erratum.** — The fraction at the end of my reply, p. 325, should be $\frac{21715}{6912}$, the lowest terms of one in our old notation answering to "3·1849," of the system of "Theta Phi," "S. H.," and the "D E C A." But these five duodecimal figures, the nearest above π are not so near it as the next below it, 3·1848, whose value in the lowest decimal terms is $\frac{8143}{2592}$, and this numerator divides by nothing lower than 17; while $31416 = 2^3.3.7.11.17$, dividing by 2, 3, 4, 6, 8, 11, 12, 17, 22, 24, and fifty-two other divisors.—E. L. G.

[62271.]—**Petroleum Engine.**—Mr. Wheeler should procure the patent specifications or search his back volumes, in which he will find details of the Brayton hydrocarbon engine. Spiel's petroleum engine is an improvement, I believe, and is working very well. It has been described recently, and the more important parts were illustrated in No. 1129, p. 231, last volume. Of course, it would drive the machines in a workshop, or even a small launch.—NUN. DOR.

[62273.]—**Water Mark.** — This querist can put a so-called "water mark" in his paper by passing the latter between rollers, one of which has the design desired raised slightly above the surface. The design will compress the paper where it touches, and leave a mark which, if the paper is of suitable substance, can be clearly seen when the paper is held up to the light.—SAML. RAY.

[62274.]—**House Lighting by Electricity.**—"L. J.," by a diligent search through the back volumes, will find all the information he requires about batteries. Nothing wonderful has been discovered in recent years, and all the useful details can be found in Mr. Sprague's work. The battery mentioned as being referred to by Lord Bury is, if I recollect, the Ross, and that will be found fully described if the querist will hunt it up in the indices, most likely under "Improvements in Galvanic Batteries." If the querist wants a battery to light up his house, I think he will find the chromic acid zinc-carbon arrangement the most convenient. It has been described in recent numbers.—NUN. DOR.

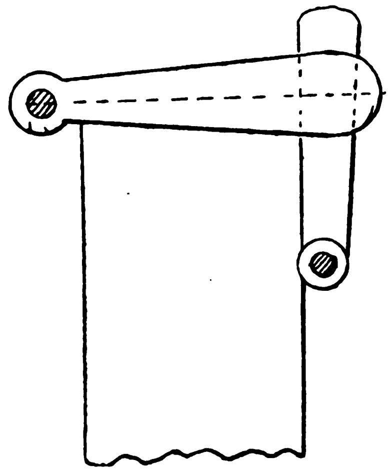
[62276.]—**Piano Soundboard.**—"Fish" had better buy a soundboard and cut it to the size required; but if he must make, let him use yellow pine a quarter of an inch thick. If, however, he will procure No. 696, he will find full directions for making a pianoforte soundboard by Mr. W. H. Davies, and if he also reads that gentleman's remarks in Vol. XXXII. pp. 27, 128, 293, 487, he will know something about soundboards. Perhaps Mr. Davies may see this, and will give suitable dimensions; but the querist must remember that the artist and the professional do not care for these nondescript instruments.—N. E. CHILD.

[62286.]—**Brass Boiler Tubes.**—I do not think the wood fire will have any injurious effect on the brass tubes, because after a little time they become coated with an oxide; but perhaps some of our American friends can give the results of practical working, as in this country there are few, if any, boilers with tubes which have wood as fuel.—T. J. M.

[62301.]—**Lime Chromate.**—It is scarcely worth while answering a query so peculiarly headed as this (see p. 208); but the advantage of lime chromate is nothing, no matter who recommends it.—S. P. T.

[62312.]—**Zoetrope.**—I observe that this query has been unanswered up to date of writing, and I would, therefore, suggest to the querist that he should refer to page 200, No. 502, where he will find some useful hints. I think the best form is that in which the images are mounted on the interior rim of a revolving cylinder, and are reflected in a central pillar of mirrors. An apparatus of the kind was illustrated in these pages, if I recollect, a few years ago; but I forget the name given to it. Perhaps some reader may remember. I do not see how the arrangement could be made up in sections, unless a framework is also provided for fixing up.—SELIM.

[62387.]—**Safety Saddle.**—Between thirty and forty years ago, when I lived on horseback and hunted the fierce Asiatic buffalo and swift antelope on the great newly-burnt plains of N. India, my English saddle had safety springs for the stirrup-leathers, than which I know no better pattern, whatever modern inventors may say. I think this saddle was made by either Peat or Wilkinson, expressly for Indian sport. This I know, that on some exciting occasions, when my horse and self rolled over together in high grass (both barrels at full cock), I have lost stirrup and leather in the jungle on more than one occasion, and had to continue the chase with a foot in a loop of raw hide I carried with me, Hottentot fashion. I never was dragged since I was a child, 60 years ago, in Surrey (when I was nearly killed), in coursing. In India I made after wild beasts alone, having full confidence in the above saddle and straight shooting combined. I sketch the very simple latch from memory. Sitting upright, or leaning forward, the stirrup-leather was secure; a backward angle of 45 or 50 degrees let loose the leather strap. No doubt the pattern is to be found among hunting men at the present day. I kept this fitting well polished and greased. A very elastic, stout spring prevented any shaking when latch was closed. The exact pattern is lost to my memory, though the principle is stamped there—feelingly, for I have had guns smashed, and bones too.—EOS.



[62396.]—**Purification of Mercury.**—Your answer, as far as it goes, is excellent. There is a process, I think, of purifying it by electricity. The price charged for electrically purified mercury is 25s. per lb. Can you or any of your readers throw any light on the subject. If you can, you will oblige.—S. LORD.

[illegible] — [illegible] Stopping - [illegible] Laval Cream Separator. — [illegible] was given by a local [illegible] I suppose is simply [illegible]. I have not found [illegible] the [illegible] because I had formerly [illegible] with the addition of a little [illegible] and as a preservative. With regard to the other questions of "[illegible] Mechanic" respecting the separator I have not used the [illegible]. The tightening [illegible] present [illegible]. When [illegible] the pipe [illegible] with [illegible] a leather band may [illegible] be used when joined in several places. If leather is employed I prefer the V-shaped band, as stated in another reply. The notes given out by the separator accurately indicate the variations of speed. The sound is caused by a slight [illegible] in the bearings, [illegible] at every revolution, and not by the [illegible] end of [illegible]. I have always [illegible] the end of [illegible], as directed in the [illegible] instructions, but the advantage is doubtful. I believe the [illegible] ordinary indicates about [illegible] vibrations or revolutions per minute. At the indicated speed I often separate [illegible] gallons per hour, the temperature of the milk being about [illegible]. I observe that more cream is abstracted from milk which has stood for some hours than from that just milked. This may be attributed to a grouping together of the smaller particles of cream, which, when isolated, would not be sufficiently influenced by the centrifugal force. Using steam power, I have no experience with horse gear, but should be glad to see particulars of horse-power successfully applied.—W. G. [illegible].

[illegible] — **Valve Gearing.** — In reply to "G. H. D." I asserted nothing of what he says as the tendency being known, sufficient length of link is allowed to allow of it being moved by lever in most cases; but if he had had to reverse the same engine with a link of only half the length it had, he possibly would not have written.—T. [illegible], Bristol.

[illegible] — **Photographic.** — Intensification proper is the strengthening of the image proportionately, vertically, right through the film, and this alone will never [illegible] the negative in question, as it will depend on the transparent [illegible] I want to gain transparency. Why should I soak in a solution of alum when the subsequent treatment with mercury [illegible] renders the film perfectly [illegible] I wish "B[illegible]" [illegible] original query, and enter into the [illegible] as it is an important point. Perhaps Mr. [illegible] has overlooked this query.—S[illegible].

[illegible] — **Judson's Luminous Water Paint.** — Mr. Har[illegible] [illegible] kind [illegible] and also [illegible] paint [illegible] man also suggests [illegible] [illegible] to be standing [illegible] Mr. [illegible] has [illegible] [illegible] this paint [illegible] and [illegible] me [illegible] sulphide, and [illegible].—Sarah Ha[illegible].

[illegible] — **Bills of Sale.** — [illegible] Statute of Li[illegible] [illegible] bill of sale [illegible] years after [illegible] [illegible] and get his [illegible].—B[illegible].

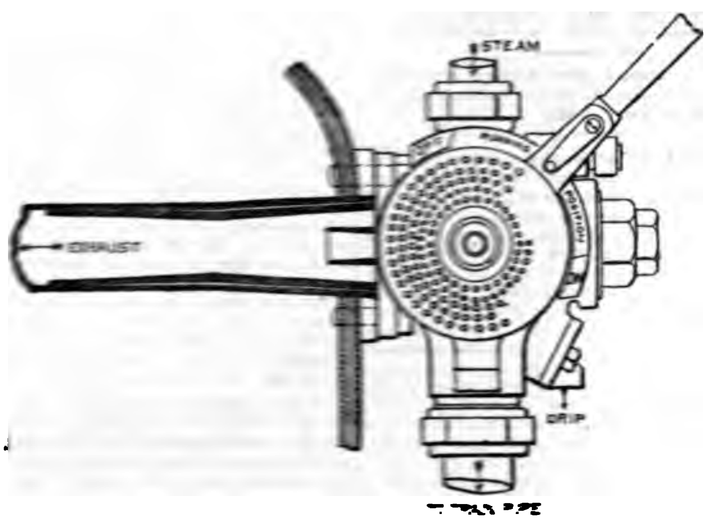
[illegible] — **Clock Pendulum.** — I [illegible] Mr. R. W. Ba[illegible] [illegible] making this kind of pendulum. The [illegible] suspending the weight [illegible] more [illegible] than the [illegible] by Ellicott, for drawings of which see Reid's "Clock and Watchmaking," Plate [illegible] and [illegible] of C[illegible]'s "Elements of Clock and Watch Work." Ellicott published a pamphlet [illegible] his invention in London in 17[illegible]. Pendulums on this principle are still occasionally seen in small French "regulators." —H[illegible].

[illegible] — **Wonderful Clock.** — In reply to query, I append the following description of a [illegible] which I think is the one [illegible] taken from an illustrated catalogue of the [illegible] Exhibition:—A clock in a case, which required [illegible] of years in its completion. The movements are as follows:—Moving panorama of Day and Night. Day represented by Apollo in his car drawn by four horses, accompanied by the twelve hours, and Diana in her car drawn by stags, attended by the twelve hours representing Night. Two figures [illegible] the panorama [illegible] semicircular plate, and the [illegible] of time represented only once in 100 years. Under the index of which shows the day of the week, with its appropriate planet [illegible] showing the leap-year, the index revolving only once in four years. The sun in his course, with the correct time of rising and setting by a hand [illegible] as the days shorten or lengthen; and the moon showing her different quarters [illegible]. Two female figures, one on each side of the [illegible], representing Fame and Terpsichore, which move in time when the organ plays. A [illegible] the clock as a repeater. [illegible] Time [illegible] when the organ plays [illegible] in the base, showing the tunes played by the organ [illegible] This clock was exhibited by Charles Frodsham [illegible] Exhibition [illegible].—[illegible].

[illegible] — **Registration.** — [illegible]

[illegible] — **Tin Alloy.** — [illegible]

[illegible] — **L. and Y. Vacuum Brake.** — I [illegible] a diagram of [illegible]. The general arrangement of the apparatus will be understood from the elevation of the ejector by which the vacuum is formed [illegible] in the train pipe and brake cylinders. It is arranged so that when the handle is in the position shown a supply of steam is constantly passing [illegible] of the small [illegible] for the purpose of keeping the vacuum from [illegible] leakage. When the handle is at [illegible] the train pipe is [illegible] with air [illegible] of the handle [illegible] steam passes through the large ejector at its full pow[illegible] drawing air from the pipes and both sid[illegible] brake pistons, and thus releasing the brak[illegible] formation of the vacuum is brought abo[illegible] inductive action of the passage of a small [illegible] of steam around the conical nozzles, th[illegible] carrying with it a very much larger qua[illegible] air. By the ejector handle the driver ca[illegible] fully apply or release the brakes, or he ca[illegible] the pressure of the brake blocks to suit a[illegible] sary requirement. The extra coal used t[illegible] steam to the ejector is said to be not m[illegible] lb. per mile.—L. AND Y.



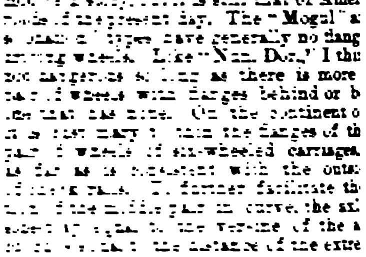
[illegible] — **Essex Chuck.** — I have onl[illegible] one of the jaws of my Essex chuck. This [illegible] been hardened to too high a temper, wh[illegible] the cause of its breaking. They shoul[illegible] hardened above spring temper.—R. R. N.

[illegible] — **Wheels without Flanges.** — [illegible] been the practice in the early day[illegible] [illegible] still that of Ame[illegible] [illegible] of the present day. The "Mogul" a[illegible] [illegible] types have generally no flang[illegible] driving wheels. Like "Nim. Dom.," I thi[illegible] not dangerous so long as there is more [illegible] pair of wheels with flanges behind or b[illegible] one that has none. On the continent [illegible] it is [illegible] to thin the flanges of th[illegible] pair of wheels of six-wheeled carriages, as far as is consistent with the outs[illegible] of [illegible] rails. The former facilitate th[illegible] [illegible] of the middle pair in curve, the ax[illegible] [illegible] the versine of the [illegible] the distance of the extre[illegible] —[illegible].

[illegible] — **Railway Query.** — I am [illegible] N[illegible] for his reply, and beg to [illegible] carriages in the [illegible] [illegible].—[illegible]

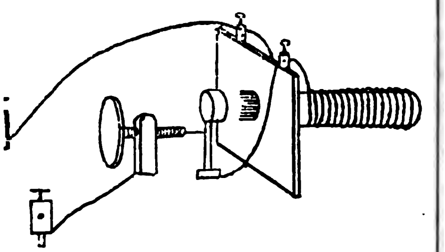
[illegible] — **Brakes.** — [illegible] the North-Eastern Ra[illegible] [illegible] — [illegible].

[illegible] — **Dynamo, 100c.p.** — [illegible]



[illegible] the [illegible]. You should [illegible] The armature core sh[illegible] [illegible] exclusive of [illegible] ring [illegible] be wound as a Gramme ring. T[illegible] ding makes the dynamo almost entirely self- ulating, so that the dynamo will work almost as l with one in circuit as with five. Annexed is tch, with correct dimensions. N.B.—The ures given in reply 62223 for the dimensions of tes are erroneous: they should have been n. × 1½in. × 3½in.—S. BOTTONE.

[62483.]—**Medical Coil.**—TO S. R. BOTTONE. I do not see any reason for your failure in your scription. I append sketch of the proper way

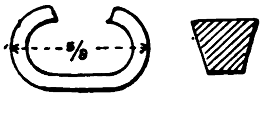


connecting up the ends of the primary wire. u will bear in mind that the secondary wire is very way perfectly independent of the primary, I has its own separate binding screws.—S. BOTTONE.

[62495.]—**Photography—Vague Formula.**— 1. It is understood in photography to mean ounce measurement. No. 2. If the working rtures of the lenses are the same, the lens of focal length will require nine times the exre; but if the working apertures are not the e, the following rule will give the exposure uired. Multiply the focal length of each lens its working aperture and square the quotients. e numbers obtained are the relative exposures. A. R.

[62495.]—**Photography—Vague Formulæ.**—In replying to this query last week I made, hink, a little error, which I hasten to correct. aid: "Weigh 10 grammes of alum (or other), and fill up the measure to 100 grammes with er." I forgot at the time that, although a mme measure of water weighs a gramme, it s not follow that a gramme of alum should equal a gramme measure; in fact, the probility is that it will not. I should have said: gh 10 grammes of alum, and add 90 measured mmes of water. This will be a 10 per cent. tion, and will altogether weigh 100 grammes, I doubt if it will measure quite so much. If Bottone will take the trouble to weigh a fluid ce of water, he will find that it is a long way rt of 480 grains, *vide* "G. G. B.'s" reply.—OS.

[62500.]—**Joining Leather Bands.**—"T. G." l find that an open steel link shaped thus will n either round or V-shaped leather banding very isfactorily. I use soft steel wire of about in. diameter. The ends are obtusely pointed r facility of hooking. The link does not require rdening, and need not be closed. I am now ing an old band 14ft. long of this section (see



etch) made of leather $\frac{3}{16}$in. thick. It is joined these links in thirteen places, and gives no uble. When joined in the proper direction, the k does not touch the pulleys, unless the round nd revolves on its axis. I prefer the V-shaped nd, as there is less slip and no turning round on s. About $\frac{5}{16}$in. from end of band make with an l a hole of proper size, and trim it, if necessary, ith penknife to about the curve of hooked porn of link.—W. G. B.

[62500.]—**Lathe Bands.**—Gut, unless specially epared, makes a very poor band, as, being hard d slippery, it has no hold on the pulley. Soft, isted line has about the best hold, and next to it strip of twisted raw hide. As to fastening, many ople in England seem to prefer splicing. This ethod has the objection of requiring some little ne to remove or tighten the band. Hooks and es as bought are practically useless, the makers parently being afraid to cut a good, deep thread them, consequently they come off without any ovocation. The hooks and eyes I am using on o ⅜in. bands have a ¼in. hole tapped with a screw t rather deeper than Whitworth's, of 16 threads r inch, the tops of the threads being rounded off prevent cutting the band. These hooks and es screw on very stiffly; but when once on, it is xt to impossible to get them off again if required. ey cannot be pulled off by any strain which is t with in driving a foot-lathe. The twisted leather bands often have a hole made in the ends, which are held together by an S-shaped hook. Solid round leather bands are not to be recommended, as they stretch considerably, and also cannot be tightened by twisting the ends before hooking together. The triangular or V-shaped leather band has perhaps a better hold on the pulley than any other; but it is, I believe, very expensive.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[62503.]—**Cutting Brass Wheels.**—Certainly; if the cutter is driven at a high speed. Wheels $\frac{1}{16}$in. thick and up to 2in. diameter, are mounted on a mandrel. Thinner wheels or those of same thickness, but, say, 4½in. diameter, would be held between flanges on a mandrel. The feed must be very slow.—A. F. SHAKSPEAR, Lüttichaustr. 14, Dresden.

[62508.]—**Balcomb Tunnel.**—The length of the Balcomb tunnel (according to Eyles and Son's "London, Brighton, and South-Coast Railway Guide") is 1,078 yards.—REV. CHARLES GAPE, Rushall Vicarage, Scole, Norfolk.

[62514.]—**Engine.**—I understand your ports to be ⅜in. diam. If so, they are not large enough; they should be equivalent to ½in. diam., and exhaust proportionally larger. If you make these alterations and put in ¾in. steam and exhaust pipes, and cut off steam at ¾-stroke, running engines at 200 revs. a minute, they should give a total of 2H.P., which should be ample for you.—T. C., Bristol.

[62515.]—**Squaring Holes.**—I think "A Reader of 'E. M.'" can obtain a hollow square chisel from A. Ransome and Co., of Chelsea, with a screw auger inside, which should revolve as the chisel is forced through the wood, and cut a beautiful clean hole at one operation.—E. R. DALE, Fell. Soc. Science.

[62518.]—**Electric Motors.**—I see no reason to doubt that with the larger types of electro-motors, an efficiency of 90 per cent. has been obtained. You will find much interesting matter bearing on this point in Silvanus Thompson's "Dynamo Electric Machinery." I may mention that as far back as 1884 I saw a machine having an efficiency of 75 per cent.—S. BOTTONE.

[62519.]—**Length of Throw for 5in. Lathe.**—Anything between 2½in. and 3in., according to fixing of treadle; 2½in. would suit yours. You might alter treadle into a bell-crank stayed with ⅝ round rod and hooks horizontal from back, instead of as you have it.—T. C., Bristol.

[62519.]—**Length of Throw for 5in. Lathe.**—There has never appeared such a drawing of a lathe before. Do not perpetuate such a thing by adopting any makeshift contrivance in the way of a bell-crank lever with the pitman at the back; but have the crank altered to 2½in. throw, and bring its centre line directly under that of the mandrel, as it no doubt originally was before it knocked your shins.—W. I.

[62519.]—**Length of Throw for 5in. Lathe.**—I think "Silver Grey" will find 2½in. quite sufficient for radius of crank throw, and I do not find it too large.—OS.

[62519.]—**Length of Throw for 5in. Lathe.**—My Holtzapffel lathe (5in.) has a throw of 2½in., the crank hook hangs perpendicularly when the treadle is at its lowest, the wheel is 29in. over all, and has eight speeds; it is hung directly under the lathe bed, and is not counterbalanced; the hook is gunmetal. Nothing could run more pleasantly. I am fitting up another 5in. lathe; crank has about the same throw, wheel is 30in., and weighs about 140lb. The wheel in your drawing looks much too far back, and cord does not seem to clear lathe bed.—N. D. F. P.

[62519.]—**Length of Throw for 5in. Lathe.**—The proper throw for the crank of a 5in. lathe cannot be given without knowing the other dimensions, any more than you can tell what should be the length of a man's leg without knowing how tall he is. The height of centres does not help, nor do the dimensions you have given, as what is required is to know the proportion of the lever formed by the treadle arm and its position under the shaft. My small 3½in. lathe crank has a throw of 4in., and the foot-board rises and falls 7½in. My 5in. slide lathe has 4½in. throw, and movement of foot-board 9½in., which, of course, gives more power. Suppose, now, you gave a movement of 10in., which will do very well if you are 6ft. high, drop a perpendicular from crank shaft to treadle, and measure 2in. forward of that for the attachment of pitman; then the proportion of treadle lever would be as 5½ to 10, so that if on measuring from the points on which treadle rocks to the point of attachment of pitman, you got, say, three times 5½ = 16½in.; then the distance from rocking points to foot-board would have to be three times 10 = 30in. If you can bring the crank axle forward, so as to be under the bed, it would help you. The wooden shears would have been better turned, so that their section would have been upright instead of flatways, as you have them. I think you will find you can use the cranks; but, if not, you might fix two eccentrics just outside each crank, and have pulleys underneath in the treadle, and a chain round them. You are sure to have such mistakes as these if you don't set out the work properly beforehand.—F. A. M.

[62521.]—**The Bansoolah.**—TO "ANGLO-CELTIC."—No bevel in the true pattern from which my little adze was copied; keep the edge very sharp. A native will shape any rough log very speedily into a beam or door-post; after marking the chalk lines he cross-cuts the wood nearly to the lines, then chips off the irregular surface so neatly as not to require the plane. Thick wood is held in a stout, square piece of timber, having a deep, angular notch in the centre, from which the work cannot slip; for slender jobs the artisan employs his toes—and rarely cuts them!—EOS.

[62522.]—**Bitumen of Judea, Solvents for.**—Bitumen of Judea, or asphaltum, is soluble in most hydrocarbons of the terebene class, such as oil of lavender, turpentine, oil of lemons, &c., as also several of those of the benzol type. Caoutchouc or indiarubber is soluble in ether, coal-tar naphtha, and bisulphide of carbon; also less perfectly in most essential oils and benzoline.—S. BOTTONE.

[62522.]—**Bitumen of Judea.**—It seems to me that the querist asks too much when he requests a list of all the liquids that will dissolve asphaltum. It is soluble in turpentine, mineral naphtha, benzol, fixed oils, caustic alkalies, and some other liquids; but as to those latter it would be necessary to experiment, and I suppose the querist might do that for himself. As to those that will dissolve indiarubber, try sulphuric ether, chloroform, bisulphide of carbon for ready solvents, and mineral naphtha, turpentine, &c., for other solvents. When the querist has completed his list, perhaps he will publish it?—NUN. DOR.

[62523.]—**Harmoniums.**—This query should have been headed brass reeds, or something like that. But "Musical," who is evidently anxious to waste time and money, may make the vibrators for a harmonium out of rolled brass, or he may hammer down brass wire until he obtains tongues or vibrators of the requisite size; then file up to pitch. Is the query put seriously? Does anyone suppose that he can make harmonium reeds cheaper than they are sold, unless he goes in for them wholesale?—N. E. CHILD.

[62524.]—**Gas-Cooking Range.**—If the enamel wanted is such as was put on my gas oven, my advice to "B.Sc." is leave well alone. The stuff cracks, and flies off in pieces. My range is from one of the best makers. I should consider tiles an immense improvement. They should be ordered with holes, and screwed on the oven.—HENDON.

[62526.]—**Organ-Making.**—The top octaves of both these sets of pipes are generally made of wood, although, of course, some are made of metal. 2. Best pine, free from knots, is most suitable wood for the smaller pipes; if oak is used, it renders the job very tedious, as it is very hard to work, and does not give any better result when finished. 3. The mouth of the flute should be cut from the inside. You will find metal pipes a very difficult job if you construct them yourself. I would recommend you to make a row of paper pipes; they are highly successful, and, moreover, are very cheap. I have made several rows myself, and can recommend them.—CLARENCE E. ALLEN.

[62527.]—**Daniell's Battery.**—Melt enough glue to fill one division or more of battery; warm battery, and then fill up with the glue. If you then empty out the glue again you will find a nice level coat behind from $\frac{1}{32}$in. to $\frac{1}{16}$in. thick.—ELAG.

[62528.]—**Electro-Magnet.**—The size of wire to put on an electro-magnet depends very much on the battery power to be used with it. Very fine wire requires more power than thick wire, owing to the resistance it offers. The common sizes for ordinary conditions are Nos. 16, 18, 20, and 26. The rule for quantity of wire is to wind as much on each leg as will make its entire thickness three times the diameter of the core.—BOBADIL.

[62528.]—**Electro-Magnet.**—The gauge of wire to be employed will vary according to the E.M.F. and current of battery used with the electro-magnet. For battery giving a large current, with low E.M.F., use No. 14 or 16. For a battery of high E.M.F., but smaller current, you had better use No. 20, or even 22. Whatever wire you use, it is useless to put more on than will treble the present diameter of the core; so that the wound core should measure 2⅝in. in diameter. This amount gives practically the best results.—S. BOTTONE.

[62531.]—**Photographic.**—Your pictures are probably over-exposed. Use more bromide with your developer; or, better still, try the ferrous oxalate developer, made by adding one part saturated solution of ferrous sulphate to three parts saturated solution of potassic oxalate. This never stains.—S. BOTTONE.

[62531.]—**Photographic.**—The make of the plates is probably the cause of the staining, as professionals here use the pyro and ammonia formula more than any other. Try Beach's developer (I have given several formulæ in back numbers) or iron and oxalate. Mr. Bottone has given this, and Continental photographers use it more than any other.—B.SC., Plymouth.

[62533.]—**Romsey Observatory.**—If "A. B." will give the dome of his Romsey Observatory two good coats of Carson's anti-corrosion paint, he will not be much troubled for some time to come. I painted my first observatory in 1880, and it is practically as good as ever. I built a large new one in 1884, on which I put three coats of Portland stone Carson on walls and roof, and it is as "tight as a bottle." I find no paint to equal it for high, exposed situations, having given it upwards of 20 years' trial.—T. R. CLAPHAM.

[62534.]—**Machine for Slicing Fat Bacon.**—I once made a machine for cutting bread something after the style of a chaff-cutter. The blade, forged from a large file, was pivoted on a cross rod, and in shape was a spiral, starting from the pivot. Perhaps this might be a suggestion for your machine. The knife would, I presume, have to be very narrow in order not to tear the slices.—HENDON.

[62535.]—**Petroleum or Benzoline Engines.**—I noticed a Spiel's patent petroleum engine at the Bath and West of England Show at Dorchester on Thursday, driving one of Richmond and Chandler's chaff-cutters, cutting up food for the cattle in the Show yard. When exerting its full power, it is stated that the consumption of petroleum is, for small engines, about one pint per horse-power, equal to a cost of 1½d. per horse-power per hour. It appears to be a rather complicated machine, as there are so many different motions. I should advise "Naws" to be careful with benzoline, as I have lately had a generator, in use with a furnace for brass founding, explode, and I had to run. Have any of "ours" succeeded in fitting up one of the small gas-engines from the castings supplied by Clarke, of Nottingham?—E. R. D.

[62536.]—**Fiddle Ribs.**—The proper way to do this is to make a mould of the required curves of cast iron if for wholesale manufacture; but hard wood will do well enough for you. Screw the pieces having the inside and outside curves formed upon them down on a piece of board, leaving sufficient space for the rib, which is to be reduced to its proper thickness. Now take a pan with a lid, put some water in same, put in a rib so that it is above the water, a bit of string, say, crossed a couple of times will do, place pan on fire, and let it steam for a few minutes, whip it out "quickly" and into the mould, and when cold the job is done for that one.—A., Liverpool.

[62537.]—**Cement for Rubber.**—"C. L." says in his query that the present cement is made (or should be) of equal parts of indiarubber and guttapercha, and yet he also says that it must not cost over 1s. 6d. a pound. If "C. L." can make a cement of rubber and guttapercha—and he evidently knows what it "should be"—to sell at 1s. 6d. a pound, he must be very clever. But is it not rather ridiculous that anyone should ask in these columns for a better way of making tire cement, when it is well known that the recipe has been given over and over again, and is simply a mixture of guttapercha and pitch? If "C. L." knows of anything better, will he publish it?—ESSAR.

[62539.]—**Inlaying Iron with Silver.**—I am informed by Professor Church that the articles referred to were published in Cassell's "Popular Educator" in 1871, 1872, under the title, "Chemistry Applied to the Fine Arts," and have since been reprinted without revision. He does not recollect describing any new or simple plan of enamelling metals.—W. A. S. B.

[62541.]—**Sight-feed Lubricators**—Are of two kinds. In one the oil passes through a medium of water, and being of less specific gravity, rises; in the other it passes through a medium of steam, and being of greater specific gravity, falls. The latter are much simpler and cheaper, and only require one connection to the steam-pipe. The uses of the various cocks can easily be understood by inspecting any of the numerous illustrated advertisements which appear.—W. I.

[62541.]—**Sight-feed Lubricators.**—These all work by condensation of steam, which, as water, is heavier than the oil, and so falls below oil, which it raises until it runs over a vertical pipe on its way to the valve casing. This pipe is led to bottom of a gauge glass containing water, where it again rises to top and overflows direct to casing by a tube connected to top for this purpose. This lubricator is no better than the old form, beyond seeing the actual working, which has some advantage.—T. C., Bristol.

[62544.]—**Half-round Bits.**—You must forge these to approximate the finished bit, and only *allow, say,* 1/16in. to file off the flat—enough, in fact, to obtain a good centre for turning.—T. C., Bristol.

[62544.]—**Half-round Bits** should in large sizes be forged nearly to shape, but leaving the cutting end more than a semicircle, sufficiently so to centre them for turning; put a good large centre at back end, turn up to size, file the centre mark half out, give the cutting edge a little "lead" so as to keep non-cutting edge from rubbing—a very little will do; harden and temper. The nearer you forge to shape the less you will have to file. Use square steel or octagon.—N. D. F. P.

[62545.] — **Moths.** — Naphthaline ("albocarbon") dissolved in benzine is an effectual preventive.—S. BOTTONE.

[62545.]—**Moths.**—Camphor wood or cedar wood drawers and chests are invaluable in the East, and in England, too, against these and all insect pests. You will find a large lump of camphor with some peppercorns sewn up in muslin a very good preventive; these are said to help each other. I have found them do so. Creasote, or turpentine, or benzine collas, in a sponge wrapped in calico, will kill any existing colony of moths.—EOS.

[62547.]—**Coins of the Present Reign.**—In Guernsey the penny is an eight-double piece, and there are pieces of four doubles, two doubles, one double. In Jersey there is, I believe, also a farthing, besides the coin you name.—HENDON.

[62547.]—**Coins of the Present Reign.**—Some years ago, when I travelled in the Channel Islands, there was to be found in Jersey pennies, half-pennies, and farthings; in Guernsey, pennies, half-pennies, farthings, and half-farthings. The Guernsey penny was called 8 doubles; half-penny, 4 doubles; farthing, two doubles; half-farthing, 1 double. A Jersey penny in those days had stamped on it "one 13th of a shilling." If this is what our friend has, he has the old Jersey coin; if not, he has the new coin, which was introduced some few years since, and to complete his list should get some of the old ones.—S. C., London.

[62548.]—**Side Lever Valves.**—These are only ordinary D valves. In some cases two are used to each cylinder, but usually only one. A cut-off valve is applied in the usual way on back of slide and worked by an eccentric, or by a stepped cam. Nothing special about the valves at all.—T. C., Bristol.

[62549.]—**Kite.**—Make your kite the same shape as we used as boys—a pointed one. Use crossed sticks, the same as you have, and spring them into four little pockets made in each corner of kite. Twist a very fine brass or copper wire in your cord for a conductor.—T. C., Bristol.

Milk Sugar.—From a chemical point of view, milk sugar stands midway between grape sugar and cane sugar. Like glucose, it browns in the presence of alkalies, and in alkaline solutions exerts a reducing action upon metallic compounds. A saturated, aqueous solution of lactose, at 10° C., contains 14·55 for 100 of sugar. Freshly prepared solutions possess a greater dextrogyrous rotary power than do those which have been kept some time. Using a 1 per cent. solution of glucose, and Fehling's solution as usually prepared, one molecule of anhydrous glucose reduced 5·26 molecules of cupric oxide. Using a solution of milk sugar of the same strength (one part to 100) and Fehling's solution, one molecule of anhydrous lactose, $C_{12}H_{22}O_{11}$ reduces 7·4 molecules of cupric oxide. Recent experiments by M. G. Bouchardat have proved that this carbohydrate, hitherto supposed to exist only in the milk of the mammalia, is present also in the milky juice of some plants belonging to the Natural Order *Sapotaceæ*. Milk sugar does not ferment in the presence of brewer's yeast, but some bacilliary ferments (schizomycetes) transform it into alcohol. This reaction explains the possibility of obtaining from milk fermented liquors, such, for example, as the nutritious koumiss, which is prepared from mares' milk by the Tartars, as they roam over the vast steppes of Asia. If Bouchardat's experiments shall be confirmed, the origin of the intoxicating liquor prepared in Africa from the flowers of certain species of *Bassia*, will no longer remain unexplained chemically. A single tree of *Bassia longifolia*, it is stated, will yield from 200 to 400lb. of flowers collected after they have fallen, and these flowers are largely consumed in the preparation of spiritous liquors.

THE report of the Deputy Master of the Mint for 1886, which is now issued, states that during the year no gold had been coined, the Mint having been exclusively engaged on silver and bronze coinage, the value of the former being £417,384, and of the bronze coins £51,669. The number of half-crowns coined was 994,752, and of florins 592,020, while the shillings struck amounted to 1,774,080, and the sixpences to 2,724,480 in number. The number of threepenny-pieces coined was 6,150,408.

UNANSWERED QUERI

The numbers and titles of queries which remai swered for five weeks are inserted in this list, and unanswered are repeated four weeks afterwards. our readers will look over the list, and send what info they can for the benefit of their fellow contributors.

62090. Estimation of Nitrogen and Phosphoric A Manures, p. 112.
62095. Midland Single Engines, p. 112.
62111. Medal, 113.
62128. Rear-Driving Safety Bicycles, 113.
62135. Gas Engine, 113.
62136. Cutter Frame, 114.
62152. Coins and Tokens, 114.
62156. Sub-sizing Paper, 114.

62269. Turkish Baths, p. 207.
62280. Warming a Chapel with Hot Air, 207.
62288. Flannel, 207.
62289. Burnishing Bowls, 207.
62290. Grinding Tools for Haydon's Cutter Bar, 207.
62300. Schuckert's Ammeter, 207.
62304. Equation, 207.
62314. Violin, 207.

QUERIES.

[62550.]—**Case-Hardening.** — Can any read form me of a good and simple way to case-harden arms and axles? I should like it to strike not les ¼in. deep.—AXLE.

[62551.]—**Compress Pad.**—Would "Eos" k inform me of a maker to carry out his explanatio recent No. of his "Compress Pad?"—many thanks t for it. I have had, I fancy, umbilical hernia for twelve months, and fancy I would require two, o each side. As I am in rather poor circumstances, a years of age nearly. I only wish comfort w anything extra. What I have is more a good than a port.—(78).

[62552.]—**V-Shaped Leather Band.**—A spondent of "Ours" once recommended this for lathe and I have used it with success; but find it very di to obtain it of good quality, and stout as the corres ing round leather band. It is easily joined (see 62500), and holds well on the pulleys. Why is i generally adopted in preference to round leath W. G. B.

[62553.]—**Printing White Enamelled with Names and Numbers.**—Can any spondent give me the particulars of how the name numbers are printed upon the face of white enamel as meter dials, &c.?—ENAMELLER.

[62554.]—**Cement.**—Want to fasten maize, m and other seeds on a sheet of glass. Should be plea hear of a cement that would secure them, and be n figuration?—W. J. F.

[62555.]—**Four-Section Induction Coil.**—some kind reader or friend favour me with a little h the point of joining up the secondary wires of a section coil? I have made primary core, 1in., two layers of No. 16, 11½in. long, the four sections a wound the same way, and the insulation all seems I have used about 5lb. or 6lb. of No. 36 wire, and l two end sections with a little less wire than the two have, and the wire is continuous; condenser is I have tried several ways to connect them up, but less spark with the four than with two, about 1½in. wit and only 1in. with the four; diameter of centre two, of end two 3½in. by 2½in. wide, paraffined after wi Having lent my Sprague's "Electricity" I cannot to this, and any help will not only oblige me, but interest many other readers beside—INDUCTION.

[62556.] — **Midland Engines.** — Wanted dimensions of the new Midland engine, now in exhibition at Saltaire, No. 1757.—LOCO.

[62557.]—**Railway Signals.** — Can any r oblige by giving an illustration or particulars o Kirby facing-point-lock, for railway signals, as now put in on the Great Northern Railway.—SIGNALMAN.

[62558.] — **Enamels.** — Would an obliging c spondent give some description of the manufactu enamelled hollow ware? Knowledge of the position of said enamel — how to make and to hollow castings — would interest many re Information also of the annealing stoves required, l of time exposed, degree of heat required for glazing general information about a little known-process be very instructive. I have not noted the use of enamel vessels for batteries, and wonder if the rea the unsuitability, or the not getting at the manufact of such ware.—VIATOR.

[62559.]—**Wooden Platters.**—What kind of is used in the making of these? Are they ever across the grain; if not, why not?—L. GUBBINS.

[62560.]—**Tap for Wooden Chuck.**—Some ago one of our readers kindly offered to lend ano tap for making the internal screw hole in wooden c as a pattern; would that correspondent kindly exte offer to the undersigned, as he believes the tool, fro illustration given at the time, a first-class articl would like to have a few made to suit 1in. mas threads to an inch.—LAUNCELOT GUBBINS.

[62561.]—**Turning Wood Boxes.**—In holl boxes in lathe, I find it very slow work, and as the seems to scrape rather than cut, it occurred to me there must be a tool for this work. Is there? If s some reader please send a sketch? I am far removed any woodturner of more advanced type.—L. GUBBI

[62562.]—**L. & N W., S.E.R., & G.N. Eng**—Can anyone give particulars of the following en L. and N.W.R.: "Siren," "Apollo," "Cornwall,"

;le express, 267, 154 and 158. G.N.R.: 229 235 6ft. 8in. single. M.R.: 1532 passenger y of the above-mentioned given in the back " E.M.," now in print? If not, where can formation?—H. V.

eam.—To "T. C."—In the recent exam. ;t. candidates were requested to write mula for the total heat of formation of ;iven temperature, adopting Fahrenheit's they were asked to determine the efficiency om the particulars given hereunder:—Revs. louble acting; 1HP., 125; feed T. 75°F.; .; dry steam used per stroke, 0·6lb.; priming stroke, 0·0251b.; jacket steam condensed per Neglect any variation in the specific heat v could one, without tables, arrive arith- a solution? Assume acquaintance with mula. I suppose that the datum line for ould be absolute zero?—SHINY BOOTS.

nger Board of Violin.—About five finger board of my fiddle came off. I ansed neck and finger board with strong water and washing soda, waited till separate 7, gently warmed and glued them together, ard firmly down to the neck, left it for 30 djusting strings. During last week I lost best make, which may probably have jarred rd, and thus has caused it to come adrift kind of stuff should I use to stick them to- The glue I gave 9d. per lb. for. Ought I to ith it, like they do for caulking decks?—ONE

old Printing.—Will some practical tell me the best method of printing in gold? bronze powder, applied after working with t does not give a sufficiently solid appear- UR PRINTER.

namalgamated Zincs for Bunsen's nyone tell me where the following is taken k it is from "Buckmaster's Electricity," but rint, I cannot refer; perhaps someone having a ge. "Hearder of Plymouth found a saturated alammoniac gave greater force with un- zincs, than dilute sulphuric and amalgam- the outer jars of Bunsen cells." I may ed it, and find it perfectly correct for short e zincs are left in long, a heavy deposit of s on them. Should the quotation referred to book mentioned, perhaps someone can tell t is in?—MEM. SOC. ENGS.

.W.R. Slip Arrangement.—Can any lers describe and illustrate the new slip s now in use on the G.W.R., whereby the con- vacuum brake is preserved throughout the portion, and how the vacuum is maintained the engine is separated?—CUMBRIAN.

imensions of Chimney.—Being about w sawmill, I shall feel obliged to anyone of ondents for information as to the above. I use one of the well-known semi-fixed loco- rs, with engine underneath, and know from rience that I shall require to burn 140lb. of coal per hour, when burning coal alone; but re is a large quantity of waste to burn in a J.

hoto-etching.—I want to obtain some 3¼ opper, and steel plates perfectly flat and plane le polished. Where can I obtain them? I the local ironmongers, but they make a mess What would the probable cost of same be?— ANCE.

mall Castings.—Have any of "ours" tul in casting iron with small furnaces with n gas and foot blowers? Also with the new for cylinders?—E. R. D.

moking.—Can anyone tell me if there is f preventing the tongue becoming sore and smoking? I am an old smoker, but have to nber of pipes on account of this effect. The s nothing to do with it, as it is just the same clay or any of the patent pipes, Col. Ross's in- E TONGUE.

View Lens.—I have a lens of good quality he front combination of a portrait lens. I nt up as a view lens; it is 2⅝in. diam., 12in. t is the proper distance to put stop in front ould such a lens work with 1-12 stop?—the e lens are not very deep, one side is almost here any rule to find out the proper distance stop in view and doublet lenses? If so, will kindly inform me how to set to work?—MC. S.

Force of Outlet Steam.—Would anyone e by stating the force power (not expansive) hing out under pressure from boiler? And rule for the force at various distances from –J. N.

Dynamo Design.—Will Mr. Bottone ying whether his 1yd. per volt is from actual in most descriptions of machines I have seen least 3yd. used, if of Gramme or Hefner- ttern, (see *Electrician*, Dec. 31, 1886)? With Liberator's" query, 3,000 amps. per square inch ; but of course the lower the C. density the termine the exc. power required. Wind your t at its normal speed, and send known C. (from lls or other source) through a known urns on magnet limbs. Multiply C × amps. urns; from this you can easily calculate wind- 1. For instance, suppose temporary coils = 1, C. = 100 amps., then ampère turns = 100 × Now, suppose you are shunt winding dynamo, C. you will send through shunt, say 5 ampères, on 1,000 turns of wire of Res., to suit voltage , if 50 volts G = 10 ohms. Same principle r series winding. Keep as low a C. density in as possible, and, according to Crompton, don't coils thicker than ⅔ thickness of core. The vire in series on A, as Mr. Bottone explained, nal to E.M.F. req., and cross section to C. You nber that there are two circuits on A, and con- rrange your wire apparently for twice the real density; for instance, you req. 30 ampères from machine at 3,000 amps dens. Then arrange your wire as though to carry 30 ampères at 6,000 dens. = cross sec. ·005sq.in., say No. 14 or 15. Process of calculation is $\frac{6000}{30} = 200$ = ratio of current in square inch, to C. req., ∴ $\frac{1}{200} = 8$ req. Mr. Bottone will understand I ask with a wish for knowledge, not to pick holes in his answer.—G. S. PARDOE.

[62575.]—**Bluing Varnish for Steel.**—Will some one tell me the best way to blue bright thin steel by means of a varnish, as the articles I require to blue could not be done by means of heat; but I want them to look as much like heat-blued as possible?—STEELBLUE.

[62576.]—**Locomotives.**—Could any reader give details of the following engines, with numbers of all engines in the same classes:—1. L.B. and S.C.: 413, 469. 2. L.C. and D.: 115 "Diomede," 155. 3. L. and N.W.: 2,037, 2,297? What engines belong to the class of L. and N.W. goods, described in *Engineering* for Oct. 8, 1880, (Vol. XXX. p. 294)?—V. J. B.

[62577.]—**Brazing Band Saws.**—TO MR. T. FLETCHER AND OTHERS.—Will someone kindly give figured sketch or full directions to fit up a gas blowpipe for above process? I have a 6in. fan driven by power, and ¼in. gas supply. Size of largest saw is 1¼in. by 1-16in. —B. P.

[62578.]—**Organ-Pipe Feet.**—How can I turn organ-pipe feet? Are any special tools or appliance needed beyond the ordinary chisels and gouges?—TURNING TYRO.

[62579.]—**Western Australia.**—Will any English Mechanic or other reader who has had any experience of West Australia kindly give all information as to outfit, &c., for one who is going out there, on railways up country? What is the climate like in the south, and who are the sort of people who do best out there?—GUILLAUME BOIS.

[62580.]—**Wave Motion.**—The following is an extract from "Blackie's VII. Geographical Readers," on page 25:—"Experiments show that each wave extends its influence downwards in a vertical direction to 350 times its own height. Thus, every wave of about a foot in height makes itself felt on the bed of the North Sea at a depth of 50 fathoms, while every oceanic billow of 33ft. is felt at about 1¾ miles down." Now, as this seems at variance with common sense, I should be very much indebted to any reader of "Ours" who can corroborate this statement or prove it to be fallacious. I have seen several books which give quite a conflicting statement to the "extract." One book said that the affected depth of sea by a 15ft. wave was 25 fathoms, another mentioned that the wave influence did not extend far below the surface (certainly not 350 times the wave's height). So, with these diverse statements I should like to know the facts.—SEDIMENTARY.

[62581.]—**Engine Query.**—Will someone tell me probable cost per H.P. of double-cylinder engine about 250H.P. nominal, with boiler and fittings, also average life of hauling engine and proportional cost of repairs? What is the life and cost of wire rope, and which is the strongest, twisted or untwisted? If there is no difference in strength, what is the advantage? What would be the consumption of coal per H.P. for above engine.—G. H. H.

[62582.]—**Photography.**—Two single landscape lenses of similar make, to cover the same size plate, but of different foci. When the same size stop, as supplied with each, is used (say F-16), are they of equal rapidity, and the time of exposure the same for each lens?—SUMMUM BONUM.

[62583.]—**Dynamo Design.**—TO MR. BOTTONE.—Many thanks for your kind notice of my last query. Would you now inform me if a current density of 3,000 ampères per square inch of armature conductor is a safe limit in a machine with a Gramme armature, wound with three layers of wire in each coil, to run about six or eight hours a day? At the above density would No. 6 B.W.G. wire carry 180 ampères safely?—AN AMATEUR ELECTRICIAN.

[62584.]—**Tour in Norway.**—Could any fellow-reader give me particulars as to the probable cost of a three weeks' tour in Norway, the best way of getting there and the best places to visit? I may say that I know nothing of the language, and am not a millionaire.—A. R.

[62585.]—**Photographic.**—Am going to start and want a full technical description of a half-plate camera, costing say from £6 to £10, so that I can order one from the maker. I am getting a half-plate, so that I can practise first on ¼ plates—is this feasible? I want one that can be packed in small compass for touring.—A. R.

[62586.]—**Locomotives.**—Would some kind reader of the "E. M.," well up in historical matters concerning the locomotive engine, tell me if there are still any engines of the "Sphynx" type, running on the M.S. and L.Ry.? These locomotives were built by Sharp, Stewart and Co., and described in "Railway Machinery," by D. K. Clarke. —E. GOBERT.

[62587.]—**Equations.**—Would some mathematical correspondent of the "E. M." solve or show me how to solve the two following systems of irrational equations, in such a manner that a complete equation of the fourth degree shall be avoided:—

$$\begin{aligned} x + \sqrt{y} &= a \\ y + \sqrt{x} &= b \end{aligned}$$

$$\begin{aligned} \sqrt{x} + \sqrt{y} + \sqrt{z} &= a \\ x + y + z &= b \\ x^2 + y^2 + z^2 &= c \end{aligned}$$

—E. GOBERT.

[62588.]—**Wood Pulp.**—How can I reduce wood to pulp and harden it again after moulding.—H. MCR.

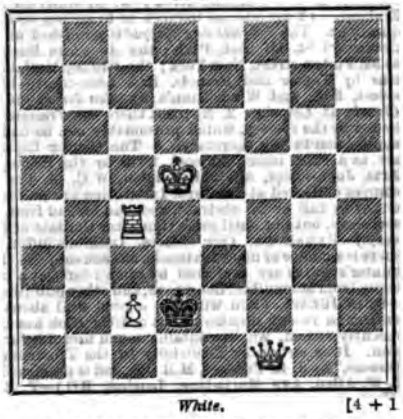
RICH gold mines have been found in Eastern Siberia, some few hundred miles from Yakutsk, extending over a district hitherto unexplored. Report declares that the region is a perfect New California in its greatest days of the gold diggings.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXLVII.—BY ANON.

Black.



White. [4 + 1

White to play and mate in three moves.

SOLUTION TO 1,045.

White.	*Black.*
1. R-Kt 4.	1. K moves (*a*).
2. R-Kt 5.	2. Anything.
3. R disco. mate.	
	(*a*) 1. P-K 4 (*b*).
2 Kt-K 7, &c.	
	(*b*) 1. R-B 6 (*c*).
2 R-Q 4, (ch) &c.	
	(*c*) 1. R-Q 6 (*d*), or B takes P.
3. P-K 4, (ch) &c.	
	(*d*) 1. Any other.
2. B-B 4 (ch) &c.	

This problem can also be solved by 1. P-Q 3, &c.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,045, by Major, A. Bolus (2) E. C. M. (Ipswich), A Beginner.

IN Tourney B, Country Boy should have headed the list immediately after the first eight, with 128 marks. The name was accidentally omitted. We should have mentioned that Mr. Robins is "Hensing," and Mr. Firth "Avon."

THE Rev. J. T. C. Chatts proposes to start a monthly chess publication, "Caissa," on September 1st. Cash prizes will be offered and the co-operation of all lovers of the game is invited. The subscription to the magazine, post-free, will be 5s. a year. Intending subscribers are requested to apply to the Editor, 106, Shepherd's Bush-road, London, W. We wish the new venture all success.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 8, and unacknowledged elsewhere:—

J. B. BROWN.—R. Gibbard.—Miss E. Brown.—H. Thorpe. —W. R. Wynne.—Lewis Swift.—J. and H. Grace.—Birmingham Small Arms Factory.—Perplexed Amateur —Hydro.—Cotton.—Levant.—W. R. Hart.—H. Watson. —J. Rawlins.—J. Latimer.—Six Years' Subscriber.—Eos.—Cygnet.—Al Fard.—Ovi.—A. G.—A. Moore.—H. P.—Sike.—Solar Radiance.—J. W. Hillier.—A Fellow of the Royal Astronomical Society.

A. R. R. (No one can say why your motor will not work unless more particulars are given; and it would be perfectly useless for us to occupy space with the illustration on the chance that some one might guess where the defect exists. We have given directions for making electro-motors many times. See pp. 257, 274, 315, Vol. XL., for instance. We certainly cannot afford space to illustrate every novel design which may turn out a failure.)—PATER L. (The only remedy is frequent cleansing, and the use of waterproof sheeting in the parts most liable to be saturated.)—TERRANOVA. (There is no work of the kind that we know of; but there are articles on the subject in the cyclopædias and our back volumes.)—E. A. MCLACHLAN. (There are many recipes for waterproofing paper in back volumes.

Probably the simplest is to coat it with tar, or melt in paraffin wax, or paint it. See pp. 167, 193, Vol. XXIX. If you mean the patent paper, it is prepared with cupra-ammonium as described in No. 1002, p. 291.)—W. STOCKWELL. (See indices for many recipes. We think the preparation named is not made now; but others can be bought, as a rule, cheaper than they can be made up on the small scale. Consult the advertisement columns of the *Building News.*)—J. G. BARTEL, New Zealand. (Your address induces us to answer so many questions. The *Journal de Physique* is published at 133, Boulevard St. Michael, Paris; the *American Machinist* at 96, Fulton-street, New York; the *Philosophical Magazine* by Taylor and Francis, Red Lion-court, Fleet-street, E.C., and Wiedemann's *Annalen der Physik and Chemie*, at Leipzig. 2. No; but there are *Transactions* issued by the society, which presumably can be had on application to the secretary. 3. The Cantor Lectures are, as a rule, issued in book form by the Society of Arts, John-street, Adelphi, London, W.C. 4. The discourses delivered at the Royal Institution are published either in full or in abstract, and can be had from the secretary, but not until some time after the date of delivery.)—PARABOLA. (See indices. Opinions differ, and there is a choice of many textbooks on such subjects. Todhunter's works are preferred by some; but get a catalogue from Macmillan, Longmans, and other publishers.)—QUIN JULEP. (You will find a good deal about the subject in recent numbers: but a little book has been recently issued, which contains much useful information. It is entitled "Electricity in the Treatment of Disease," by J. R. Tunmer, M.R.C.S., and is published by H. W. Allen, Ave Maria-lane, London, E.C.)—T. H. G. (How can anyone say why you cannot get a current through your secondary coil without examining it, or without at least a full description of the connections? See what has been said in back volumes, and endeavour to trace out the cause.)—NOVICE. (You will want a strong spring to drive such wheels; but the gear will be similar to that of a clock.)—R. LORD. (Thanks. That is the ordinary plan of wire lacing, but it is apt to cut through the leather. Flat belts are often secured that way; but most lathemen prefer the hook-and-eye and gut.)—S. WILLIAMS. (We do not understand. Cannot the stem be tapped into the piece of steel, and then held by a nut.)—SOUTHAMPTON. (All the explanation needed of such a matter can be found in the textbooks. Fizeau and Foucault applied that method.)—FREEZER. (There is scarcely likely to be any book giving instructions. They are made in various forms; but the majority either retain the cold air, or the ice is used to cool a current of air. The best thing to do would be to examine some of those "on sale," and then ask for information about points not understood. Under heads of "Ice Safe" and "Refrigerating Chamber" several patterns are illustrated in Knight's "Dictionary of Mechanics," published by Cassell and Co.)—SAMSON. (You can melt platinum wire by means of the oxy-hydrogen blowpipe or the electric arc.)—ENQUIRER. (For so-called self-acting fountains see Nos. 402, 405, 459, 582, 801, 967, 973, 974. 2. The part is covered with glair, the gold applied, and pressed in with the warm brass letter.)—M. P. (Make red, and place in a box of wood-dust until cold.)—H. SWAN. (It depends on how much gas it consumes, and the price of the gas. If 5 cubic feet an hour at 3s. per 1,000, ·180d. per hour.)—SCIENCIST. (You must make application on the proper forms, and then when you go up you will learn the subjects and the marks allotted. They are not easy to gain, because there are so many applicants. The secretary of the classes you attend can give you all available information.)—NOVICE, SOLDERING PEWTER. (What is the question? Bronze or pewter? Soldering pewter has been answered in recent numbers—last week, for instance.)—SOLITUDE. (Simply the effect of refraction. 2. Yes, they are well-known experiences. 3. Why not refer to some elementary textbook, or think for a moment on the nature of the origin of a sound. The simple answer to the definite question put is that it has "died of exhaustion" or want of strength to continue longer.)—VERITAS. (See indices for references to recipes of sensitive inks.)—G. J. A. (If you are a "thoroughly practical workman," you should apply to the captain of the Steam Reserve at any of the Government dockyards. From him you can obtain all requisite information, and he may probably engage you at once.)—HEREWARD. (In our back volumes, or Overman's "Moulder's and Founder's Pocket Guide," Sampson Low and Co. If you would say more definitely what it is you wish to do, no doubt some of our readers would tell you how to do it.)—J. D. (Spread a sheet of tinfoil on a flat baize-covered table, with a rim round three sides. Pour mercury over it and spread with a hare's foot until it is about an eighth of an inch thick; then take the perfectly clean glass and placing the edge well below the surface of the mercury, push steadily on. Drain off the superfluous mercury and weight the glass down until dry, when the foil should be varnished for protection. If, however, you are wise, you will get a piece of glass already "silvered.")—ELI JOHNSON. (As you can get the volumes from the library, don't you think you might as well search the indices for the information you require? Try Vols. XXXII. to XXXIV. 2. Suitable spectacles form the only remedy for myopia. The lotions you speak of are utterly useless. Read Brudenell Carter on "Eyesight, Good and Bad," published by Macmillan.)—W. TROTT. (If you will explain definitely what it is you wish to know about "preparing" electros, we may be able to help you; but at present the question is rather vague.)—A. FARROW. (Permanganate of potash.)—A TWELVE YEARS' CONSTANT SUBSCRIBER. (There is no law to prevent a marriage with a deceased wife's sister: it is simply not recognised as a marriage by the law.)—NEW SUBSCRIBER. (Better have an electric arrangement. You will find several in back numbers.)—AN OLD READER OF THE "ENGLISH MECHANIC." (Send the particulars to the Commissioners of Income Tax, Somerset House, E.C.)—SILKE. (We quite agree with you as regards the swash-plate, and we think it hardly necessary to occupy so much space or engrave so many diagrams to prove it.)—QUACKS OF VARIOUS TIMES. ("E. L. G." sends us a long letter on this topic which we reluctantly decline to insert. It deals ably—from the writer's point of view—with the subject; but the vast majority of our readers are not interested in the matter.)—F. (1. Yes. 2. No.)—G. FRYER. (Better follow Dr. Allinson's directions in the *Weekly Times and Echo*; we have no space to spare here.)—A POOR MARRIED MAN. (A little rye-flour is added to the high-priced food—that is all. It makes it no better and no worse.)—ST. KITTS. (Emery and rouge are the commonest polishers for such articles; but there are many other things that will do.)

A New Washable Truss.—An Important Invention.—Harness Xylonite Truss is the most perfect appliance ever invented. It gives complete comfort and support without irritation. It has a beautifully smooth, flesh-coloured surface, and is guaranteed to last a lifetime.—Address: MEDICAL BATTERY COMPANY (Limited), 52 OXFORD STREET, LONDON, W.

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Holloway's Pills.—These famous Pills purify the blood, and act most soothingly on the liver, stomach, bowels, and kidneys—the great mainsprings of life. They are wonderfully efficacious in all ailments incidental to females. To the emigrant, traveller, soldier, and sailor, they will be found invaluable in the time of need.

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Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Lathe, back motion, 2½in. centres, four-jawed centring, drill, and other chucks, slide-rest, tools, drills, &c. Exchange 10 by 8 Group or View Lens.—CHARLES MC'NAB, 51, Dallfield Walk, Dundee.

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Exchange **Horizontal Engine,** 6in. stroke, in good condition, for Piccolo or Violin.—J. BROOKS, Brouncker-road, Acton, Middlesex.

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Repousse Work.—Wanted, Instruction Book and Tools. Good, useful exchange.—JANE BELL, opp. Golden Sun, Bexley Heath.

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Youth's **Tricycle,** 30in., rear-steering, new, complete; 5in. Slide-rest, good order. Exchange 1H.P. Engine and Boiler. Stamp.—THOS. ELLINGWORTH, Church-street, Leighton Buzzard.

Exchange **Electric Motor** (will dri machine) for Jeweller's Rollers or Fletcher's Foot offer.—TAYLOR, 40, Bentinck-street, Ashton-under-Lyn

My large £40 **Harmonium** for disposal condition, not much worse for wear. Exchange Telesco and part cash. Offers.—SPIRES, North Skelton, Cleve shire.

Microscope Objects.—Slides of sple tomaceæ, neatly mounted. Exchange invited. Wa slides or unmounted objects. Send list.—Mr. Es Hagley-road, Birmingham.

Camera, ½, 3 slides, rapid lens, by Hume, new, cost £5 10s. Want 12 by 10 Rapid Lens, good ma Double Slide, best quality, cash to balance.—J. RU Jardington, Dumfries.

Regalia (A. O. F.), splendid P.C.R. Silk Sas woven on breast, never used. cost 15s. 6d.; also oak-fram cost 9s. Exchange Lathe Tools, Bicycle Parts, or off Avon-street, Rugby.

6in. Tulley **Refracting Telescope,** eq mounted, and nearly new Observatory for same, wit dome, cost over £150; price now asked £75; or will change a good Horse and Trap equal to that amou REID, 23, Ludgate-hill, E.C.

Wanted, Portable Forge and Vice, in exc Watch or Domestic Machine, all new.—ELLIOTT, 6 villas, Park-end, Bromley, Kent.

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Salvo **Tricycle,** ball bearings through gong, &c., good as new, cost £26. Exchange.—9, Well Bowdon.

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2,000c.p. **Arc Lamp,** 20c.p. laminated Dy Lamps, 20 c.p. Armature, Mr. Bottone's book, 1 Galvano Lathe.—DEW, Peterhouse, Cambridge.

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Mahogany **Card Stamping and Cutt** CHINE; cost £10. Also Gas Bag, one 7in. Lens, and offers?—SWIGG, 159, Drummond-road, Bermondsey, Lo

What offers for new **Cash Box,** 12in. long, and 7 deep, with 4 compartments.—J. T. SMITH, 23, S Southport.

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"**Illustrated Times,**" 1858-59, 70 c numbers. Also "Illustrated London News," 1859, 4 (volume complete.) Anything useful, or offers.—As ab

Cyclemeter (good), wanted for 40in. wheel, in for No. 2 Saloon Gun, cost 30s.—C. E. K., Ladycross, Ha

THE SIXPENNY SALE COL

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Patent Heat Conductors. for cooking, third time and firing, and one pound of meat in every cooked, retaining all nourishment.

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New Illustrated Price List of **Screws, Bo** NUTS for Model Work, drawn to actual size, sent o stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Wheel-Cutting to 12 inches diameter in —CLEGG, 15, Belinda-street, Hunslet, Leeds.

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Electric Depot, 10, Deansgate, Ma Handiest shop in the trade. Largest stock. Greatest var prices.

Silvered Glass Specula.—LINSCOTT, Gives truly parabolic figure. Moderate prices. pieces, and Flats.

Gut Band (Lathes), best, per yard, ⅛, 6d.; ¼, 1s.; 5-16, 1s. 4d.; ⅜, 1s. 11d. Hooks and Eyes (Ste 5-16, 7d.; ⅜, 8d.; 7-16, 1s.; ½, 1s. 6d. Postage extra.—L

Saws, Disston's American, agent for sam new, London, malleable iron and gunmetal, every d LUNT'S.

Vices, bench, parallel steel jaws, to open ditto 4, 14s. 6d.; ditto 4½, 20s.—LUNT'S.

Taps (Engineers'), Whitworth, plug and ¼, 5-16, each 6d.; ⅜, 8d.; 7-16, 10d.; ½, 1s.; ⅝, 1s. 3d. LUNT.

Tools every description. Sixth edition, illustrated reduced price catalogue free—A. S. LUNT, road, E.

"**Sheet-Metal Workers' Instru** (Warne's).—Few copies cheap, covers slightly Augustine's-road, N.W.

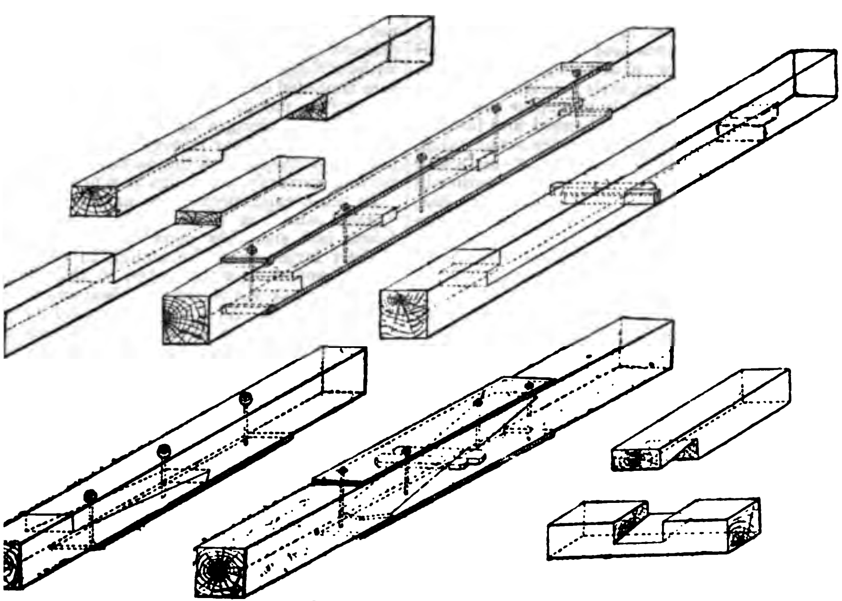
Steam **Boilers** of all kinds, one horse- upwards.—GRANTHAM CRANK and IRON COMPANY Grantham.

Stone-Breaking Machines.—Apply to Stone-Breaking and Grinding Machine Works, Leicester.

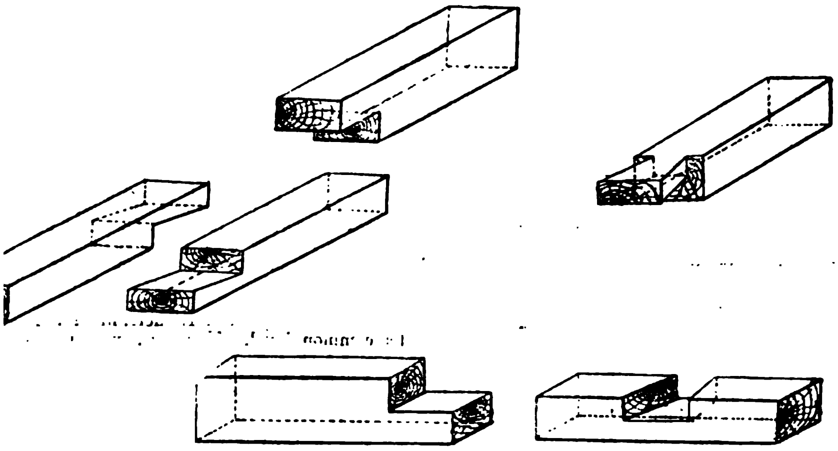
The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JUNE 17, 1887.

THE AMERICAN EXHIBITION.

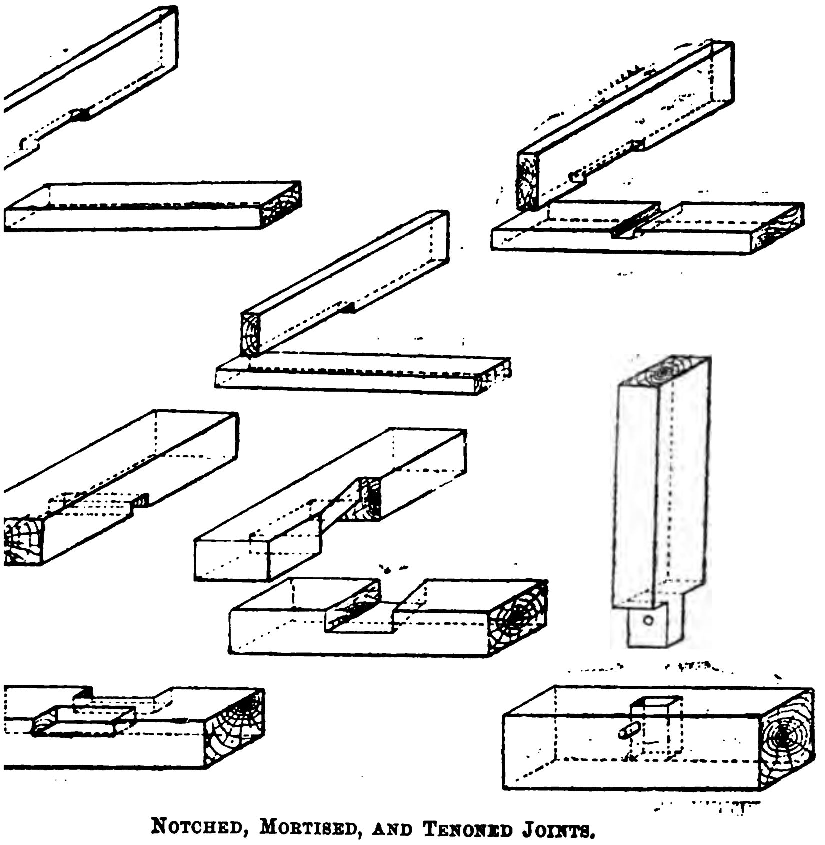
THE American Exhibition at West Kensington is now in a fairly complete condition, although a few of the more interesting exhibits have still to be put in place. As the catalogue has been issued, the visitor who desires to see what our American cousins have to show us will be able, by the exercise of some little ingenuity, to find out the exhibits which are of special interest to him; but of real novelties he will discover very few if he is already acquainted with the contents of the stores kept by the agents of American firms. Possibly the most convenient railway station is that of West Kensington, as an entrance has been made at the rear direct into the grounds close against the toboganning slide, and a short walk will take us into the main building of the Exhibition. The bulk of the visitors enter at Earl's Court Station, but that involves quite a journey through the "Wild West" before the Exhibition itself is entered. The building is 1,130ft. long by 120ft. wide; but there are various annexes and a Fine Art gallery, which is said to be perfectly fireproof. Old railway rails are utilised for the columns, and the roof is of galvanised iron and glass, with wrought-iron tie rods binding the whole together in an effective manner, which also has the advantage of being economical. The principal entrance to the Exhibition is in the Lillie-road, near West Brompton Station, and the visitor who enters there may be excused if he expresses some little surprise that the clock bears the name of Benson, that the ornamental lamps are by Sugg, the mats by Treloar, and the acme flooring of the steps by Duffy and Son, of London. However, a group of bisons in the centre at once gives an American colour to the Exhibition, especially as it is supported by a life-size golden eagle, worked in copper with certainly marvellous skill, the feathers of the wings and the down on the legs being produced with great fidelity. Close by are models of the *Alaska*, the *Belgravia*, and the *City of Rome*, three well-known Transatlantic liners. At the right hand in Cleveland Avenue will be found a splendid collection of minerals, exhibited by Dr. A. E. Foote, of Philadelphia, who also has in "Second-street" a hexagonal pavilion glittering with mica, in which he exhibits gems and ornamental stones, rare or curious minerals from various parts of America. The mineralogist and metallurgist will certainly devote much time to Prof. Foote's exhibits, which include something like eleven tons of specimens, and a number of valuable books. The Chicago and North-Western Railway Co. exhibit an interesting collection of ores, coal, building stone, woods in the trunk and planed panels, tobacco, and samples of cereals, pulse, &c., raised in the "golden North-West," with specimens of the soils on which they were grown. The State of Rhode Island has a somewhat similar exhibit, with the addition of coloured plates of the flora, and some Indian antiquities. Interesting as these exhibits are, especially to speculators and intending emigrants, machinery in motion, tools, and other appliances have a greater attraction for the majority of visitors. The machinery is driven by a Wheelock engine having a cylinder 23in. by 8in. stroke, and a flywheel 16ft. in diameter. Steam is supplied by two 120H.P. Babcock and Wilcox boilers. We described the Wheelock engine in connection with the Inventions Exhibition, p. 272, Vol. XLI. It is chiefly noticeable for the valve arrangements, which permit of any desired cut-off and automatically drain out condensed water, while the engine runs with great steadiness, no matter how often or quickly the load varies. Its performance in driving the different machines in this Exhibition will be a good test, for they are liable to be thrown off and on at any moment, and vary in weight from a heavy brick machine to light sewing-machines. The former is called a clay tempering brick machine, and is supplied with clay by means of an elevator which drops it into a hopper. The clay is tempered and mixed in the machine and forced out in a continuous bar which, by an ingenious arrangement, automatically controls the device that cuts it into bricks. That is done by means of a sort of paddle-wheel which, instead of paddle-boards, carries wires to cut through the clay. As the bar advances this paddle-wheel revolves, and the bricks are cut off as true to gauge as if they had been made in moulds. As shown at work, the bricks as fast as cut are taken up the elevator to the hopper, but as the clay is supposed to be fed direct to the machine as taken from the pit, the bricks might not turn out so well in practice as they do here, where the same clay is worked over and over again. The machine will save a great deal of labour, and is accompanied by an artificial brick-drier, which dries the bricks in a few hours ready for setting in the kiln. Both are exhibited by Messrs. Chambers, Brothers, and Co., of Philadelphia. Close by the Barnard and Leas Manufacturing Co., of Moline, Illinois, and Howes and Ewell, of Silver Creek, New York, exhibit machines which will attract the attention of millers; but several machines are shown at the stand of one agent. The Walter A. Wood Mowing and Reaping Machine Co., Hoosick Falls, New York State, exhibit grass mowers, a self-delivery reaper, and some light harvesters and binders, while the Johnston Harvester Co., of Batavia, New York, have also a good collection of such implements, the action of which can be shown to a certain extent. In this class, Holt's Lightning Hay Knife, made by the Hiram Holt Company, East Wilton, Maine, deserves looking at. It is a very stout blade, with handles placed at right angles, some little distance apart, the cutting edge being produced by very widely serrating it, and chamfering off the upper side of the metal, so as to produce a firmly-supported cutting edge with curved serrations. It will cut corn-stalks and unthreshed oats in bundle, baled hay and straw, and it can be used for cutting peat and ditching. Machines which will attract the attention of mechanics from their novelty are the sand-papering machines of the Berlin Machine Works, which include machines for papering or polishing both bent and straight stock, and a useful combined planer and polisher which reduces all stock to a thickness before it reaches the polishing drums. In the way of machines and tools for working metal, wood, and stone, there is a singular scarcity and an almost entire want of novelty, for though Morse Twist Drill and Machine Co., Pratt and Whitney Machine Co., Oneida Steam-Engine Co., Browne and Sharpe Manufacturing Co., and some other well-known makers of tools are represented, they are to be found mainly at one stall—that of the agents, Buck and Hickman, of Whitechapel-road, and C 51, Washington-avenue, American Exhibition. The Seneca Falls Manufacturing Co. (agents, Chas. Churchill and Co., Cross-street, Finsbury), exhibit their well-known fret-sawing machines, with a large number of examples of work accomplished with them. Of machines in motion, those which draw the largest number of visitors (on a hot day) are the fans—especially those of the Exhaust Ventilator Company, or Blackman Air Propeller and Wing's Disc Fan, which in one form is used to blow fluff and down about in a glass-fronted ∩ tube. Another exhibit that attracts attention is the Fleuss Domestic Hand Ice Machine; but useful as it is, it can scarcely be considered American. Machines of the kind work on the principle that water will freeze when rapidly evaporated by means of a vacuum pump and a powerful absorbent, such as sulphuric acid, and these appeal for patronage because they are more simple and compact than anything else on the market. Typewriters also attract considerable attention—especially the lower priced patterns; but the most interesting exhibit in the group is the Thorne Machine Co.'s type-setting and distributing machinery, which is fairly well known in the United States if not here. Like others, the types are in long slides placed vertically, and the required character is removed from the bottom and conveyed to the "stick." American pitchforks, rakes, digging forks and spades can be compared with English makes of the same articles to be found in the shops; while at the stall of the Mosler Safe and Lock Co., Broadway, New York, can be seen specimens of ornamented fire and burglar proof safes, which present a very different appearance to the more simple looking articles seen in this country—which latter may, however, be the more serviceable. Similarly in the exhibit of Anshutz, Bradberry, and Co., of Pittsburg, and in that of the Smith and Anthony Stove Co., we find a collection of improved fire-grates and stoves, which, however, might have been seen at other exhibitions. Amongst scientific and philosophical instruments there is nothing very special, the exhibits of the watch and clock companies being, however, very striking—that of the Waterbury Co., for instance, having some hundreds of watches "running on time," an ingenious device for keeping the assistants busy. The American Camera Co., of Edgware-road, exhibit useful novelties in photographic apparatus, including the Camunilux, a combination of a half-plate camera, magic-lantern, and enlarging apparatus. Amongst musical instruments there is only one exhibitor of pianofortes, and apparently only one novelty—an æolian combination organ to play either mechanically or by the ordinary keyboard or both in combination. An improved specimen of this instrument has been constructed for the Mechanical Organette Company by Mason and Hamlin. Of clothing, jewellery, furniture, and American novelties generally, there is a good display; while W. R. Warner and Co., of Market-street, Philadelphia, have a very fine show of pharmaceutical preparations in sugar-coated pills and parvules and other forms. At previous exhibitions a good display of wheels of American make have been seen from the works of Hoopes Bros. and Darlington, of West Chester, Pennsylvania; but the Woodburn Sarven Wheel Co., of Indianapolis, which claims to be the largest company of the kind in the world, sends an exhibit of rows of spoke cases, upon which all the different varieties of wheels known are ranged in rotation, while the component parts of wheels are also shown. A material which seems likely to come into considerable use is a fireproof building earthenware, pottery, brickwood, or terra-cotta lumber as it is called. Earthy and vegetable matters are made plastic by the addition of water, and shaped into the desired forms by heavy pressure; these are then dried and burned as bricks are treated, but with this difference, that the vegetable matter (sawdust for instance) having been burned out, a porous brick is left behind which can be cut with a saw, will hold nails, and is said to be absolutely fireproof, and to possess considerable insulating properties against sound, heat, and electricity. The International Terracotta Lumber Co., of 115, Dearborn-street, Chicago, are the exhibitors.



Scarfed Joints.



Halved and Dovetailed Joints.



Notched, Mortised, and Tenoned Joints.

study and construction of the leading kinds of joints used for various purposes is rapidly becoming popular in existing technical schools, and thus leads the pupils to take up more advanced subjects allied to it.

To give efficient instruction in the subject of carpentry it is therefore absolutely needful that the teachers be provided with correctly-made examples of the leading descriptions of joints for the resistance of strains applied under various circumstances, and they should be of a sufficient size to be clearly seen by all the members of a class at the same time. For this purpose Mr. James Rigg, of 11, Queen Victoria-street, E.C., has recently added to his list of apparatus for technical instruction a series of eighteen joints used in carpentry given in the illustrations herewith. They are of hard wood, all measuring 1¾in. across, of proportionate length, and made to illustrate the standard work on this subject, "Notes on Building Construction" (Rivingtons), 1883. From this book, therefore, their leading characteristics and purposes may be ascertained as well as an explanation of the theories which have led to their construction, and they thus possess a far greater value for their intended purpose than simple models made at haphazard proportions and unaccompanied by any descriptions.

Other models in this subject are similarly illustrated, including the various forms and cast and wrought iron girders used in building construction.

USEFUL AND INTERESTING APPLICATION OF STATICAL ELECTRICITY.

On the evening of the ladies' soirée of the Royal Society, and also at the Friday evening meeting of the Royal Institution, Mr. Wimshurst exhibited an exceedingly interesting experiment showing that small type placed upon a disc and revolved several thousand times a minute could, while in motion, be seen and read distinctly.

This was done by having a commutator arrangement attached to and revolving with the disc, which caused the circuit to be shortened at the instant when the type was vertical, brilliant sparks occurred only at that instant and illuminated the print, which, but for the buzzing caused by the great velocity of the disc, would have been supposed to be at rest.

By the application of this system, scientists and others have a ready means of observing any and all changes which may take place in either matter or machinery in rapid motion; in fact, the more rapid the motion the better is the result.

To show this experiment openly and in well-lighted libraries, a large supply of electricity is, of course, needed. This supply Mr. Wimshurst easily, and with certainty, furnished from one of his beautiful influence machines, illustrated and described in our pages.

FIFTY YEARS' PROGRESS IN SCIENCE.*

Fifty years ago science was still inchoate. Much had already been done by the early pioneers. The ground had been cleared; the building materials had been in part provided; the foundations had been duly and ably laid; but the superstructure as yet had hardly been raised a poor foot or two above the original level. The work of the last half-century has been twofold. On one side it has been accumulative merely: new stocks of organisable material—the raw bricks of science—have been laid up, as before, ready to the call of the master mason, but in far greater profusion than by any previous age. On the other side it has been directive and architectonic: the endless stores of fact and inference, thus dug out and shaped to the hand by the brickmakers of knowledge in a thousand fields, have been assiduously built up by a compact body of higher and broader intelligences into a single grand harmonious whole. This last task forms indeed the great scientific triumph of our epoch. Ours has been an age of firm grasp and of wide vision. It has seen the downfall of the anthropocentric fallacy. Cosmos has taken the place of chaos. Isolated facts have been fitted and dovetailed into their proper niche in the vast mosaic. The particular has slowly merged into the mental, the general into still higher and deeper cosmical concepts. We live in an epoch of synthesis, simplification, correlation, and universality. When after ages look back upon our own, they will recognise that in science its key note has been the idea of unity.

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* From a paper by Grant Allen in the Fortnightly *Review*.

In the pride of our hearts we forget for the most part how very young science still is. We, who have seen that infant Hercules strangling serpents almost from the very cradle; we, who have beheld it grow rapidly under our own eyes to virile maturity and adult robustness of thew and muscle, we forget how new a power it is in the world, and how feeble and timid was its tender babyhood in the first few decades of the present century. Among the concrete sciences, astronomy, the eldest-born, had advanced furthest when our age was still young. It had reached the stage of wide general laws and evolutionary aspirations. But geology had only just begun to emerge from the earliest phase of puerile hypothesis into the period of collection and colligation of facts. Biology, hardly yet known by any better or truer name than natural history, consisted mainly of a jumble of half classified details. Psychology still wandered disconsolate in the misty domain of the abstract metaphysician. The sciences of man, of language, of societies, of religion, had not even begun to exist. The antiquity of our race, the natural genesis of arts and knowledge, the origin of articulate speech, or religious ideas, were scarcely so much as debatable questions. Among sciences of the abstract-concrete class, physics, unilluminated by the clear light of the principles of correlation and conservation of energy, embraced a wide and ill-digested mass of separate and wholly unconnected departments. Light had little enough to do with heat, and nothing at all to do in any way with electricity or sound or motion or magnetism. Chemistry still remained very much in the condition of Mrs. Jellaby's cupboard. Everywhere science was tentative and invertebrate, feeling its way on earth with hesitating steps, trying its wings in air with tremulous fear, in preparation for the broader excursions and wider flights of the last three adventurous decades. The great campaign of the unity and uniformity of nature was the first to be fought, and in that campaign the earliest decisive battle was waged over the bloody field of geology. In 1837—to accept a purely arbitrary date for the beginning of our epoch—Lyell had already published his sober and sensible "Principles," and the old doctrine of recurrent catastrophes and periodical cataclysms was tottering to its fall in both hemispheres. Wholesale destruction of faunas and floras, wholesale creations of new life-systems, were felt to be out of keeping with a humane age. Drastic cosmogonies were going out of fashion. But even the uniformitarianism, for which Lyell fought and conquered was in itself but a scrappy and piecemeal conception side by side with the wider and far more general views which fifty years have slowly brought to us. One has only to open the "Text Book of Geology," by Lyell's far abler modern disciple, Archibald Geikie, in order to see the vast advance made in our ideas as to the world's history during the course of the last half-century. The science of the earth's crust no longer stands isolated as a study by itself; it falls into its proper place in the hierarchy of knowledge as the science of the secondary changes, induced under the influence of internal forces and incident energies, on the cooling and corrugated surface of a once incandescent and more extended planet. I knew no better gauge of the widening which comes over the thoughts of men with the process of the suns than to turn from the *rudis indigestaque moles* of the "Principles" and the "Elements" (great as they both were in their own day) to the luminous, lucid, and comprehensive arrangement of Geikie's splendid and systematic "Text-book." The one is an agreeable and able dissertation on a number of isolated and floating geological facts; the other is a masterly and cosmically-minded account of the phenomena observable on the outer shell of a cooling world, duly considered in all their relations, and fully co-ordinated with all the chief results of all elder and younger sister sciences.

Evolution is not synonymous with Darwinism. The whole immensely exceeds the part. Darwinism forms but a small chapter in the history of a far vaster and more comprehensive movement of the human mind. In its astronomical development evolution had already formulated itself with perfect distinctness before the period with which we have here specially to deal. The nebular theory of Kant and Laplace was the first attempt to withdraw the genesis of the cosmos from the vicious circle of metaphysical reasoning, and to account for it by the continuous action of physical and natural principles alone. Our own age has done much to cast doubt upon the unessential details of Kant's rough conception; but, in return, it has made clearer than ever the fundamental truth of its central idea—the idea that stars, and suns, and solar systems consist of materials once more diffusely spread out through space, and now aggregated around certain fixed and held together by the gravitative force inherent in their atoms and masses. As these masses of atoms drew closer together in their aggregation, the [illegible] [illegible] their primitive potential energy of separation, (or, to employ the terminology of our own time) was changed first into the kinetic energy of [illegible] motion in the act of [illegible], and then into the kinetic energy of molecular motion or heat, as they clashed with one another in bodily impact around the central core. Each star, thus produced, for ever gathers in materials from its own outlying mass, or from meteoric bodies, from its solidifying nucleus, and for ever radiates off its store of associated energy to the hypothetical surrounding ether. The fullest expression of this profound cosmical conception has been given in our own time by Tait and Balfour Stewart, working in part upon the previous results of Kant, Laplace, the Herschels, Mayer, Joule, Clerk Maxwell, and Sir William Thomson. Deeply altered as the nebular hypothesis has been by the modern doctrine of correlation and conservation of energies, and by modern researches into the nature of comets, meteors, and the sun's envelopes, it still remains in its ultimate essence the original theory of Kant and Laplace. Science has thus, within the period of our own half-century, exhibited to us the existing phase of the universe at large in the light of an episode in a single infinite and picturable drama, setting out long since from a definite beginning, and tending slowly to a definite end. Other phases, inconceivable to us, may or may not possibly have preceded it: yet others, equally inconceivable, may or may not possibly follow. But as realisable to ourselves, within our existing limitations, the physical universe now reveals itself as starting in a remote past from a diffuse and perhaps nebulous condition, in which all the matter, reduced to a state of extreme tenuity, occupied immeasurably wide areas of space, while all the energy existed only in the potential form as separation of atoms or molecules; and the evidence leads us to look forward to a remote future when all the matter shall be aggregated into its narrowest possible limits, while all the energy, having assumed the kinetic mode, shall have been radiated off into the ethereal medium. Compared to the infinite cosmical vistas thus laid open before our dazzled eyes, all the other scientific expansions of our age shrink into relative narrowness and insignificance.

A NEW PROCESS OF CASTING IRON AND OTHER METALS UPON LACE, EMBROIDERIES, FERN LEAVES, AND OTHER COMBUSTIBLE MATERIALS.*

THE art of making charcoal—if, indeed, so crude a process is worthy of being dignified by the name of an art—dates back to a remote antiquity, and has been practised with but little change for hundreds of years. It is true that some improvements have been recently made, but these relate to the recovery of certain volatile by-products which were formerly lost. Everyone is familiar with the appearance and characteristics of ordinary charcoal, yet I hope to show you this evening that we still have something new to learn about its qualities and the unexpected practical uses to which it may be applied. We commonly regard charcoal as a brittle, readily combustible substance, but we have before us specimens in which these qualities are conspicuously absent. Here is a piece of carbonised cotton sheeting, which may be rolled or folded over without breaking, and, as you see, when placed in the flame of a Bunsen burner, the fibres may be heated white-hot in the air, and when removed from the flame, the material shows no tendency to consume. Here, again, we have a piece of very fine lace, which has been similarly carbonised, and displays the same qualities of ductility and incombustibility.

These carbonised fabrics may be subjected to much more severe tests with impunity, and, when I tell you that they have been exposed to a bath of molten iron without injury, you will readily admit that they possess some qualities not ordinarily associated with charcoal. When removed from the mould in which they were placed after the iron casting had cooled, not a single fibre was consumed, but upon the face of the casting there was found a sharp and accurate reproduction of the design, thus forming a die. This die may be used for a variety of purposes, such as embossing leather, stamping paper, sheet metal, &c., or for producing ornamental surfaces upon such castings. Some of the carbonised fabrics displayed upon the table are almost as delicate as cob-webs, and one would naturally suppose that when a great body of molten metal is poured into a mould in which they are placed, they would be torn into fragments and float to the surface even though they were unconsumed, yet such is not the case. I have found in practice that the most delicate fabrics may be subjected to this treatment without danger of destruction, and that no special care is needed either in preparing the mould or in pouring the metal. By the aid of the megascope, the enlarged images of some of these castings, showing the delicate tracery of the patterns, will now be projected upon the screen, and you can all see how perfectly the design is reproduced.

In these experiments, the mould was made in "green sand" in the ordinary manner, and the fabric laid smoothly upon one face, being cut slightly larger than the mould, in order that it might project over the edge, so that when the moulding-flask was closed the fabric was held in its proper position. As the molten metal flowed into the mould it forced the fabric firmly against the sand wall, and when the casting was removed, the carbonised fabric was stripped off from its face without injury. In this way several castings have been made from one carbonised material.

These castings are as sharp as electrotypes, whether made of soft fluid iron or of hard quick-setting metal. This peculiarity is owing to the affinity between molten iron or steel and carbon, the molten metal tends to absorb the carbon as it flows over it, thus causing the fabric to hug the metal closely. It is somewhat analogous to the effect of pouring mercury over zinc. You know that when mercury is poured upon a board, it runs in a globular form, it does not "wet" the board, so to speak, but when poured upon a plate of clean zinc, it flows like water and wets every portion of the zinc; or, as we say, it amalgamates with the zinc: so when molten iron is poured into an ordinary sand mould, which has been faced with this refractorily-carbonised fabric, it wets every portion of it, tending to absorb the carbon, and doubtless would do so if it remained fluid long enough, but as the metal cools almost immediately, there is no appreciable destruction of the fibres.

The casting which I shall now exhibit represents a very interesting and novel experiment. In this case, the piece of lace, having open meshes a little large than a pin's head, instead of being laid upon one face of the mould, was suspended in it in such a way as to divide it into two equal parts. Two gates or runners were provided, leading from the "sinking head" to the bottom of the mould, one on each side of the lace partition, the molten iron was poured into the sinking head and, flowing equally through both runners, filled the mould to a common level. The lace, which was held in position by having its edges imbedded in the walls of the mould, remained intact. When the casting was cold, it was thrown upon the floor of the foundry and separated into two parts, while the lace fell out uninjured, and the pattern was found to be reproduced upon each face of the casting.

The question naturally arises, why did not the iron run through the holes and join together? The answer may be found in the fact that the thin film of oxide of iron or "skin," as it is popularly called, which always forms on the surface of molten iron, was caught in these fine meshes, and thus prevented the molten metal from joining through the holes. I have repeated the experiment a number of times, and find that the meshes must be quite small (not over one-fiftieth of an inch) otherwise the metal will reunite.

I think that this observation explains the cause of many obscure flaws found in castings, sometimes causing them to break when subjected to quite moderate strains. We frequently find little "cold shot," or metallic globules, imbedded in cast iron, or steel, impairing the strength of the metal, and it has long been asked, "What is the cause of this defect?" The pellicles have been carefully analysed, under the supposition that they might be alloys of iron and nickel, or some other refractory metal, but the analysis has failed to substantiate this theory. Is it not probable that in the process of casting little drops of molten metal are sometimes splashed out of the stream, which immediately solidify and become coated with a skin of oxide, then falling back into the stream of rapidly cooling metal, they do not remelt, neither do they weld or amalgamate with the mass owing to this protective coating, thus forming dangerous flaws in the casting?

The process of carbonising the delicate fabrics, leaves, grasses, &c., is as follows:—The objects are placed in a cast-iron box, the bottom of which is covered with a layer of powdered charcoal or other form of carbon, then another layer of carbon dust is sprinkled over them, and the box is covered with a close-fitting lid. The box is next heated gradually in an oven, to drive off moisture, and the temperature slowly raised until the escape of blue smoke from under the lid ceases, the heat is then increased until the box becomes white hot, it is kept in this glowing condition for at least two hours; it is then removed from the fire, allowed to cool, and the contents are tested in a gas flame. If they have been thoroughly carbonised, they will not glow when removed from the flame, and the fibres may even be heated white hot before consuming.

Of course, the method employed to carbonise the materials is suspectible of variation, but the scientific principles involved are unchangeable, viz.:—1. Partial exclusion of air and substitution therefor of a carbon atmosphere. 2. Slow heating to drive off moisture and volatile elements. 3. Intense and prolonged heating of the partly-charred objects to eliminate remaining foreign elements, and to change the carbon from the combustible form of ordinary charcoal to a highly refractory condition.

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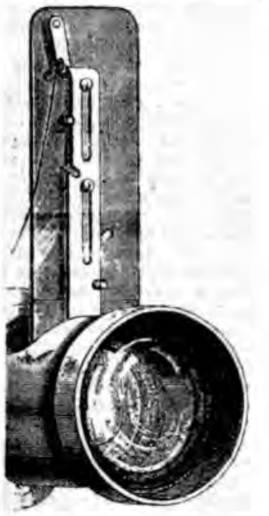
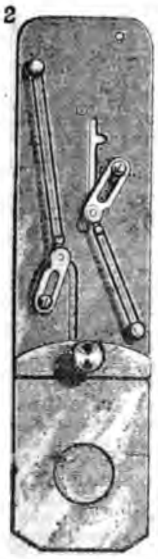
* By A. E. Outerbridge, Jun. Abstract of a paper read at a meeting of the Franklin Institute.

IMPROVED CAMERA SHUTIER.

THE camera herewith illustrated is, according to the *Scientific American*, extremely simple in construction, and quick and reliable in operation. The shutter is designed to be inserted in the diaphragm opening in the lens tube. It consists of two principal parts. The main plate, Fig. 2, is composed of two sections, the upper one of which carries the slide, Fig. 3, which normally closes the exposing aperture in the lower section. It is designed to have several of the lower sections with apertures of different sizes, so that the proper exposure may be effected in any light, by selecting the section of proper aperture, and attaching it to the other by simple means. Attached to the main plate and to pins sliding in slots in the plate, and adapted to engage notches in the slide, are two elastic bands so arranged that when the holding catch at the top of the main plate, Figs. 1 and 3, is tripped, one band will raise the shutter to the top, when the second band will instantly act to pull it down. In Figs. 1 and 3 the parts are in position to be operated, while Fig. 2 shows the bands after the slide has been moved to make the exposure. The extreme simplicity of this device, and the certainty of making an instantaneous exposure, are evident. This invention has been patented by Mr. F. K. Betts, of 2,028, Madison-avenue, New York City.





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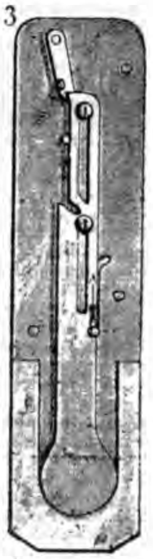

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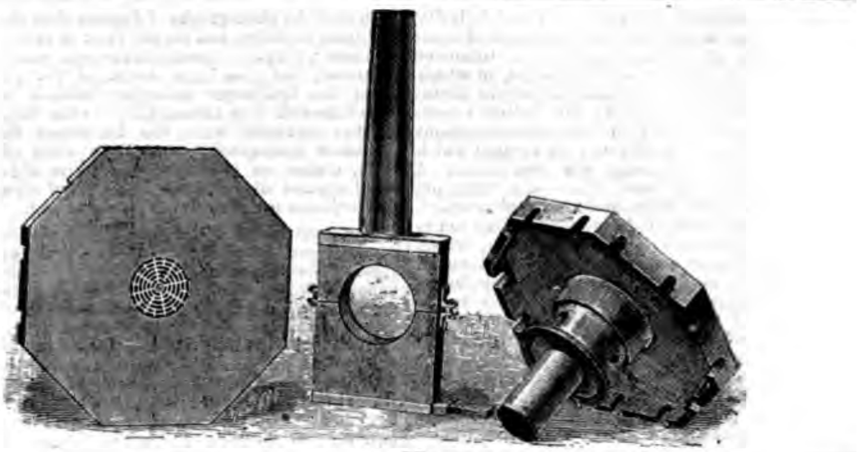
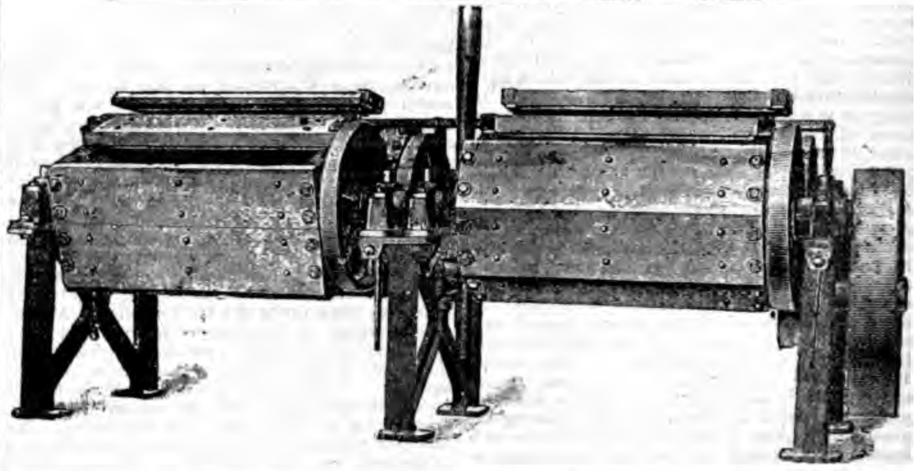
EXHAUST TUMBLING BARRELS.

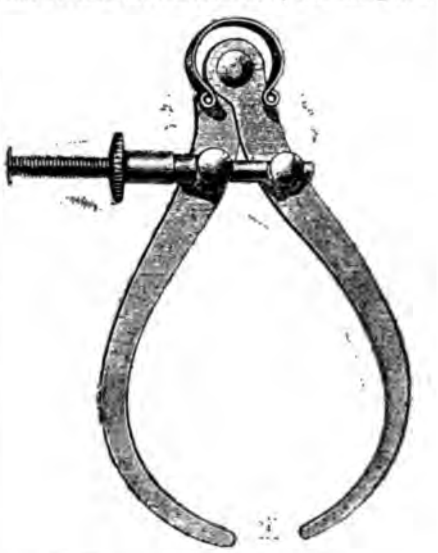
TUMBLING barrels occupy a place of importance in some of the principal branches of modern industry. So cheaply is a smooth, bright surface obtained by their use that the form of many finished articles is determined with reference to it. The many purposes for which they are used—ranging from the pulverising of coke to the burnishing of brass buttons, and from the cleaning of heavy castings to the brightening of tiny tacks—have led to the bestowal of much thought upon them. Slowly, improvements have been developed, because manufacturers, as a rule, have made their own, each having his own preference as to form and size, ways of mounting, driving, and so forth, which made it difficult for anyone to make a speciality of their manufacture and introduce a style which would please everyone. Such preferences can still be retained, as the exhaust can be applied to almost any plain barrel now in use; although it is better to construct the barrel expressly for it, and the preferences can then be wrought in also. For at least thirty years nail and tack manufacturers have employed air currents to carry off the dust and hasten the brightening of their goods when being tumbled in barrels; yet it is not generally known what a saving of time it makes, and how much better the work is done. A properly-constructed barrel, connected with an exhaust fan, keeps all the *débris* within it till the fan removes it and deposits it in a proper place outside the building. The damage which is done in some establishments by the dust from the barrel permeating other rooms and polluting the finished goods is so completely remedied by the use of exhaust barrels, that the wonder is why the old nuisance was so long tolerated. Whilst either blast or exhaust may be used, the exhaust allows a simpler construction of the barrel, and it gives the best results from the power expended to drive the fan. A small pipe with a quick draught through it, when connected with a well-made barrel, which only the smallest possible streams of air can get into, removes the dust as fast as the tumbling can separate it from the articles, and as the film of dirt which envelops them is removed, the articles rub closer together, and are cleaned and brightened rapidly; the small, sharp, inrushing streams of air aiding very considerably in the work. The tumbling barrels illustrated herewith are made by Henderson Brothers, Waterbury, Conn.—*American Machining.*

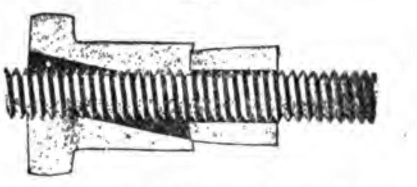




IMPROVED CALIPERS.

THE calipers illustrated in the annexed engravings are being introduced by the Wright Machine Co., Worcester, Mass., and are calculated to save considerable time where much callipering has to be done. By pressing the bows inwardly just sufficient to overcome the tension of the spring and relieve the pressure against the nut the latter is freed from the thread, and can be instantly moved to any position on the screw; then by releasing the pressure on the bows the bevelled end of the washer is forced against the corresponding inside bevel on the end of the nut; this straightens the nut on the screw, locking the threads as shown in the detached view. The nut can then be used for the necessary fine adjustment, as if it were of the ordinary construction. The nut, as will be seen, is in one piece, and hence not subject to derangement.





THE GREENWICH VISITATION.

THE Greenwich Visitation was held this year usual, and we extract from the report of the Astronomer Royal portions which are likely to be of interest to some of our readers. The Admiralty have, it seems, sanctioned the extension of computing rooms, and above them the Astronomer Royal proposes to erect an 18ft. dome, in which the Cooke equatoreal will be mounted, with a photoheliograph tube attached. By this means a complete view of the sun will be obtained throughout some days, and photographs may be secured which are at present lost through the intervention of trees and the Lassell dome. The old instruments and apparatus have been thoroughly overhauled, and any that are likely to be of use are disposed so as to be readily available. The remainder, which are merely of historic interest, have been stored in a room hitherto used as a library. The only change of importance made in the transit circle is the renovation of the apparatus for recording the observations of zenith distance, which had become much worn by fourteen years' constant use. The regular subjects of observation with the transit circle have been the same as in former years—viz., the sun and moon on every possible occasion, planets and fundamental stars, and others from a working list. At the end of 1886 a working list was prepared which contains all stars in the "Harvard Photometry," and all stars observed by Mr. Groombridge between 1806 and 1817 (published in 1838 by the late Astronomer Royal) which have not been observed at Greenwich since 1867. In the year to which the report refers, 6,366 observations of transits and 5,983 of zenith distance were made, the average corresponding numbers for the preceding 17 years being 4,273 and 4,050. About 400 transits were observed with a prism eyepiece, which enables the observer to reverse the apparent direction of the motion and thus gives means for determining the personality in observing depending on the direction of motion. In the year 1886 the number of stars observed was 1,665, the average of the preceding 16 years being only 1,110. As it was decided to publish the observations of stars made with this instrument between 1877 and 1886 in catalogue form, special efforts were made during 1886 to secure at least three observations of each star. Towards this catalogue a large amount of preparatory work has been done in reducing the observations printed in the annual volumes to a homogeneous system. As the Greenwich observations of fundamental stars during the last ten years are better represented by the proper motions recently determined by Dr. Auwers from discussion of observations made by Dr. Bradley (the third Astronomer Royal) than by those hitherto used, it has been decided to adopt those of Mr. Auwers in the catalogue. The observations have also been reduced to a uniform law or correction for the difference between observations made when the star's image is reflected in mercury and seen directly. The corrected results have been entered in the sheets for collection of observations in each year for the first two hours of the right ascension, and the mean result, reduced to the epoch 1880, has been formed for 178 stars. The Astronomer Royal estimates that the catalogue will contain about 4,000 stars. With the altazimuth, the observations of the moon have been restricted to the first and last quarters, the transit circle being available for the remainder of the lunation; observations were secured on 94 days. With the reflex zenith tube 33 double observations of "Gamma Draconis" were made. The observations made from 1883 to 1885 for determining the temperature correction are being tabulated, but the discussion is not yet completed.

Additions have been made to the Lassell 2ft. reflector, with a view to making it available for astronomical photography and general use, the effect being to greatly increase the steadiness and general usefulness of the instrument. A camera to take circular plates 8½in. in diameter (giving a field about 2deg. in diameter) has been mounted in the principal focus of the mirror, and some trial photographs have been taken. A 6½in. refractor has been mounted below and parallel to the tube of the reflector to serve as a directing telescope in taking photographs, and also for the observation of occasional phenemena. The other equatoreals have been in good working order, and with one or more of them 29 occultations of stars by the moon, and 12 phenomena of Jupiter's satellites, have been observed, and 25 complete sets of comet observations have been secured.

A photographic corrector, consisting of a concave crown and convex flint lens (in contact), placed about 30in. within the focus, has been applied to the telescope of the south-east equatoreal to correct the chromatic aberration of the object-glass for photographic rays without alteration of the focal length. A Dallmeyer doublet (formerly used in the photoheliograph) has been employed to enlarge the primary image about 7½ times, so as to give on the photographic plate an image on a scale of about 0·45in. to one minute or arc, or 15in. to the sun's diameter. A number of trial photographs of Castor, Gamma Virginis, Venus, Jupiter, and Saturn have been obtained. The photographs of the double stars appear to be *susceptible of very accurate* measurement, and several of the photographs of Jupiter show the four satellites, the belts, and the red spot. A photograph of Gamma Virginis, showing the components widely separated, has also been taken at the primary focus, the Dallmeyer enlarging doublet having been removed. It is intended also to use the photographic corrector with the Dallmeyer doublet to obtain photographs on a large scale of sunspots, craters on the moon, and other objects of small angular dimensions. The field of view with the corrector is necessarily very restricted.

The construction of the new 28in. refractor has been delayed by difficulty in obtaining the discs of glass. Messrs. Chance are engaged in removing a bunch of fine veins from the flint glass disc, and have every hope of being able very shortly to report the disc practically perfect; and M. Feil's successor has successfully moulded a crown disc from which he believes he has removed all defects. Meanwhile the details of the special tube and other mechanical parts have been settled, and Mr. Grubb has made considerable progress with its construction, so that when the object-glass is completed it will be mounted without delay.

With the spectroscope the solar prominences have been observed on two days only, the observations being reluctantly discontinued, as under existing circumstances a sufficient number to serve any useful purpose cannot be secured. For determination of the motion of stars in the line of sight 226 measures of the displacement of F and *b* lines in 84 stars have been made. The observations of Sirius indicate that the displacement of the F line is now insensible. The displacement of the F line in the spectrum of Algol has been measured as frequently as possible during the winter months, in order to ascertain if any evidence could be obtained of rapid orbital motion such as would result from the hypothesis of the variability of Algol being caused by the transits of a large satellite. A sufficient number of observations has not yet been obtained to allow a definite conclusion to be formed, but as far as the observations go there are indications of a variation of the motion in the line of sight corresponding to orbital motion having the same period as that of the star's variability. The fact that the number of spectroscopic observations is less than usual is accounted for by the absence of one observer on the Solar Eclipse Expedition to the West Indies and the pressure of work in the magnetic department preventing the other observer devoting time to spectroscopic work.

In the 12 months ending May 20, 1887, photographs of the sun have been taken at Greenwich on 215 days. For the year 1886 photographs have been measured for 463 days, thus giving a practically complete record of the state of the sun's surface. The spotted area of the sun has continued to decline during 1886 and 1887, the sun being entirely free from spots on 61 days during 1886. Since April 17 of the present year there has been a revival of solar activity. As the Astronomer Royal considers it not improbable that changes in the earth's magnetism and other terrestrial effects of the sun's action may have relation to the projection of the solar spotted area on the plane perpendicular to the line of sight rather than to the actual area of the spots on the surface, he proposes to print the projected area of spots as measured uncorrected for foreshortening as well as the area on the sun's surface.

For the year 1886 the mean temperature was 48·7, being 0·6 below the average of the preceding 45 years. The highest temperature of the air in the shade was 89·8 on July 6, and the lowest 16·5 on January 7. The mean monthly temperature was below the average in January, February, (6·0), March, June, and December, and above the average in September, October, and November. In the period of 156 days from 1886, Dec. 16, to 1887, May 20, the mean temperature was 3·1 below the average of 20 years, the daily temperature being below the average on 115 days. The mean daily motion of the air was 291 miles, being seven miles above the average of the preceding 19 years. The greatest daily motion was 857 miles on December 8, and the least, 56 miles, on October 8. The recorded pressures exceeding 20lb. on the square foot were 27·6lb. on March 31 and 23·5lb. on December 9. The number of hours of bright sunshine recorded by Campbell's sunshine instrument during 1886 was 1,228, which is about 20 hours above the average of the preceding nine years. The aggregate number of hours during which the sun was above the horizon was 4,454, so that the mean proportion of sunshine for the year was 0·276, constant sunshine being represented by 1. The rainfall was 24·2in., being 0·5in. below the average of the preceding 45 years.

The automatic drop of the Greenwich time-ball failed on one day only during the past 12 months. On three days the ball was not raised on account of the violence of the wind, and on five days on account of accumulation of snow on the mast. As regards the Deal time-ball, there have been 12 cases of failure owing to interruption of the telegraph connections, and on three days the violence of the wind prevented the rising of the ball. For 14 days after the snowstorm of December 26-27, no signals were sent to or received from the Deal time-ball tower, telegraphic communication being interrupted. There have been four cases of failure of the 1 p.m. signal to the Post Office Telegraphs. The success of the arrangements for dropping a time-ball at Devonport induced the Astronomer Royal to recommend that the Government should provide the apparatus for hourly signals at the Lizard, which the committee of Lloyd's have consented to maintain.

MULTIPLEX PERSONALITY.*

By Frederic W. H. Myers.

ONE or two brief instances may indicate the moral and the physical benefits which hypnotisation is bringing within the range of practical medicine. At first I will cite one of the cases—rare as yet—where an insane person has been hypnotised with permanent benefit.

In the summer of 1884 there was at the Salpetrière a young woman of a deplorable type. Jeanne Sch—— was a criminal lunatic, filthy in habits, violent in demeanour, and with a lifelong history of impurity and theft. M. Auguste Voisin, one of the physicians on the staff, undertook to hypnotise her on May 31st, at a time when she could only be kept quiet by the strait jacket and bonnet d'irrigation," or perpetual cold douche to the head. She would not—indeed, she could not—look steadily at the operator, but raved and spat at him. M. Voisin kept his face close to hers, and followed her eyes wherever she moved them. In about 10 minutes a stertorous sleep ensued; and in five minutes more she passed into a sleep-waking state, and began to talk incoherently. The process was repeated on many days, and gradually she became sane when in the trance, though she still raved when awake. Gradually, too, she became able to obey in waking hours commands impressed on her in the trance—first trivial orders (to sweep the room and so forth), then orders involving a marked change of behaviour. Nay, more; in the hypnotic state she voluntarily expressed repentance for her past life, made a confession which involved more evil than the police were cognisant of (though it agreed with facts otherwise known), and finally of her own impulse made good resolves for the future. Two years have now elapsed. and M. Voisin writes to me (July 31st, 1886) that she is now a nurse in a Paris hospital, and that her conduct is irreproachable. In this case, and in some recent cases of M. Voisin's, there may, of course, be matter for controversy as to the precise nature and the prognosis, apart from hypnotism, of the insanity which was cured. But my point is amply made out by the fact that this poor woman, whose history since the age of 13 had been one of reckless folly and vice, is now capable of the steady, self-controlled work of a nurse at a hospital, the reformed character having first manifested itself in the hypnotic state, partly in obedience to suggestion, and partly as the natural result of the tranquillisation or morbid passions.

M. Voisin has followed up this case with others equally striking, into some of which a committee of the Société Médico-Psychologique is now inquiring. And M. Dufour, the medical head of another asylum, has adopted hypnotic suggestion as a regular element in his treatment. "Dès a présent," he says, "notre opinion est faite: sans crainte de nous tromper, nous affirmons que l'hypnotisme peut rendre service dans le traitement des maladies mentales." As was to be expected, he finds that only a small proportion of lunatics are hypnotisable; but the effect produced on these, whether by entrancement or suggestion, is uniformly good. His best subject is a depraved young man, who, after many convictions for crimes (including attempted murder), has become a violent lunatic. "T.," says Dr. Dufour, "a été un assez mauvais sujet. Nous n'avons plus a parler au présent, tellement ses sentiments moraux ont été améliorés par l'hypnotisme." This change and amelioration of character (over and above the simple recovery of sanity) has been a marked feature in some of Dr. Voisin's cases as well.

There is, indeed, in the sleep-waking state even of sane persons a characteristic change of character more easily recognised than described. Without generalising too confidently, I may say that there seems usually to be an absence of self-consciousness and anxiety, a diminution of mere animal instincts, and a sense of expansion and freedom which shows itself either in gaiety or in a sort of beatific calm. In Madame B. (a subject whose susceptibility to hypnotisation by Dr. Gibert and Prof. Janet from a distance has recently attracted much notice) there was something—as it seemed to me—indescribably absurd in the contrast between the peasant woman's humble, stolid, resigned cast of countenance and the childish glee with which she joked and babbled during the "phase somnambulique" of her complex trance. On the other hand, M. Richet says of a recent subject of his own, "She seems when in the somnambulic state to be normal in all respects except that her character has changed. When awake she is gay and lively; when entranced, grave, serious, almost solemn. . . . Her intelligence seems to have increased."

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* From the *Proceedings* of the Society for Psychical Research.

And I may remark that this phase of the somnambulic character, this tendency to absorption and ecstasy, is a fact of encouraging significance. It is an indication that we may get more work out of ourselves in certain modified states than we can at present. "Ecstacy," which in former ages was deemed the exalted prerogative of saints, is now described as a matter of course among the phases of a mere hysterical attack. The truth is, perhaps, more complex than either of these views would admit. Ecstasy (we may certainly say with the modern alienist) is for the most part at least a purely subjective affection, corresponding to no reality outside the patient, and appearing along with other instabilities in the course of hysteria. True; but, on the other hand, ecstasy is to hysteria somewhat as génius is to insanity. The ecstasy, say, of Louise Lateau assuredly proves no dogma, and communicates to us no revelation. Yet, taken strictly by itself, it is not altogether a retrograde or dissolutive nervous phenomenon. Rather it represents the extreme tension of the poor girl's spirit in the highest direction which her intellect allows; and the real drawback is that this degree of occasional concentration usually implies great habitual instability. The hysterical patient has an hour of ecstasy, during which her face, if we may trust Dr. Paul Richer's drawings, often assumes a lofty purity of expression which the ordinary young person might try in vain to rival. But she pays for the transitory exaltation by days of incoherent scolding, of reckless caprice. And similarly, as I maintain, the power of exaltation, of concentration, which constitutes genius implies a profound *modifiability* of the nervous system, a tendency of the stream of mentation to pour with a rush into some special channels. In a Newton or a Shelley this modifiability is adequately under control; were it not so, our Shelleys would lapse into incoherence, our Newtons into monomania.

And I maintain that the hypnotic trance, with its liberation from petty preoccupations, its concentration in favourite channels, has some analogy to genius as well as to hysteria. I maintain that for some uneducated subjects it has been the highest mental condition which they have ever entered; and that, when better understood and applied to subjects of higher type, it may dispose to flows of thought more undisturbed and steady than can be maintained by the waking effort of our tossed and fragmentary days.

I have dwelt at some length on the *moral* accompaniments of the hypnotic trance, because they are as yet much less generally known than the physical. It would, indeed, be a mere waste of space to dwell on the lulling of *pain* which can be procured by these methods, or even on the painless performance of surgical operations during the hypnotic trance; but I will cite a case illustrating a point comparatively new—namely, that the insusceptibility to pain need not be confined to the entranced condition, but may be prolonged by hypnotic suggestion into subsequent waking hours.

An hysterical patient in the hospital of Bordeaux suffered recently from a malady which was certainly not imaginary. She had a "phlegmon," or inflamed abscess, as big as a hen's egg, on the thigh, with excessive tenderness and lancinating pain. It was necessary to open the swelling, but the screaming patient would not allow it to be touched. Judging this to be a good opportunity for testing the real validity of deferred hypnotic suggestion, Dr. Pitres hypnotised the woman by looking fixedly in her eyes, and then suggested to her that *after she had been awakened* she would allow the abscess to be opened, and would not feel the slightest pain. She was then awakened, and apparently resumed her normal state. M. A. Boursier proceeded to open and squeeze out the abscess in a deliberate way. The patient merely looked on and smiled. She had no recollection of the suggestion which had been made to her during her trance, and she was not a little astonished to see her formidable enemy thus disposed of without giving her the slightest pain.

Cases like these are certainly striking enough to give a considerable impetus to further experiment. Hypnotism, however, has in England many prejudices to contend with. I shall touch on one such prejudice only—a very excusable one, and germane to the main argument of this paper. "These duplications of state," it is said, "are not *natural*; and what is unnatural, even if it is not morbid, can never be more than a mere curiosity." I would ask of such an objector one single question: "Which state, then, do you consider, as unnatural, your own ordinary sleep or your own ordinary waking?"

This rejoinder goes, I think, to the root of the matter; for we do indubitably undergo every day of our lives a change of state, a shifting of our internal mechanism, which is closely parallel to the artificial changes whose induction I am here recommending. Our familiar sleep, whether considered from the psychical or the physiological side, has a curious history, strange potentialities. In its psychical aspect—to take the point which here most concerns us—it involves at least the rudiments of a "second state," of an independent memory. I should like, had I space, to show how the mere recurrence of a dream-scene—a scene which has no prototype in waking life—is the first stage on the way to those recurrent accesses of somnambulism, linked by continuous memory, which have developed into the actual ordinary life of Félida X. Leaving this point for future treatment, and passing to sleep's *physiological* aspect, we recognise in it the compromise or resultant of many tentative duplications of state which our lowly ancestors have known. Their earliest differentiation of condition, it may be, was merely the change between light and darkness, or between motion and rest. Then comes *encystation*, a fruitful quiescence, originally, perhaps, a mere immobility of self-defence, but taken advantage of for reproductive effort. And passing from protozoa to metazoa, we find numerous adaptations of this primitive duplicability of condition. We find sleep utilised as a protection against hunger, as a protection against cold. And, on the other hand, we find animals for whom what we call "true sleep" is wanting, whose circumstances do not demand any such change or interruption in the tenor of their lifelong way.

Yet why describe this undifferentiated life-history as a state of waking rather than of sleep? Why assume that sleep is the acquired, vigilance the "normal" condition? It would not be hard to defend an opposite thesis. The new-born infant might urge with cogency that his habitual state of slumber was primary as regards the individual, ancestral as regards the race; resembling at least, far more closely than does our adult life, a primitive or protozoic habit. "Mine," he might say, "is a centrally stable state. It would need only some change in external conditions (as my permanent immersion in a nutritive fluid) to be safely and indefinitely maintained. Your waking state, on the other hand, is centrally unstable. While you talk and bustle around me you are living on your physiological capital, and the mere prolongation of vigilance is torture and death."

A paradox such as this forms no part of my argument; but it may remind us that physiology at any rate hardly warrants us in speaking of our waking state as if that alone represented our true selves, and every deviation from it must be at best a mere interruption. Vigilance in reality is but one of two co-ordinate phases of our personality, which we have acquired or differentiated from each other during the stages of our long evolution. And just as these two states have come to co-exist for us in advantageous alternation, so also other states may come to co-exist with these, in response to new needs of the still evolving organism.

And I will now suggest two methods in which such states as those described, say, in Dr. Voisin's or in Dr. Pitres' case, might be turned to good account. In the world around us are many physical invalids and many "moral invalids," and of both these classes a certain percentage are sure to prove hypnotisable, with patience and care. Let us try to improve the moral invalid's character by hypnotic suggestions of self-restraint, which will continue effective after he wakes. And let us try to enable the physical invalid to carry on his intellectual life without the perturbing accompaniment of pain. I am not bringing out a panacea, and I expect that with the English race, and in our present state of knowledge, but few of these experiments will succeed. But increased experience will bring the process under fuller control, will enable us to hypnotise a larger proportion of persons, and to direct the resulting phenomena with more precision. What is needed is the perseverance in experiment which springs from an adequate realisation of the ultimate gain, from a conviction that the tortuous inlet which we are navigating is one of the mouths of a river which runs up far into the unexplored interior of our being.

I have dealt elsewhere with some further cases which go to show the persistent efficacy of moralising suggestions—suggestions mainly of abstinence from pernicious indulgences—when made to a subject in the hypnotic trance. It must suffice here to point out that such moralisation, whether applied to a sane or an insane subject, must by no means be considered as a mere trick or a mere abnormality. It is but the systematisation of a process on which religious and moral "revivals" have always largely depended. When some powerful personage has thrown many weaker minds into a state of unusual perturbation, unusual plasticity, there is an element in that psychical tumult which may be utilised for lasting good. A strong suggestion may be made, and its effect on the brain will be such that it will work itself out, almost automatically, perhaps for years to come. When Father Mathew spread the temperance pledge through Ireland he showed this power at its best. What it can be at its worst we see, for instance, in the recent epidemic of frenzy in the Bahamas, where the hysterical symptoms were actually the main object sought, and the dogma only served to give to that hysteria a stimulating flavour of brimstone. Scenes not dissimilar have been witnessed in England too; yet the sober moralist has been forced to recognise that a germ of better life has often been dropped, and has quickened, amid the turbulence of what to him might seem a mere scandalous orgy.

Just so did the orthodox physician look on in disgusted contempt at the tumultuous *crises* of the patients around Mesmer's *baquet*. But science has now been able to extract from that confused scene its germ of progress, and to use a part of Mesmer's processes to calm the very accesses which Mesmer employed them to generate. Let her attempt, then, to extract the health-giving element from that moral turbulence as well, and to use the potency which in ignorant hands turns men and women into hysterical monomaniacs, to revive in the spirits which she dominates the docility of the little child.

This last phrase represents a true, an important analogy. The art of education, as we know, rests on the physiological fact that the child's brain receives impressions more readily, and retains them more lastingly, than the adult's. And those of us who have been well drilled in childhood are not apt to consider that the advantage thus gained for us was an unfair or tricky one, nor even that virtue has been made unduly easy to us, so that we deserve no credit for doing right. It surely need not, then, be considered as over-reaching Destiny, or out-witting the Moral Law, if we take persons whose early receptiveness has been abused by bad example and try to reproduce that receptiveness by a physiological process, and to imprint hypnotic suggestions of a salutary kind.

I ventured to make a proposal of this sort in a paper published in 1885; but, though it attracted some comment as a novelty, I cannot flatter myself that it was taken *au sérieux* by the pedagogic world. But as I write these lines I see from a report of the Association Français pour l'Avancement des Sciences (Session de Nancy, 1886) that the "Section de Pédagogie" has actually passed a resolution desiring "que des expériences de suggestion hypnotique soient tentées, dans un but de moralisation et de'éducation, sur quelques-uns des sujets les plus notoirement mauvais et incorrigibles des écoles primaires." I commend the idea then, with the sense that I am not alone in my paradox, to the attention of practical philanthropists.

My second suggestion—namely, that we may conceivably learn to carry on our intellectual life in a state of insusceptibility to physical pain, may appear a quite equally bold one. "We admit," the critics might say, "that a man in the hypnotic trance is insensible to pinching; but, since he can also notoriously, when in that state, be made to believe that his name is Titus Oates, or that a candle-end is a piece of plum-cake, or any other absurdity, the intellectual work which he performs in that mood of mind is not likely to be worth much." But my point is, as may have been already gathered, that this clean-cut, definite conception of the hypnotic state is now shown to have been crude and rudimentary. Dr. Pitres' case, above cited (where the patient was restored to ordinary life in all respects except that she continued insensible to pain), is a mere sample of cases daily becoming more numerous, where power is gained to dissociate the elements of our being in novel days, to form from them, if I may so say, not only the one strange new compound "hypnotic trance," but a whole series of compounds marking the various stages between that and the life of every day. Hysterical phenomena, now for the first time studied with something like the attention which they deserve, point strongly in this direction. And apart from hysteria, apart from hypnotism, we find in active and healthy life scattered hints of the possible absence of pain during vigorous intellectual effort. From the candidate in a competitive examination who forgets his toothache till he comes out again, and to the soldier in action unconscious of the bullet-wound till he faints from loss of blood, we have instances enough of an exaltation or concentration which has often made the resolute spirit altogether unconscious of conditions which would have been absorbing to the ordinary man. And here, too, as in the case of moral suggestibility, already dealt with, the function of science is to regularise the accidental and to elicit from the mingled phenomenon its permanent boon. Already men attempt to do this by a mere chemical agency. There have been philosophers who have sought in laudanum intellectual lucidity and bodily repose. There have been soldiers who have supplemented with "Dutch courage" the ardour of martial fire. Philosopher and soldier alike expose themselves to an unhappy reaction. But by the induction of hypnotic anæsthesia we are taking a shorter road to our object; we are acting on the central nervous system without damaging stomach or liver on the way. It was an *abridgment* of this kind when subcutaneous injection of morphia replaced in so many cases morphia taken by the mouth. Yet though the evil done *in transitu* was subtler and slower, evil still was done. On the other hand, the direct non-chemical action on the central nervous system, in which hypnotism consists, is not proved to be in any way necessarily injurious, and has thus far, when under careful management, resulted almost uniformly in good. Such, at least, is the view of all physicians, so far as I know, who have practised it themselves on a large scale, though it is *not* the general view at present of those men—physicians or others—who are content to judge from hearsay and to write at second-hand.

Let us not then, I would say, be satisfied if we can merely give some poor sufferer a good night by hypnotism, or even if we can operate on him painlessly in a state of trance. Let us approach the topic of the banishment of pain in a more thorough-going and bolder spirit. Looking at that growing class of civilised persons who suffer from neuralgia, indigestion, and other annoying but not dangerous forms of *malaise*, let us consider whether we cannot induce—in those of them who are fortunate enough to be readily hypnotisable—a third condition of life, which shall be as waking but without its uneasiness and as sleep without the blankness of its repose, a state in which the mind may go serenely onwards and the body have no power to distract her energy or to dispute her sway.

Is there anything in nature to render this ideal impossible? Let us consider the history of pain. Pain, it may be plausibly suggested, is an advantage acquired by our ancestors in the course of their struggle for existence. It would be useless to the fortunate animalcule, which, if you chop it in two, is simply two animalcules instead of one. But as soon as the organism is complex enough to suffer partial injury, and active enough to check or avoid such injury before it has gone far, the pain becomes a useful warning, and the sense of pain is thus one of the first and most generalised of the perceptive faculties which place living creatures in relation with the external world. And to the human infant it is necessary still. The burnt child must have some reason to dread the fire, or he will go on poking it with his fingers. But, serviceable though pain may still be to the child and the savage, civilised men and women have now a good deal more of it than they can find any use for. Some kinds of pain, indeed (like neuralgia, which *prevents* the needed rest), are wholly detrimental to the organism, and have arisen by mere correlation with other susceptibilities which are in themselves beneficial. Now if this correlation were inevitable—if it were impossible to have acute sense-perceptions, vivid emotional development, without these concomitant nervous pains—we should have to accept the annoyance without more ado. But certain spontaneously occurring facts, and certain experimental facts, have shown us that the correlation is *not* inevitable; that the sense of pain can be abolished, while other sensibilities are retained, to an extent far beyond what the common experience of life would have led us to suppose possible.

Our machinery is hampered by a system of checks, intended to guard against dangers which we can now meet in other ways, and often operating as a serious hindrance to the work of our manufactory. A workman here and there has hit on an artifice for detaching these checks, with signal advantage, and is beginning to report to the managers his guess at a wider application of the seemingly trivial contrivance.

Be it mentioned, too, that not only pain itself, but anxiety, ennui, intellectual fatigue, may be held in abeyance by hypnotic treatment and suggestion. There is not, indeed, much evidence of any increase of sheer intellectual acumen in the hypnotic state, but in most kinds of ordinary brain-work the difficulty is not so much that one's actual power of thinking is inadequate to the problems proposed as that one cannot use that power aright, cannot focus one's object steadily or gaze on it long. Hypnotism may not supply one with mental lenses of higher power, but in its *artificial attention* we have at least the rudiment of a machinery like that which holds firm the astronomer's telescope and sweeps it round with the moving heavens, as compared with the rough and shifting adjustments of a spy-glass held in the hand.

These speculations, especially where they point to moral progress as attainable by physiological artifice, will seem to many of my readers venturesome and unreal. And in these days of conflicting dogmas and impracticable Utopias, Science, better aware than either priest or demagogue of how little man can truly know, is tempted to confine herself to his material benefit, which can be made certain, and to let his moral progress—which is a speculative hope—alone. Yet, now that Science is herself becoming the substance of so many creeds, the lode-star of so many aspirations, it is *important that she* should not in any direction even *appear to be either timid or cynical. Her humble missionaries at least need not show themselves too* solicitous about possible failure, but should rather esteem it as dereliction of duty were some attempt not made to carry her illumination over the whole realm and mystery of man.

Especially, indeed, is it to be desired that biology should show—not, indeed, a moralising bias, but—a moral care. There has been a natural tendency to insist with a certain disillusionising tenacity on the low beginnings of our race. When eminent but ill-instructed personages in Church or State have declared themselves, with many flourishes, "on the side of the Angel," there has been a grim satisfaction in proving that Science at any rate is "on the side of the Ape." But the victory of Science is won. She has dealt hard measure to man's tradition and his self-conceit; let her now show herself ready to sympathise with such of his aspirations as are still legitimate, to offer such prospects as the nature of things will allow. Nay, let her teach the world that the word *evolution* is the very formula and symbol of hope.

But here my paper must close. I will conlude it with a single reflection which may somewhat meet the fears of those who dislike any tamperings with our personality, who dread that this invading analysis may steal their very self away. All living things, it is said, strive towards their maximum of pleasure. In what hours, then, and under what conditions, do we find that human beings have attained to their intensest joy? Do not our thoughts in answer turn instinctively to scenes and moments when all personal pre-occupation, all care for individual interest, is lost in the sense of spiritual union, whether with one beloved soul, or with a mighty nation, or with "the whole world and creatures of God?" We think of Dante with Beatrice, of Nelson at Trafalgar, of S. Francis on the Umbrian hill. And surely, here, as in Galahad's cry of "If I lose myself I find myself," we have a hint that much, very much, of what we are wont to regard as an integral part of us may drop away, and yet leave us with a consciousness of our own being which is more vivid and purer than before. This web of habits and appetencies, of lusts and fears, is not, perhaps, the ultimate manifestation of what in truth we are. It is the cloak which our rude forefathers have woven themselves against the cosmic storm; but we are already learning to shift and refashion it as our gentler weather needs, and if perchance it slip from us in the sunshine then something more ancient and more glorious is for a moment guessed within.

HOW TO DO BLACKSMITH'S WORK.*

NOW and then a man or a boy is heard to say, "I wish I understood the blacksmith's trade." Well, then, if you want to know how to work hot iron, why don't you pitch in and do it? Nothing can be easier, for there is hardly a blacksmith in the country but who will (for a consideration) let the would-be smith have the use of forge and anvil an hour or two of an evening, or when idle at other times. In many shops an extra forge is provided for handling extra work, and when this is the case, the amateur is "all hunki." The first thing a novice should attempt is building a fire, and as this has been already told in a previous article, the writer will simply say: Clean the tuyere thoroughly, blowing all the time while so doing; let kindling or waste get thoroughly ignited before putting on the coal; then carefully put on some clean lumps of coked coal which has been left from a former fire. Be sure to let the coal get thoroughly ignited before putting the iron in the fire, for wet dirt and half-melted coal fused to the work will not advance the novice in the least. The first thing to do after the iron is hot is to hammer it. Don't try to make anything; simply try to hammer the piece of iron flat. The chief trouble will be the hammer marks. A blacksmith's hammer in the hands of a stranger has a most unpleasant habit of turning cornerwise and forming big dents in the work.

It is a good practice for several lessons to take a heat and hammer the iron until it gets down to a dull red, then heat again, and try to pound out the marks made during the previous heat. After the novice has become able to strike a blow with the face of his hammer, he must try to hammer a bit of iron into a square rod. It will be found easy enough to form up four sides on a bar of iron; but to make up four right-angles between those four sides is quite another question. The work invariably assumes a diamond-shaped cross section, and the more it is hammered the more diamonding it gets. The only remedy is to forge right down the two most acute angles, forming an irregular six-sided section, from which a square bar may again be attempted. In the course of several lessons, the square section will have been tolerably well achieved, and the student may try to make other shapes. It is well to bear in mind that whatever shape may be desired the iron must first be made into a square, if its size is to be in degree made smaller, or, as technically termed, "drawn down" or "out." "Drawing down" may best be done on the back edge of the anvil. Lay the bar flat on the anvil, then raise the left hand until the bar clears the front edge of the anvil ¼in. of ⅛in. Now strike the bar square with the hammer, the further edge of the hammer just projecting beyond the further edge of the anvil. Drawing down a rod of iron may be done upon the front edge of the anvil, by lowering the bar of iron until it rests on the front corner of the anvil, then letting the forearm and wrist drop until the hammer face bears true with the iron bar. This position is not as easy, and is used by the smith but very little, except when a shoulder is to be formed, as the position is so unhandy that a heavy blow cannot be easily struck.

As before stated, draw down to a square shape, no matter what the section is to be, when finished. In cases when a round bolt is to be made one-sixteenth or one-eighth of an inch smaller, the section can be preserved in a circular shape, but circular dies must be used for swaging down the iron, and it must not be done with the hammer. If a round rod of iron be hammered down to a point, and the circular section be preserved, the rod will split in several pieces, or "broom up," as technically termed, and be useless for any purpose whatever. Draw down the rod to a square shape, so that by hammering on two sides only the rod may be elongated and its size reduced. Let the hammering be done on one side, only striking on the edge of the bar to correct the tendency to widen. The inexperienced man will hammer one side of the bar as much as he does the other, but this is wrong and will hurt the quality of the iron. Strike two blows on the flat of the iron, then one on the edge, and the tendency to split will be entirely obviated unless the iron is of very poor quality. Should the iron be wretchedly poor, a welding heat must be taken nearly every time the iron is returned to the fire. When the required size is attained the bar of iron may be either rounded or worked into any section desired. After the workman can make a decent square, or round, either taper or straight, he may try to bend the iron into various shapes. Quite a knack is required to turn a square corner or a right angle. To do this neatly, the iron must be upset at the point, when it is to be bent—that is, the rod must be heated to a temperature between a white and a red heat, then put in a vice, or stood on an anvil, and the metal driven against itself until it is reduced in length and increased in section. After bending the extra size at the angle must be reduced by hammering, thus leaving the bend sharp and square, and the iron all of a size.

A plain weld may be next attempted. The ends of the pieces being first upset, then scarfed or bevelled a length equal to their diameter, then heat both pieces with the side downward which is to come in contact with the other piece of iron. This lets that part of the weld get the greatest heat.

Dip each piece in sand as the sparks begin to fly, and urge the fire until a soft, mellow, white heat, (best known by experience) is obtained, then place the pieces in contact, and hammer quickly together.

AUTOMATIC COMMUTATOR FOR INCANDESCENT LAMPS.

INCANDESCENT electric lighting, already pushed to such a degree of perfection in the details of construction and installation, continually finds new exigencies that have to be satisfied. As it is more and more firmly established, it has to provide for all the comforts of existence by simple solutions of problems of the smaller class. Take, for example, this case: Suppose a room, such as an office, lighted by a single lamp. The filament breaks; the room becomes dark. The bell push is not always within reach of the arm, and it is by haphazard that one has to wander around in the dark. This is certainly an unpleasant situation. The comfort we seek for in our houses is far from being provided. M. Clerc, the well-known inventor of the Sun lamp, has tried to overcome troubles of this sort, and has attained a simple, elegant, and at the same time cheap solution. The cut shows the arrangement. The arrangement is connected at the points, B B', with the lighting circuit. The current entering by the terminal, B', passes through the coils of a bobbin, S, before reaching the points of attachment, *a* and *b*, of the lamp, L, the normally working one. Thence the circuit runs to B. Within the coil, S, is a small hollow cylinder, T, of thin sheet iron, which is raised parallel with the axis of the bobbin during the passage of the current through the latter. At its base the cylinder is prolonged into two little rods, *l* and *h'*, which plunge into mercury cups, G [illegible] G'. The [illegible] shows that one of the cups, [illegible] is connecte[illegible] [illegible]inal B', and the [illegible] the te[illegible] [illegible] lamp L'.

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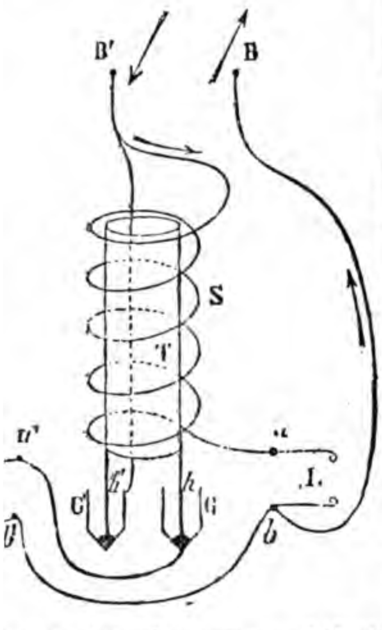
* By James F. Hobart, in the *Manufacturers'*

tion of the current in the bobbin ceases, ider T descends, and the rods *h* and *h'* dip mercury. It follows that the current, starting from the terminal B', will, by f the cups G and G', pass through the lamp by the original return wire to B. The tion of the lamp L for L' is almost in- ous. It can scarcely be perceived. It goes



t saying that such an arrangement of auto-commutation is applicable to lamps with more filaments, of which only one is to be at a time. The apparatus costs little, and made as ornamental as desired. No ration is indulged in if we pronounce it and ingenious. It may be used in a great of cases. The diameter of the wire is $\frac{55}{100}$), its length eighteen mètres (60ft.), its re- e one ohm; ¾ ampère is needed to work it, ss than a watt is absorbed by it.—*Elec-*

'UL AND SCIENTIFIC NOTES.

tricity as Cheap as Gas.—The New ic Light Syndicate, Limited, of 2A, West- Finsbury-pavement, are now temporarily ting, through the courtesy of Messrs. Mar- Singer and Co., of 47, St. Mary-axe (pending ting-up of permanent premises), their pri- attery for lighting houses, churches, clubs, offices, &c., without a dynamo or engine- The battery will be hired by the consumers minal rental. A brilliant and steady light intained for 120 hours without attention. an be used in 5 days or in 120 days, just as ed. The price to be charged the public can d as low as gas at 4s. 6d. The battery will charged, as required, by a company, so the f domestics dealing with it is not incurred. be made of any candle-power, and can be in a cellar or shed, and one to feed 50 lamps ccupy only 7ft. by 3½ft. by 3½ft. The nega- ole is iron or copper, the positive is zinc, the riser is a plate of oxide of lead, and the ng fluid is a caustic alkali.

Rotundity of the Earth.—In a recent to the Helvetic Society of Natural Science, Dufour, of Morges, calls attention to the nation of images on large sheets of still through the roundness of the earth. Instead pearing equal to the object, the image is imes so compressed in the vertical direction be almost unrecognisable. Such is the case the church-tower of Montreux (on the Lake neva) as seen from Morges. One may see the thing in images of distant ships and their the eye being near the water-surface. After g for a moment (M Dufour says), one ves the roundness of the earth distinctly as f a ball held in the hand.

s estimated that the total production or coffee world is about 600,000 tons, to 650,000 tons, ich Brazil alone produces between 340,000 and 0 tons and Java 60,000 to 90,000 tons, the pro- n of British-grown coffee being only about tons of which India contributes 15,000 to Ceylon 10,000 to 12,000 tons, and 000 tons. Although numerically ations of h Colonies ron to their

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE last meeting before the summer vacation was held on Friday, June the 11th, Mr. J. W. L. Glaisher in the chair. Lieut. Arthur Mostyn Field, R.N., H.M.S. *Dart*; Herbert Ingall, Champion-grove, Champion Hill, S.E.; Henry Addenbrook Wassell, Addenbrook Villa, Love-lane, Stourbridge; and Rev. Chas. John Young, Stafford-place, Halifax, were balloted for and duly elected Fellows of the Society. Admiral Mouchez, director of the Observatory, Paris, was elected an Associate of the Society.

Prof. Pritchard read a paper on "The Parallax of 61 Cygni as obtained by Means of Photography." He said the present paper must only be regarded as a preliminary announcement of the results which have been obtained in a research which has involved 30,000 bisections of star images and the measurement of 330 photographs taken on 89 nights. Eight independent determinations of the parallaxes of the two components of 61 Cygni have resulted from all this work, and they indicate a substantial agreement with a parallax value between that of Bessel and Dr. Ball. The probable error of a single determination is only 13 thousandths of a second of arc. Measures have been made to determine whether there is any shrinkage or change of scale in passing from one photographic plate to another. There are four reference stars (those used by Bessel) from which the parallax is determined. The whole distance between these stars, which amounts to between 2,000 and 3,000 seconds, has been measured on each plate, and sensible variations, amounting in some instances to as much as two seconds of arc, have been found. But these differences do not in the slightest degree interfere with the measurements, for the distances between the reference stars affords a scale from which the measures made on the plate may be reduced for comparison.

Mr. Gill said: I happened to be at Oxford about the time when the equations of condition resulting from Prof. Pritchard's measurements were on the point of solution. Prof. Pritchard laid all his results before me, and I am astonished at the accuracy of the results he has obtained. One new fact which Prof. Pritchard's research has brought out is that there is a slight change of scale in passing from one plate to another, whether it is entirely due to stretching of the film I do not know. It may be due to a difference of focussing, for it is very difficult with the reflector to focus precisely or to point with accuracy, so that the stars are not always in the same position on the plate. It may be, to some extent, due to slight changes in the curvature of the speculum; but I do not see any reason why in a future research the plates should not be rejected in which the change of scale exceeds a certain limit. Prof. Pritchard's plates are small, not more than 2in. across, and if the change of scale is due to a stretching of the film, this might amount to something much more serious in a larger plate.

Mr. Ranyard said: Prof. Pritchard was a little hurt by the comparison I made at a recent meeting between the magnified photographic image of a star and a heap of shingle. On the day after he had shown his star photographs at the Royal Society soirée, he wrote to me and asked me if I would take an early opportunity of saying whether the magnified photographic images he had shown on the previous evening did look like a heap of shingle, or whether they could be more correctly described as circular patches with a definite edge surrounded by a fringe. I cannot quite agree with Prof. Pritchard in his description of them, either as being circular or as having a definite edge; but I am happy to say that the granulation was smaller and less obvious than I had supposed, when Prof. Pritchard read his paper. He then spoke of his photographs as being under-exposed. When a star first begins to impress its image on the plate the granulation is very marked indeed, and I think it may be not inaptly described as looking like a heap of shingle when magnified; but with further development and exposure the shingle merges together, and a granulated dark patch is the result, which I think is very well represented in a woodcut from one of the Henry photographs published in a little volume on the table by Admiral Mouchez; but the real question at issue is whether the position of the centre of such patches of photographic action can be measured to 13 thousandths of a second—that is, with an accuracy of nearly one 100th of a second. I am inclined to think that they cannot be determined with an accuracy of a quarter of a second. The differences between the determinations of the parallax of 61 Cygni by different astronomers of the first rank amount to nearly half a second, and they each of them believed that they had determined the parallax with a probable error of a tenth of a second or less. There must be an error somewhere—probably a systematic error, which cannot be, or is not, detected by the observer. I think that I am understating the case when I say that there are not thirty nights in the year in England, or even at Nice, when you can, even with a large instrument, fairly split a double star a second apart. I do not mean when you can recognise that it is a double star; but nights on which you can split it so as to see two circular discs; and I think that we are very far from being able either to see or to measure a tenth or a hundredth part of this distance.

Prof. Pritchard: I think Mr. Ranyard's remarks are due to want of experience in making such measures. Does he think that anyone in his senses would go on making thirty thousand measures of objects that could be fitly compared to a heap of shingle? Then, again, Mr. Ranyard talks of my deducing too small a probable error. Does he not know that the astronomer cannot control his probable error; it takes care of itself—it is a matter of arithmetic? I believe that our results are comparable with Mr. Gill's best heliometrical determinations, and that they are quite comparable in accuracy with the result of Bessel.

Father Perry: I think that my friend Prof. Pritchard is a little hard upon Mr. Ranyard, in ascribing his remarks to want of experience; at all events, Admiral Mouchez, who has been assisted with all the experience of the brothers Henry, gives a wood cut representing the images of stars seen under a high magnifying power, which may be described as looking something like a heap of shingle. I have had the advantage of examining some of the plates of the brothers Henry, and also many of the plates taken by Mr. Isaac Roberts, and though Mr. Roberts's images are very small and round, they certainly, when magnified, show a a great deal of granulation.

Capt. Noble: I examined Prof. Pritchard's photographs the other evening at the Royal Society Soirée, and though the images might be described as granulated, they presented a perfectly definite outline, which could, I think, be bisected with great accuracy by a micrometer wire. In one of the photographs which I looked at, one of the stellar images was not quite circular, but it was a circle with a sector cut off, which could be easily bisected, I think, with greater accuracy than you could bisect a dancing stellar point of light as seen in the telescope with a micrometer wire.

Mr. W. H. Wesley read a paper on "The Form of the Solar Corona as Traceable in The Photographs of Recent Total Eclipses." He said there are various characteristic structures to be made out in the corona photographs. As a rule, they appear darker or denser in the lower parts of the corona, and they evidently spring from the sun. Their curvature also is, as a rule, greater in the lower parts of the corona than in the higher parts. I think there is evidence that this is not merely due to an effect of perspective, but that the structures exhibiting greater curvature are really situated in the lower regions of the corona, and that there are forces acting upon the structures other than the projectile force and the force of gravity. These structures evidently interlace with one another in contrary directions, and they effectually dispose of Prof. Hastings's theory that the corona may be accounted for as a diffraction phenomena, and they also cannot be accounted for by a mere drifting back of the coronal matter, owing to the difference of rotational velocity at various altitudes, as suggested by Dr. Huggins; otherwise all the structures at any one part of the corona would appear to bend together in one direction. In many of the corona photographs there is a great rift, or V-shaped opening in the corona somewhere in the neighbourhood of the solar poles, and there is some sort of symmetry about a line which roughly corresponds with the sun's axis, though what may be called the axis of symmetry is frequently inclined at 10°, 20°, or even 30° to the sun's axis. On either side of the polar rifts are what Mr. Ranyard has called groups of synclinal structure. At the time that Mr. Ranyard wrote his book on solar eclipses there certainly seemed to be a pretty general law, connecting the inclination of the groups of synclinal structure with the number of sunspots; when there were few sunspots the synclinal groups were depressed towards the solar equator—and when there were many sunspots—the synclinal structures were at a higher latitude. But the more recent coronal photographs do not seem to correspond with the law deducible from the earlier coronas, and in many cases there is no axis of symmetry of these recent coronas, or the symmetry is so masked by irregular structures that it cannot be recognised with any certainty.

The following papers were also announced and taken as read:—

Prof. G. W. Hough, "Observations of the Companion of Sirius made at the Dearborn Observatory, Chicago"; Prof. Auwers, "A Catalogue of 480 Stars to be used as Fundamental Stars for Observations of Zones between 20° and 80° South Declination"; J. E. Gore, "On the Orbit of Σ 1757"; T. G. Elger, "Physical Observations of Saturn in 1887"; H. C. Russell, "Measures of Southern Double Stars"; J. L. E. Dreyer, "A New General

Catalogue of Nebulæ and Clusters of Stars," being the Catalogue of the late Sir F. J. W. Herschel, revised, corrected and enlarged; Capt. W. Noble, "An Old Drawing of Jupiter"; J. G. Lohse, "Observations of Nova Cygni and of some of the Planets made at Mr. Wigglesworth's Observatory with the 15·5in. Cooke Equatoreal"; T. Buckney, "Remarkable Performance of the Westminster Clock"; A. M. W. Downing, "A Comparison of the star places of the Argentine General Catalogue for 1875 with those of the Cape Catalogue for 1880, and with those of other Southern Star Catalogues"; W. H. M. Christie, "On a Corrector for adapting an Ordinary Object-glass to Photography."

WESTERN MICROSCOPICAL CLUB.

THIS club met on Monday week at the house of Prof. G. S. Boulger, F.L.S., F.G.S. The subject of the evening was entitled "Wood-structure in relation to its economic uses." The host, who was demonstrator for the evening, said:—In spite of the increasing use of iron, wood will always be used for many purposes, and for these it is important that standard tests should be recognised more than at present. Our museums are mainly confined to British and Colonial woods, and the microscope has not yet been applied as it might be to wood analysis. Among the chief economic groups of woods are, first, the dense, dark-coloured, close-grained woods of some tropical dicotyledons, such as teak, greenheart, and ebony (prepared examples of several of which were exhibited by the secretary); second, the soft, wide-ringed, rapidly-grown woods of conifers; third, the soft, white woods of willows, poplars, and other quick-growing dicotyledons, many of which are now much used in the manufacture of paper; fourth, the slower-grown, moderately hard, building and furniture woods, such as oak, elm, and beech; fifth, the ornamentally-marked veneer woods, such as holly, walnut, and mahogany; and, sixth, the very close-grained engraving woods, such as box, South African box, and hawthorn. The geographical distribution of these groups is somewhat interesting, the first being mainly confined to within ten degrees of the Equator, the second mainly to the cooler temperate zones, and the sixth being very largely represented in South Africa. The high specific gravity and dark colour of the first group is connected with much thickened and lignified cell walls in the heartwood. The lowest group of ligneous plants produces some of the densest wood, though only in patches, several tree ferns figuring in the list of Indian timbers, though, like palms, they are mainly suitable for use "in the round." The age at which heartwood forms varies remarkably, the common acacia (*Robinia*) beginning to form it at eight years old. The breaking weight and flexibility of woods, for which standard lengths and sections are desirable, are largely dependent upon the length of the fibre; and the microscope can be used to discriminate similar woods, such as apple and pear, though sometimes allied species differ widely in their wood, *e.g.*, the white beam (*Pyrus Aria*) and the service (*Pyrus terminalis*). The soft wood of the Spanish chestnut, with no distinct "silver grain" or medullary figure, has been confused with the oak, which it so resembles in colour as to be a useful substitute in carving. Other valuable stem structures, such as bast fibres and cork, are also amenable to microscopic analysis.

Remarks were also made on the exhibition of woods for educational purposes, the speaker proposing to illustrate timbers used in Britain by a collection at the Surveyors' Institution; a series of slides of woods cut in three directions, lent by Mr. George Smith; some of oaks in various stages of growth, prepared in boroglyceride, by Mr. A. P. Wire; Burckhardt's series of thin opaque sections of European woods, a slab of Ampthill oak, wood and bast of the deciduous cypress (*Taxodium*), a halter of lace-bark (*Lagetta*), and specimens of coniferous wood, silicified from the Kentish rag, and as lignite, from the Weald, were exhibited by the host, besides fresh branches of various British trees.

Microscopes, under which were exhibited a great variety of woody structure, were contributed by Messrs. Boulger, Gwinnell, Karop, Moore, R. T. and E. Swain, and Stokes. Some exceedingly interesting stereoscopic projections of crystallographic forms, some illustrative of the crystalline forms found in woody tissues, were shown by Mr. J. Love. Mr. A. W. Stokes, F.C.S., F.I.C., Public Analyst to Paddington, was unanimously re-elected hon. secretary.

THE 68,200lb. anvil block, recently cast by the Otis Iron and Steel Co., of Cleveland, for the Morgan Engineering Works, is said to be the largest single steel casting ever turned out in the United States. The block is 8ft. square by 3ft. 10in. high; 78,525lb. of steel were melted, and this was poured in 4min. 20sec.

SCIENTIFIC NEWS.

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THE Albert Medal of the Society of Arts, presented annually for "distinguished merit in promoting arts, manufactures, or commerce," has been accepted by the Queen, who represents the personal embodiment of the nation.

Another small planet has been discovered by M. Borrelly on June 9. It is No. 268 in the list, and the 14th minor planet due to the astronomer at Marseilles.

Small planet, No. 266, discovered by Dr. Palisa, of Vienna, on May 18, has been named Aline.

The fifteen candidates chosen by the council of the Royal Society, for the Fellowship, were duly elected on the 9th inst. We gave the names on p. 218.

The proposed banquet to Prof. Tyndall will take place on June 29, the president of the Royal Society, Prof. G. G. Stokes, in the chair.

A meeting of Members of Parliament and others was held the other day in one of the committee-rooms to make arrangements for the purpose of establishing a national association for promoting technical and commercial education. The meeting was unanimously of opinion that an association should be formed, and a resolution to that effect was adopted. On the motion of Prof. Huxley, seconded by Sir Lyon Playfair, some discussion ensued in reference to (1) the co-ordination of the technical education of the country in accordance with the needs of the various classes of the employers and employed; (2) the foundation of a board of advice and recommendation; (3) the spread of information as to the progress of technical education both at home and abroad; (4) the adaptation of schools to the industrial requirements of the several necessities of the working classes; and (5) the removal of legislative disabilities, and the support of measures for the promotion of technical education in all its branches. On the motion of Mr. Mundella, seconded by Mr. George Howell, a provisional executive committee was appointed and authorised to make arrangements for the organisation of a general committee to draw up and circulate a statement with regard to the objects of the association, and to convene at an early date a public meeting for the inauguration of the association. At this meeting Lord Hartington will be proposed as president of the association, and an influential list of vice-presidents will be submitted. It is proposed to ask members of School Boards and town councils, representatives of Universities and local colleges, of trade-unions and co-operative societies, and the like to join the general committee. Sir H. Roscoe, M.P., and Mr. A. Acland, M.P., have consented to act as provisional secretaries.

The Science Committee of the Recreative Evening Schools Association, which consists, among others, of Mr. Lant Carpenter, Prof. Jeffrey Bell, Mr. Rudler, and Mr. J. J. Harris Teal, is desirous of obtaining assistance from those who are willing to lecture in evening schools next winter. Further information may be obtained from the Secretary, 37, Norfolk-street, Strand.

The Bentham Trustees have purchased, for the purpose of presenting them to the Library of Kew Gardens, the collection of portraits of the Bromeliaceæ accumulated by the late Dr. Morren, professor of botany in the University of Liège.

The Howard Quinquennial prize of the Institution of Civil Engineers has been awarded to John Percy, M.D., F.R.S., in recognition of his researches on the uses and properties of iron.

In a paper read before the Institute of Patent Agents, on the "Compulsory Working of Patents," Mr. A. V. Newton, Fel.Inst.P.A., concludes "that the provision for the compulsory working of patents is a mistake, because it discourages inventors from, rather than urges them towards, the establishment of new branches of manufacture, by destroying the incentive to foreign inventors to create a demand for imported inventions." That view, we need scarcely say, is held by all who know anything of the actual working out of patented inventions.

According to a contemporary, a writing telephone appears to be the latest electrical novelty. It hails from Munich, and its inventors claim that the words of the speaker are duly written down by the apparatus as they are spoken. Such a telephone as that is much wanted. According to an American paper, Mr. Tainter, who has long been associated with Prof. Alex. Graham Bell, of telephone fame, has taken up Edison's phonograph at the point where he left it, and developed it from a toy to an article of commercial value. Before long the new instrument will be placed upon the market. It is constructed on the same principle as the phonograph, but instead of giving out a squeaking, metallic sound, as when the sheet of tinfoil was used, it now produces a full, sonorous sound, which can be distinctly heard and understood in any part of an ordinary room. The conversation is recorded upon thin sheets of wax in shape of a tube placed upon a cylinder. One of these little tubes will hold 1,000 words. A merchant who has forty letters to answer can sit before one of these machines, turn the crank, and talk his answers directly into the machine, which records them upon the wax tube in the same manner as in the old phonograph. Afterwards one of these little tubes can be slipped off the cylinder and sent by mail to any part of the country. When received it will only be necessary to put the wax tube into a similar machine, and it will reproduce the words of the original speaker as often as may be wished. The thin wax tubes will be on sale at stationery stores at about the same rate as letter paper.

In a paper read before the Paris Academy of Medicine, Dr. Bouchard, of Bordeaux, described a "discovery" of a means of preserving dead bodies, and the correspondents of the English dailies forthwith wired it over. The ingredients of this preparation are 20lb. of hydrated sodium borate, containing ten equivalents of water, and 34lb. of glycerine at 30° Réaumur. The borate is reduced to fine powder and shaken through a hair sieve. The glycerine is added little by little in such a manner as not to make lumps. The mixture is then brought up to a temperature of 80° C. (176° Fahr.), being meanwhile well stirred to dissolve the borate. The solution is finally allowed to drip through a woollen cloth. It is of the consistency of glycerine, but can be made of the required thinness by addition of alcohol. It is injected in the carotid or the femoral artery, and when properly done the tissues are preserved for upwards of two months. Perhaps Dr. Bouchard has never heard of the experiments of Dr. B. W. Richardson and those of Prof. Barff with boroglyceride.

An International Exhibition is to be held at Glasgow during the summer of 1888. The guarantee fund already exceeds £240,000, and is being increased. The objects of the Exhibition, as stated in the prospectus, are "to promote and foster industry, science, and art, by inciting the inventive genius of our people to still further development in arts and manufactures; and to stimulate commercial enterprise by inviting all nations to exhibit their products, both in the raw and finished state." Examples of the manufactures of Glasgow and the surrounding districts—chemical, iron, and other products, engineering, shipbuilding, electrical and scientific appliances, and textile fabrics—will be shown; and similar and more varied exhibits may be expected from other parts of Great Britain and from the Continent. Promises of support have also been received from America, India, the Canadian, Australian, Cape, and other colonies. The site, which has been granted by the Glasgow Corporation, extends to sixty acres, and the buildings will cover about ten acres.

Plans have been filed for making a new ra[illegible]way between New York and Boston, which wi[illegible] shorten the time by two hours and a half.

Experiments with roburite, a new explo[illegible] of the hydrocarbon type, were carried on Monday last at Chatham. Wi[illegible] charges on soft steel plates, 2in. thick: r[illegible] made indents of 1¾in., dynamite 1¼[illegible] plates were smashed by 5lb. of gunco[illegible] [illegible]lb. charges rol[illegible] a 8[illegible] [illegible] dynamite.

., with 10lb. charges, roburite made a 12ft. wide and 2ft. 9in. deep, blasting e 14ft. across and 3ft. 1in. deep. With 2oz. charges in brickwork roburite was The experiments terminated with 12lb. s upon 4in. plates, the craters being 2in. he guncotton fissuring the base of the for a length of 13in.

' Microscope, and Some Objects from my t," a simple introduction to the study of nfinitely little," by a Quekett Club-man, nounced for immediate publication by . Roper and Drowley. The little volume icated to the president and members of ekett Microscopical Club.

UL AND SCIENTIFIC NOTES.

◆

nge Foods.—The old saying that what is n's meat is another man's poison is realised opposite tastes of people. The Turks r at the thought of eating oysters. The Indians of the Pacific Coast rejoiced in the ocust swarms of 1875 as a dispensation of the Spirit, and laid in a store of dried locust sufficient to last them for several years. ench will eat frogs, snails, and the diseased f geese, but draw the line at alligators. nd declares the taste of the boa constrictor good and much like veal. Quass, the ted cabbage-water of the Russians, is their r tipple. It is described as resembling a mix- stale fish and soapsuds in taste, yet, next to has more votaries than any other fermented ge. A tallow candle washed down with forms a meal that it would be hard to be ul for. In Canton and other Chinese cities e sold at the rate of 2s. a dozen, and the uarters of the dog are hung up in the r's shop alongside of mutton and lamb, but nd a higher price. The edible birds' nests Chinese are worth twice their weight in the finest variety selling for as much as £6 d. The negroes of the West Indies eat snakes and palm worms fried in fat, but they be induced to eat stewed rabbits. In parrots are eaten, but they are rather tough. uachos of the Argentine Republic are in the f hunting skunks for the sake of their flesh. topus or devil fish when boiled and then l is eaten in Corsica and esteemed a delicacy Pacific Islands and West Indies lizard eggs en with gusto. The natives of the Antilles igator eggs, and the eggs of the turtle are r everywhere, though up to the commence- f the last century turtle was only eaten by r of Jamaica. Ants are eaten by various s. In Brazil they are served with a resinous and in Africa they are stewed with grease or . The East Indians catch them in pits and lly wash them in handfuls like raisins. In curry of ant eggs is a costly luxury. The ese eat the bees after robbing them of their Caterpillars and spiders are dainties to the n bushmen. After they have wound the silk he cocoon the Chinese eat the chrysalis of the rm. Spiders roasted are a sort of dessert the New Caledonians.—*Cassell's Saturday l.*

ORTS have been received of further practice he 45-ton guns of the Colossus, carried out off . The object was to ascertain the rapidity which accurate fire could be delivered, the eing in motion. For the first time in the y of naval gunnery this was tried with heavy loading guns worked entirely by hydraulic . Great importance was, therefore, attached practice. The ship ran at a speed of eight per hour along a measured base distant at the nce rather over 1,900 yards from the target. results are said to have been highly satis- y. The heaviest charge of powder was used ghout, and all the machinery is reported to stood the test admirably. Several times a as fired, loaded again, pointed, and fired a l time in 1¼ minutes, and four charges of the gun were completed in six minutes. Every ruck the target, and out of one series of four apid shots, no fewer than three struck it.

E export of ice from Norway is a growing The quantity sent abroad in 1886 was about 0 tons, against 228,000 tons, in 1885. Last was the largest export on record except that 4, which reached 490,000 tons, consignments sent to every part of Europe. Prices were last year, however, than they had been any years past, and, according to Mr. Consul- al Michell's report, the exporters can be g no profit. There must indeed be a loss ny cases, if the interest on capital employed e cost of maintaining a great number of ice- s are taken into account. It is only the e lowness of freights (scarcely sufficient to ips' expenses) that enables transactions effected at all.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

HAVE SALT IN YOURSELVES—STARS VISIBLE IN DAYLIGHT—THE VELOCITY OF LIGHT—LUNAR, PLAINS CLEFTS, AND CRATERS—SIMULTANEOUS VISIBILITY OF THE SUN AND ECLIPSED MOON—LENGTH OF THE VISIBLE ARC OF THE MERIDIAN—THE JOURNAL OF THE LIVERPOOL ASTRONOMICAL SOCIETY—CASSINI'S DIVISION IN SATURN'S RING.

[27426.]—I CANNOT conceive that Dr. Allinson will advance the cause he has at heart by such extraordinary statements—or misstatements—as those contained in your extract from the *Weekly Times and Echo*, on p. 310. "Animals," he there says, "in a natural condition will not usually eat salt, nor will the untutored savage." To which assertion anyone in the slightest degree familiar with the habits of wild animals can only apply the epithet employed by Dr. Allinson himself in connection with the story of the Dutch prisoners. Did, I ask in some wonder, Dr. A. never hear of the Salt Licks of North-Western America, and of the stupendous herds of wild buffalo that frequent them? Does he know that the South African hunter lies up at night by the salt springs, for the large game that come trooping thither to indulge in the luxury (or, rather, necessity)? Did he ever have a lump of rock-salt in the manger in his own stable? Will he put a piece of it into any field full of cattle, and watch the result? Did he ever read one of the experiments made by Messrs. Lawes and Gilbert on pigs, which, when fed merely on Indian meal, became affected with large tumours breaking out on their necks, with great difficulty of breathing and swallowing; but which not only recovered but became the very fattest and most saleable of the whole set, when a mineral mixture of 20 parts of coal-ashes, 4 parts of common salt, and 1 part of superphosphate of lime was added to their food? . . . As for his dictum anent "the untutored savage," I suppose that he has been reading "Cook's Voyages," and has a hazy recollection of the astonishment of the Otaheitans at seeing Cook and Forster eating white powder with their meat; wholly ignoring the fact that these same savages (of one particular race) cooked their fish and meat *in sea water*! Besides, he must have heard or read of men actually being sold for salt in some parts of Africa; and how the natives of Sierra Leone will sell their sisters, wives, and children for this precious commodity. Dr. Allinson may (or may not) be a burning and shining light among physiologists; but he has obviously something yet to learn of the habits of wild animals, and of the manners and customs of the savage inhabitants of the Dark Continent.

The concluding paragraph of letter 27352 (p. 316) suggests to me to recall to the memory of its author those very beautiful lines of the old poet—

"Teach not a parent's mother to extract
The embryo juices of an egg by suction,
That good old lady can the feat enact,
Quite irrespective of your kind instruction."

In reply to the Bishop of Grafton and Armidale (letter 27381, p. 323), I would say that while it is perfectly true that the first approximation to the determination of the velocity of light was made by Römer in the 17th century by noting the discrepancy between the observed and computed times of the eclipses of Jupiter's first satellite, as viewed from opposite sides of the earth's orbit; yet that that velocity has been measured with incomparably greater accuracy recently by terrestrial means. I do not know whether my right reverend querist has access to any back volumes of the ENGLISH MECHANIC in New South Wales; but should these be attainable, perhaps I may refer him to letters 25722 and 25853 (on pp. 254 and 347 respectively), in your XLIIIrd. volume. By aid of the superb apparatus there described, the velocity of light is measured in air, and the refractive index of air being known, the trivial correction necessary to determine its velocity in vacuo is made at once. Now, space is either filled with a resisting medium, or it is a vacuum. Very elementary dynamics will suffice to show the inevitable result of the former supposition upon the suns and systems of the universe, and hence we are driven to the conclusion that space is everywhere vacuous. This being so, the inference is irresistible that light must travel to us at the same rate from the moon and from α or β Centauri.

Mr. Fasnacht (reply 62181, p. 323) omits to give a reference to the work and page whence his quotation from Proctor is derived. Not though I think that this matters much, as I should exceedingly like to see such a theory applied—in detail—to the explanation of such formations on the moon as Langrenus, Petavius, Arzachel, Alphons, Ptolemy, Walter, Regiomontanus, Archimedes, Copernicus, Grimaldi, &c. One would be curious, too, to know the size of the meteor which excavated the 2,700 square miles of Plato. No one who has ever examined a single one of the lunar regions I have mentioned, with adequate optical means, and compared them with maps of volcanic regions on the earth's surface, will, I venture to think, subscribe to the idea that meteoric rain can ever have produced them. They are too obviously the result of *internal* forces of gigantic magnitude to be referable to an external one inadequate to produce them.

"G. B. B." (query 62542, p. 330) makes, doubtless unintentionally, rather a cool request in the first part of his question, asking me, in effect, to hunt through old almanacs to see the occasions on which the moon rose eclipsed at sunset—a task which he is, at least, as competent himself to perform as I can possibly be. The last time the phenomenon referred to happened in this country was on Dec. 5, 1881. With reference to the second portion of his query, of course, were there no atmosphere (and hence no refraction), and were the observer's eye *on* the surface of the earth, just 180° of the meridian would be visible. The amount of "dip," however, from 6ft. of elevation may be taken as 2′ 21″, and the mean refraction at the horizon is very approximately equal to 34′ 54″. Hence there will be an addition of 37′ 15″ to his arc of 180° at the south point of his horizon, and the same at the north point; together 1° 14′ 30″, so that an eye situated 6ft. above the earth's surface will see very approximately 181° 14′ 30″ of the Meridian.

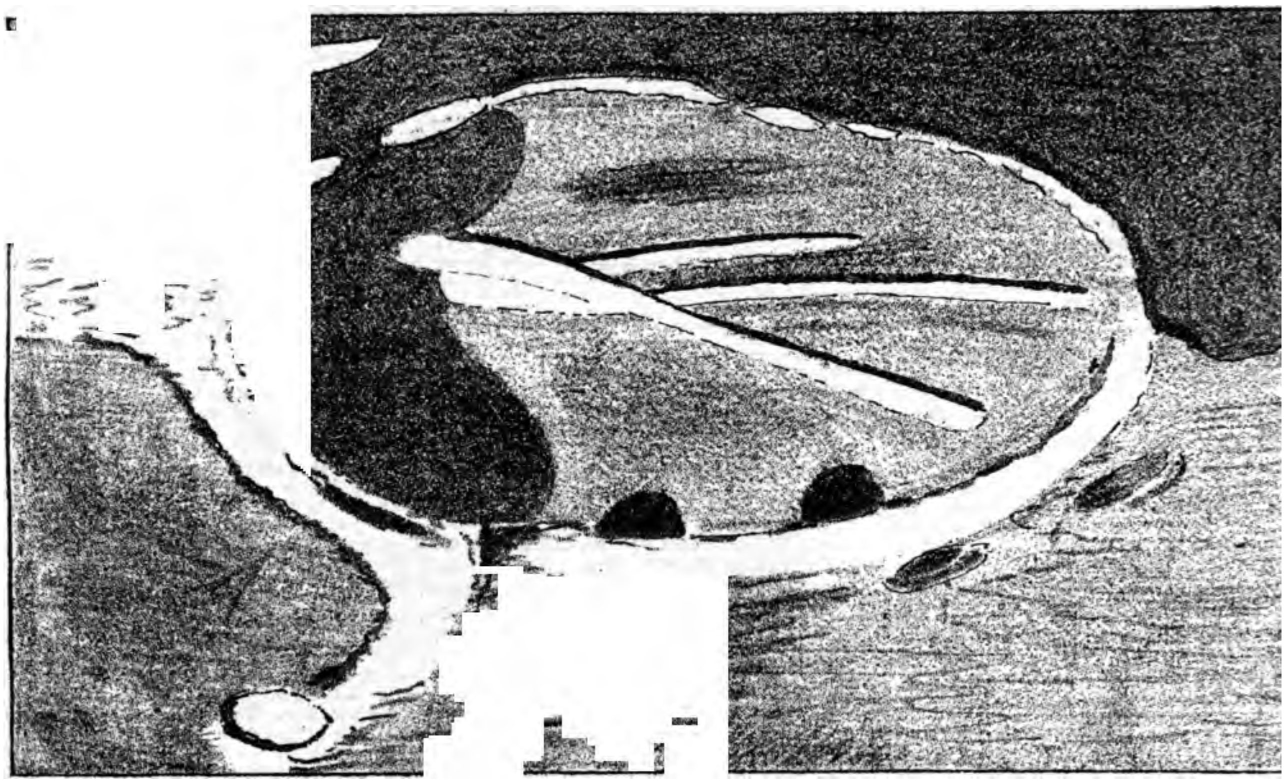
The Liverpool Astromical Society may, I think, legitimately be proud of the fifth volume of their *Journal*, which, in its collected form, lies before me as I write. The contrast with the latter portion of the one preceding it is nothing short of astonishing; and but few indeed who perused the wretched little part for May, 1886, could have conceived by what a very different type of publication it was to be immediately followed. Here we have Mr. Elger's lucid descriptions and beautiful drawings of Lunar scenery; Miss Brown on Sun Spots; Gore, Franks, and Gage on Stars and Star Colours; Monck on Celestial Physics; Denning on the Telescope; Wesley on the Pleiades Nebulæ, and other authors more or less known on various matters of Observational Astronomy. Added to all this are reviews of books, and notes on matters of current astronomical interest, the whole filling 234 pages, in addition to six occupied by an excellent index. This volume affords a capital illustration of the amount of really useful work that may be accomplished by the earnest amateur.

If Mr. Watson (letter 27383, p. 341) will read the ENGISH MECHANIC, *Knowledge*, the *Athenæum*, the *Observatory*, the *Astronomical Register*, &c., for the end of 1882, he will find that the principal division of Saturn's ring is not called Ball's, for the simple but sufficient reason that it was discovered by Cassini, and that Ball *never saw it at all!* The fable of his having done so had its origin in a misreading by Dr. Kitchiner of a passage in the *Philosophical Transactions* for 1666.

A Fellow of the Royal Astronomical Society.

SATURN — QUERY — BALL'S OR CASSINI'S DIVISION.

[27427.] — UNTIL very recently, like Major Watson (letter 27383), I could not understand why Cassini is credited with the discovery of the principal division in the ring system of Saturn, as Grant ("History of Physical Astronomy," p. 526) states, on the authority of a paper in *Phil. Trans.* 1666, that William Ball, of Mamhead, near Exeter, perceived on 13th October, 1665 (or nearly 10 years before Cassini made a similar observation), that the ring round the planet was double. The question, however, is practically settled in the *Astronomical Register* for November, 1882, by a communication from Mr. C. Leeson Prince, of Crowborough, in which he reproduces Ball's drawing from Lowthrop's abridgment of the *Phil. Trans.*, and goes far to show, from a reference to the original paper, what had been previously suspected by Mr. Lynn and himself, that the description of the observations made by the brothers Ball with their 38ft.



elescope relate not to any actual division in the ring, but to a peculiar appearance of the ansæ.

June 11. **Thos. Gwyn Elger.**

SATURN.

[27428.]—In a letter to you headed "Saturn—Struve's Division," signed H. Watson, June 8, I made one slight error. The sentence "Struve never saw any division between B and C, neither did Secchi or Lassell; and Bond and Coolidge especially looked for this on nights of the finest definition with power of 688 on the 26in." should read "power of 688 on 15in.," and not 26in.

Newbridge, June 7. **H. Watson.**

[27429.]—Your correspondent, H. Watson (letter 27383), should certainly call the principal division in the ring of Saturn Cassini's, if it is to be called after its discoverer, for there is no doubt that Cassini was the first to observe it. His observation was made in the year 1675. I have seen it stated, but cannot now recollect where, that the division was first seen in England by Pound. If that is correct, it would probably be about the year 1718, more than forty years after its first discovery. Optical power sufficient to show the division was probably not to be obtained in this country until that time. The credit of the discovery was, I believe, first given to Ball by Mr. (now Dr.) Hind in his "Solar System" under, I think, a misunderstanding as to the nature of the problem at that time in process of solution. The question was not then as now whether Saturn had many rings, but whether it had any ring at all; it was, in fact, a question between the opinions of Hevel and Huyghens, and it is somewhat strange that the Royal Society of that period should, after the publication of the "Systema Saturnium" in 1659 have put forward anything in support of the opinions of Hevel. The paper containing the observations of Ball is inserted in Vol. I. of the *Philosophical Transactions*. Anyone reading that account will have no doubt that the ring was not seen at all by Ball—*i.e.*, as a ring, but just as any bad telescope of the present shows it as two bodies joined to Saturn on either side; but there is given in No. 14 in the same vol. a communication by Mr. Hook, being an account of an observation on Jan. 29th, 1666, which shows that he saw the ring plainly, and which was probably sent by him in support of the ring theory.

Henry T. Vivian.

WARGENTIN—THE LUNAR SECTION, L.A.S.

[27430.]—To the best of my knowledge no drawing of the peculiar ring-formation Wargentin has appeared in the columns of the English Mechanic, and I send a sketch, made at 9.45 on the evening of June 8: power 200, on 8½in. Calver; definition, fair. Neison says: "On the surface, both Schröter and Mädler succeeded in detecting some *very delicate* ridges, only visible for a very short time." When my drawing was made the ridges were easy objects, but the interior, on the whole, as seen by me agrees but little with the representations of Neison and Nasmyth. I saw no craterlets in Wargentin, though Mr. Elger tells me he has detected some. Would he or other observers give "us" what they see of this unique walled plain?

On receiving my copy of the last issue of the L.A.S. *Journal*, I was disappointed to note that only some half-dozen observers constitute the lunar section, whilst about half the drawings contributed are the work of one indefatigable member. Considering the fascination of lunar study, and the ability and uniform kindness of the director, I marvel greatly that more members have not enrolled themselves to forward our physical knowledge of the moon. In no department can it be so justly said that the harvest is plenteous, the labourers few.

Llanelly, June 10. **Arthur Mee.**

STARS VISIBLE BY DAYLIGHT.

[27431.]—I have not examined a catalogue to see what large stars cross the zenith in the North of England, but as I understood "F.R.A.S.," he tells us in "E. M." of 3rd June that γ Draconis is the only star which could be seen by daylight from a chimney or well in this country, and then only under the most favourable circumstances. How does he reconcile this statement with his belief in stories of a star or stars (for they are usually in the plural number) having been accidentally so seen? The duration of the transit of γ Draconis across a field of 1° would be less than four minutes, and as the sky is clear for not much more than one hour out of four, the odds against a chance observer having caught γ Draconis on a clear day and under the most favourable circumstances are too great for ordinary credulity. The stories should be relegated to the realms of fiction, and I am no longer **Dubitans.**

OBSERVATIONS WITH REFLECTORS.

[27432.]—Dr. Ferguson's letter hereon (27349) is very interesting to users of reflectors—as was his previous one. I am, however, somewhat surprised that with an 8½in. he failed to see the canals or rifts in the Andromeda nebula. Using as I have for some years a 6½in. Calver, this nebula always appeared to me very much as is shown in Herschel's drawing in his "Outlines"—a simple lenticular nebula, not easily to be reconciled with the strange drawing of the same object by Bond. But one fine night I turned my brother's 8½in. With-Browning on this nebula, without for a moment thinking I should see these rifts, as Webb described them as only seen by him with a 9⅓in. after a knowledge of the fact, and to my surprise they were *obvious*—the darker one forming (as Webb states) the boundary of one side of the nebula as seen with a small aperture. I should, however, add that the mirror was newly silvered, and that a prism was used instead of a flat.

With reference to currents in the tub
always found on cold nights that defini
impaired by heavy deposits of dew or wh
on the upper side of the tube. To obvia
cover over the tube with a sheet or cl
preventing the iron from radiating so f
getting colder than the air. This experie
me to credit the statement that mirro
perform so well as in the wooden tubes w
used by the makers for testing. I am
act on this belief, for having jointly
brother purchased one of the three 15in.
lately offered for sale by Mr. With (the o
going to Oxford University Observat
intend to fit it up in a wooden tube w
With had made for it, and intended fo
private use. If the Editor of the "E.
permit me, I may hereafter send some n
the performance of this instrument.

Southampton, June 10th. **A.**

PROPELLING STEAMSHIP

[27433.]—The true method of propellin
ships is duck's feet or under-water paddl
screw is an abominably inefficient and
contrivance, working into its own backwas
long, breakable, vibrating shaft, and pr
irreversible. Why should not steamships
even 100 miles an hour safely? The pre
of progress is absurdly slow for their size.
row of, say, eight paddles, reversible und
you could propel a vessel at almost any
liked, and stop it immediately by reversi
all the power of the engine would be exp
the simplest possible action direct on the
paddle. Consider this, for depend upon i
shortly come to pass in actual concrete for

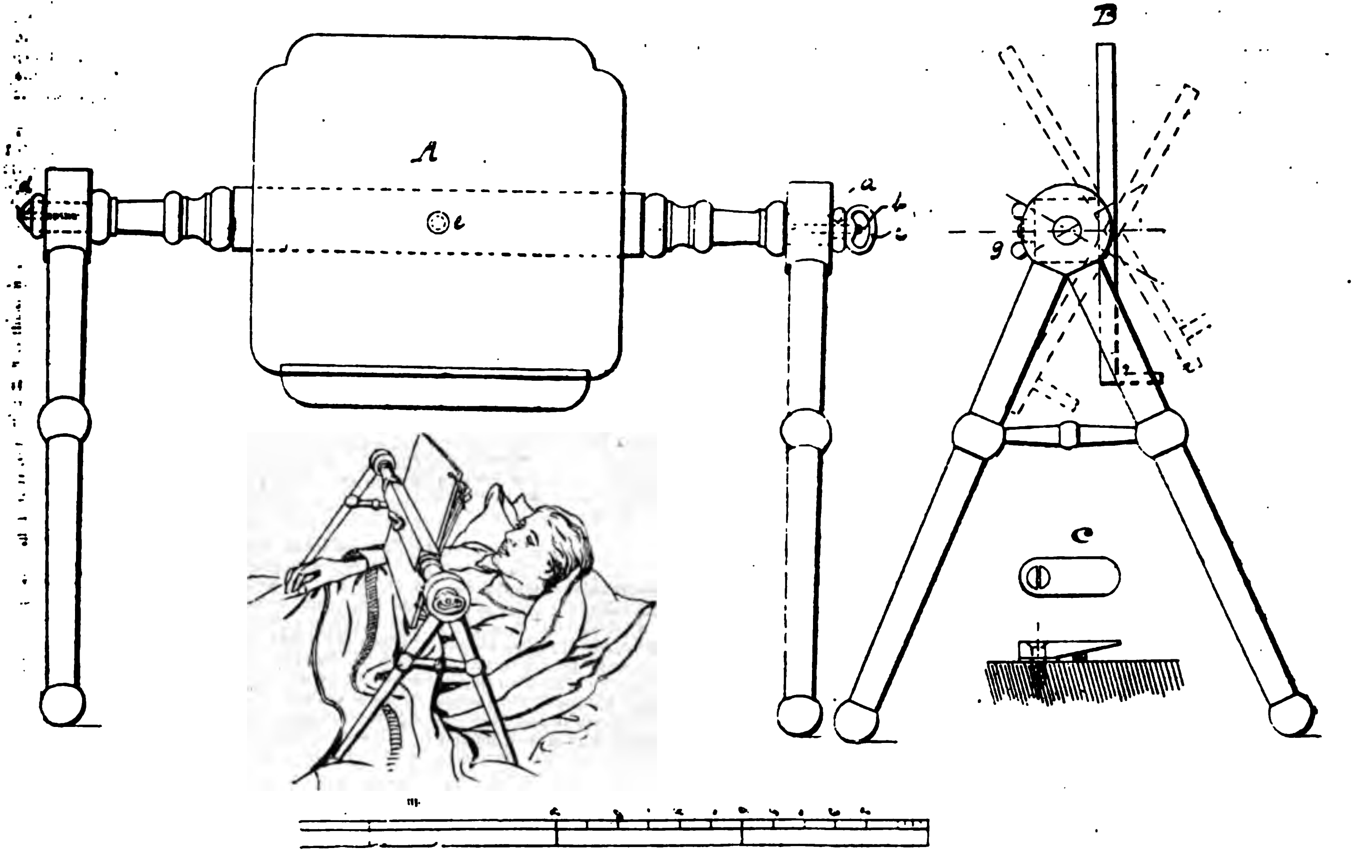
Thos. J. T

TOBACCO PAPER.

[27434.]—Very long ago at Brussels t
and refuse of tobacco manufactories were
by being made into paper, a substance wh
busy worker, the "paper wasp," turned
turies ago, though composed of other ve
The new invention was hailed with deligh
legion of cigarette smokers. I always tho
burnt linen smell of cigarette fumes de
and when living with foreigners I carried
cigars to avoid their favourite form of in
I never could obtain this improved wrap
stance in England. I suppose it has been
by our jealous Customs Department; I ho
now be home-made and cheap.

AN INVALID'S BOOK-RES

[27435.]—I was once asked to sugg
thing for an invalid who had lost the u
limbs, but was mentally healthy. The
greatest pleasure was to be able to read w
one kindly assisted. For the greater p
day no such aid was forthcoming. I inclos



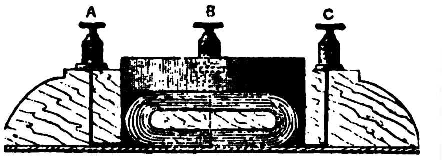
of the contrivance I managed, as I am sure some of your readers would be glad of the idea. The whole may be made for two or three shillings. Two pairs of legs are made like the letter A; one of these fits over the end of a cross-bar, and is held in place by a wooden button (screwed to the cross-bar) so that it is free to move on the cross-bar. The other pair of legs fits over the cross-bar, but is clamped to it by means of a wing nut. On the cross-bar is fixed a board with ledge to carry a book. This board may, if wanted, also be made movable on a pivot, and secured by a nut as shown. The book is held against the board by cross strings, and may then be tilted to any angle to suit the reader—the clamping nut at the end allowing necessary adjustment. By having one pair of legs movable, the whole thing adapts itself to any unevenness of the bed. The clamping bolt should be firmly fixed in the cross bar either by a pin going through both, or by being tightly screwed into the wood, preferably the former means, the cross-bar end should just extend beyond the pair of legs, and be squared to take a wooden washer with square hole, the clamp nut screwing this latter against the legs. I think the rest is clear enough.

Silke.

A SIMPLE GALVANOMETER.

[27436.]—A SIMPLE galvanometer, which may be of interest to some of your readers, has been described here by Mr. G. C. Sonn, of Newark, New Jersey, and, as I know you are always ready to do anything that may help amateurs, I send you the description and diagrams.

The base is about 3in. in diameter, and about 1in. in thickness. It carries a small pocket compass, set as shown, over a silk-insulated wire, the ends of which are attached to binding posts on the upper side. It is well for the purchaser to test the compass, before buying, with a magnet. Select the one that is swift to obey the influence of the magnet. Then mark out upon the upper side of the base the outline of the compass. With a knife, sink the circle thus outlined ⅛in., as a pocket for the compass. Cut the wood so as to form a bobbin, upon which is wound wire, as shown in the upper sectional view. This should be laid carefully, one end being left for attachment to binding post A, and the wire being wound about the core by passing the other end through the openings, and then attaching it to the binding post, C. About 20ft. of good quality silk-covered wire, of a size between [illegible] and [illegible] is amply sufficient. After the wire has upon the core, there may be attached little care, at its middle, a short piece with a third binding post, B. short circuit of one-half the terminal A or C is con- B. A fine gimlet hole will serve to carry each end to its binding post, where it is best attached to the foot of the post, leaving the holes in the post for other connections. A circular piece of tin may then be fastened to the base, so as to cover the wire, and the whole base may then be varnished or oiled to suit the fancy. The compass may be firmly united to its receptacle with a bit of Chatterton compound or glue, care being taken to set it perfectly level. An instrument thus constructed will be sensitive to delicate currents, and forms a useful galvanoscope for amateur and professional electricians.



Buffalo, N.Y. **J. B. M.**

KEYLESS WATCHES.

[27437.]—IF you have a buttonhole made in the centre of the watchpocket band, and button it to your waistcoat, you will, I think, find the pendant (when sprung on) to be an advantage. The thief, I presume, grabs at the chain, the pendant slips off, leaving the watch in your pocket. I have adopted this method of securing my watch, and find no trouble with it. You are not obliged to always keep the pocket buttoned; but if you do, it can be unfastened in a moment. If this method does not prevent your watch being stolen, leave it at home. But perhaps someone can suggest a better method.

Nomen.

[27438.]—I CANNOT understand the difficulty Christian Lange finds in winding a keyless watch. Keeping the large bow between his fingers, he can turn the milled boss just the same as if the bow were not there. And if he chooses he can turn down the bow, and then it is as much out of his way as if it were off entirely.

However, I quite agree with him in the latter part of his letter. The bow being merely snapped on, and depending on its spring for its hold, is a source of great danger. I have often had the bow of my watch detached, and on account of this, I doubt whether I would now purchase a keyless watch, if I required one.

However, I think this objection might be easily met, by attaching the bow to a small ring that would fit just below the milled boss. It is rather a reproach to the watch trade to have the bow so insecurely attached as it is at present.

J. Rawlins.

[27439.]—IT would certainly seem that the bows of ordinary keyless watches are not to be trusted. If I remember Mr. Lange's arrangement right, it cannot be applied to an existing watch, but the latter must be "built that way" to begin with. To those who already have an ordinary keyless watch, I can recommend a small dodge I have used for years. This is a small piece of chain with a sort of screw swivel at each end; total length 2½in. One end is attached to neck of watch below bow, the other to chain just above swivel. Of course, the plan is not so good as Mr. Lange's, but as a makeshift it is cheap and, I think, efficient.

D. G.

SHOULD WE EAT SALT OR NOT?—A CURIOUS LENS.

[27440.]—I SEE that Dr. Allinson has been writing again on the subject of salt being unwholesome, and I wish to mention to your readers that in Vol. XL. most of his statements were disposed of by various correspondents.

I suppose his recent article in the *Weekly Times and Echo* is a set-off to the German professor's statement, which lately appeared in some of the papers, that if you eat salt enough you may defy disease and live to be ninety.

In looking over an old cabinet containing odds and ends, collected probably over the better part of a century, I found a square lens, very neatly mounted in horn, somewhat like a watchmaker's glass. The lens was not merely an ordinary lens cut square, but its faces were parts of a cylinder, the lower face being at right angles to the upper one. The size was rather over 1in. square, and the focus about 4in. I found to my surprise that it defined well as a magnifier, and gave a very clear image when held in front of a sheet of white paper.

If any of your readers have seen anything similar I should be glad to know the probable date of its manufacture and use. From the high polish of the glass and the neatness of the work, I should say that it had been made by an optician.

Lasant.

DECIMAL COINAGE.

[27441.]—It seems clear from Mr. Goschen's answer to the deputation from the London Chamber of Commerce last week that he, at least, has no present intention of doing anything to introduce a decimal coinage—the one point in the system in which, I suppose, our duodecimal friends would admit that there is some advantage. I was surprised to learn, on the authority of Mr. Samuel Montagu, M.P., that out of 69 provincial Chambers of Commerce 68 had passed resolutions in favour of decimal coinage. The object of the deputation was to urge upon the Chancellor of the Exchequer the necessity of conferring upon our country the advantages of decimal currency which every foreign country already possessed, and they were sanguine enough to hope that they would receive his assistance. There were five principal reasons for the adoption of the decimal currency—first, that every foreign country in the world possessed a decimal currency, and some of the British possessions (Canada, Ceylon, and Mauritius); secondly, that no country which had once adopted the decimal system of currency had retraced its step; thirdly, that the mathematical education in our schools would be simplified by the use of the decimal system for measuring values, and consequently the period necessary for education in the elementary schools would be shortened; fourthly, that experience proved that in business houses in decimal-using countries considerable time was saved in calculations both for home and foreign business, while transactions between countries using the decimal system were rendered uniform, and an economy of labour therefore resulted; and, fifthly, that the British currency might be placed upon a decimal basis with a *minimum* of change by decimalising the pound sterling. The sovereign would be equal to 1,000 mils, the half-sovereign 500 mils, the crown 250 mils, the double-florin 200 mils, the half-crown 125 mils, the florin 100 mils, the shilling 50 mils, and the sixpence 25 mils. Then it would be necessary to have three new coins—viz., the dime, equal to 10 mils, the half-dime, equal to five mils, and the new farthing, equal to one mil. If the Chancellor of the Exchequer hesitated on account of the working classes, it might be permissive for two or three years; but the Chambers of Commerce and the bankers and merchants would adopt the decimal system as soon as the new coins were issued.

Mr. W. Crawford, delegate of the British Chamber of Commerce in Paris, stated that he had been face to face with the practical side of the question for the last 25 years, and could testify to the saving of time and trouble effected by the use of a purely decimal system. The advantages of it were so great that he had recommended the practice by his friends in England of doing all their mental calculations in pence, setting down the value, however large, of each line in pence instead of in pounds, shillings, and pence. He read a letter from the accountant of a Belfast house, which now made its calculations in this way, testifying to the saving of time, the simplicity of the calculations, the diminution of liability to error, and the facility of detecting errors. Our manufacturers were spending large sums to bring the machinery of their factories to the highest pitch of productiveness; but we had done as yet nothing to improve that mental machinery by which we made up our costs and prices, and this should be no longer neglected in these days of ever-increasing competition. One of the impediments to familiarity with the decimal system in Great Britain was the way in which it was taught. In England it figured after the compound rules instead of following the four simple rules done by decimal notation, as it logically should do.

Several other representative gentlemen spoke; but Mr. Goschen, while recognising the importance of the question and the status of the Chambers of Commerce, said that the change, even if it commended itself to the Government as a desirable change in itself, could only be carried with the great consensus of opinion throughout the country. The changes which it would involve in most of the smaller transactions of life were so great—it would involve such enormous alterations in the prices or the mode of calculation for nearly all commodities and all transactions—that he thought no one could deny but what there would be an immense inconvenience. That inconvenience might or might not be outweighed by the advantages which the change would confer; but he was quite certain, and he was sure many members of Parliament would agree with him in this, that a legislative measure for the introduction of decimal coinage could only be carried in Parliament after it had penetrated *the general sense* of the country that such a *change was desirable. The deputation had*, said Mr. Goschen, advanced in a very clear manner two advantages as being mainly involved in the change—namely, a saving in the educational processes of the country, and, on the other hand, that greater simplicity in our transactions with foreign countries which they believed would further our international trade. They had also spoken of the simplicity of bookkeeping, and everybody must acknowledge that that was an advantage which would certainly be derived from the change. Those were the main advantages which they had put forward—a saving in the cost of the education of children and greater simplicity in international trade. He would admit both those advantages to a certain extent. He thought that a case could be made out, though not to the degree to which some of the speakers had gone in that direction, but he thought that the advantages should be acknowledged. He must say that he did think it somewhat Utopian that out of five millions contributed by the State a million would be saved by the children ceasing to learn our own system of coinage, because they would still have to learn a great portion of their common arithmetic, they would have their weights and measures and a vast number of arithmetical operations to perform; and that this one point connected with the pounds, shillings, and pence in the calculations involved should represent one-fifth of the total education given to the working classes of the country seemed to him, he was bound to say, a somewhat exaggerated statement.

Mr. Samuel Montagu having said that what the deputation would like the Chancellor of the Exchequer to do would be to issue a proclamation, similar to that about the double florin, Mr. Goschen replied that to adopt a decimal coinage by proclamation would be a revolutionary step, for which he should be very soon censured by the House of Commons, and he thought the deputation, while realising the advantages of the change, would find great difficulty in persuading others who realised the immense changes that would be necessary if the suggested alteration in the coinage were enacted. They would have, in the first place, to change the whole system of administration, the rates, and the duties of every article—for instance, 3d. an ounce upon tobacco—and all these questions, when they came to fractions, would have to be changed; the penny receipt stamp, the penny postage, and the tariff of many associations would have to be changed. The question of savings banks would be extremely difficult, and they would have to accustom the working classes to a change in prices. In the case of Germany, they have passed to the decimal coinage. Very considerable stress had been laid upon this fact, and that the change had taken place in other countries. In the case of Germany, Mr. Montagu knew that the Germans had passed through an extremely long discipline as regarded complicated coinage before they came to this system. All the small States had got coins of their own; all the adjoining German States had got different systems of currency, so that the Germans had got a system so detestable and so complicated that it was a relief to return to the decimal system. He confessed that that did not afford a fair analogy to the change from our comparatively simple system to the simpler system of decimal coinage. In the abstract most persons would admit that it would be desirable that they should have the same system as they had in other countries, and he admitted that for the foreign commerce of the country it might be a matter of considerable importance, and also that educationally great advantages might be gained; but they must convince not only the Government and the House of Commons but the public to a greater extent than had been done before any Government would propose such a change as they advocated.

That, then, is how the matter really stands. The Chancellor of the Exchequer admits the advantages, but cannot hold out much hope until the country is converted. Now, what have our Duodecimals to say about it?—for with decimal coinage we should soon have decimal measures.

J. T. B.

ELECTRIC LIGHTING.

[27442.]—As there appears to be a good deal of interest taken in the above just now, I inclose a copy of an actual estimate for lighting up a moderately large private house by electric light. It is so arranged that there will be practically no variation of pressure on the mains. It will be noticed that there is an apparent discrepancy in the statement of current; that, in fact, 13 ampères are allowed for in calculating resistance of mains and 14 ampères odd are taken to drawing-room. This may be accounted for by the explanation that the average current was taken, and that when the drawing-room and dining-room lights were on, the bedrooms were not, or only one or two. Accumulators also are not allowed for because of the small current given by the dynamo (15 ampères), and in the present instance they would probably receive little or no attention for weeks at a time. The estimate does not include labour, carriage, or such odds and ends as lead pipe, &c. It should also be mentioned that the installation was never carried out, as it is only an estimate of what the cost would be if the owner fitted it himself. It is given in detail so that the quality of the fittings may be judged. Everything is of best quality. Criticisms are invited.

Estimate for lighting house of ten rooms and offices by electric light without an accumulator:—Extreme length of mains, 120 yards; current (average through whole length), 13 ampères; maximum variation allowed 1 volt, and total res. from engine room to end equal ·077ohm, and res. per 100 yards ·061, nearest size according to list, ·066 actual res. ·0792 ohm per 120 yards. Price, £6 10s. Stranded $\frac{7}{14}$, class E, medium insulation, 1s. 1d. per yard.

Service leads to drawing-room supplying dining-room and balcony.—Maximum current, 14·3 ampères; maximum variation allowed ·25 volt, res. ·0175, length of branch 20 yards, res. per 100 yards ·0875, nearest size ·085 per 100 yards, actual res. ·017 ohm, size $\frac{7}{13}$. Price, 10½d. per yard. Total price, Class E, No. 793, £3 15s. 20 yards of No. 783, Class D, twin wire, No. 16 B.W.G., at 5d. per yard for outside lights on balcony. Price 8s. 4d. 30 yards, Class C, twin wire for indoor lights, No. 16 B.W.G., No. 773, at 3d. per yard. Price 7s. 6d.

Service leads supplying kitchen and two bedrooms equal 4 ampères.—Total fall allowed ·25 volt, res. of branch equal ·0625 equal ·313 ohm per 100 yards, nearest size ·354 ohm, res. of branch equal ·071 ohm, variation about ·28 volt, length of branch 20 yards, Class E, No. 790. Price 5d. per yard. Total cost 8s. 4d. 20 yards of Class C twin wire for these lights, No. 773. Price 5s. 30 yards of Class C twin wire for lights upstairs and odd lights on ground floor, 7s. 6d.

Details of installation.—

300ft. of double continuous casing (deal) for $\frac{5}{8}$ leads	£3	0	0
32 lamps at 5s.	8	0	0
32 switches at 2s.	3	4	0
1 main switch 30 ampère	0	15	0
1 main magnetic cut out with alarm bell	1	5	0
32 single-light (branch) fusible cut-outs in hard wood	0	16	0
3 single-light brackets (ornamental) for drawing-room	3	15	0
3 crinkled opal shades for above	0	16	6
1 ornamental three-light pendant for dining-room	5	10	0
1 ornamental one-light bracket to match	1	5	0
4 crinkled opal shades for above	1	2	0
1 ornamental bracket for hall	1	4	0
1 globe for above (opalescent)	0	2	0
1 plain pendant (by conductors) for kitchen	0	5	3
1 opalescent shade for above	0	2	0
2 plain brackets, without shade, one each scullery and larder	0	7	6
1 common suspension light for engine-room	0	4	3
1 engine (steam or gas) about 3I.H.P.	90	0	0
1 dynamo, 16-light	25	0	0
Foundation rails and tightening-screw for above	2	0	0
1 link-band	2	0	0
1 five-gallon oil-can, with plug-cock to draw off oil	0	15	0
1 oil-feeder, copper spout	0	2	6
Total prime cost	£163	7	8
Spare Gear (advisable).—			
1 spare armature	£12	0	0
Spare commutator	2	15	0
	£14	15	0
If driving by gas-engine, heavy flywheel on dynamo shaft	5(extra)		
Light in pantry, bracket and shade (opalescent shade)	0	7	6
Also large 12-light cut-out, 10s., to protect drawing-room branch.			
Fittings for Bedrooms and Passages.—			
8 plain brass brackets for shades, at 7s. 6d.	£2	12	6
8 opalescent shades for above, at 2s.	0	16	0
Ammeter and voltmeter	17	17	0

Govan. **Engineer.**

SAFETY SADDLE.

[27443.]—"Eos" seems to have used a safety-latch, invented forty or more years ago, and now in general use on saddles. Its defects, of not releasing with a forward fall, or with a leg pulling the leather over the opposite side of a saddle, have led to many subsequent patents, some of which release the leathers from the saddle when a horse rises for a leap, causing accidents to riders.

The inventor of the safety-saddle has made practical trials for years of every new invention relating to saddle-bars, as they are called, and has found none free from the fault of partial action, or too easy a relase, causing a rider to lose a stirrup-leather if a horse rears or plunges with a rider on his back.

Steeplechaser.

HARRINGAY PARK ACCIDENT.

ɪ1.]—"NUN. DOR.," p. 345, seems to want a ꞙf self-acting railway, made so that a driver run past signals. It looks well on paper, will not do. If a driver will not obey , I say, Protect him against himself most ly by taking him off the engine. A man on't obey signals is not fit to be a driver. tretton, all railway men, and the Amal- ıd Society will all agree with me. If a man n the wrong line, and against signals, he ake what comes, and, if he kills people, he o to prison, and very proper too. **Loco.**

RAILWAY COUPLINGS.

15.]—"ROVER," p. 345, 27405, goes to the ottom of the coupling question when he to know the use of self-acting couplings. are no use. Give us an ordinary three-link hat can be lifted up and put over the next y means of levers or rods, and gear without going between; give us a good non-automatic ıg. **Shunter.**

16.]—YOUR correspondent "Rover" makes ıertion in your last issue that "non-automatic ıgs are better than automatic ones," but I ly think it would be better not to come to ty a conclusion on that point. As an ex- n shunter and an old railway workman of rable experience, I happen to hold quite a nt opinion, and would say that, other things qual, the automatic coupler would give the t facilities to railway working. "Rover" o think that if you have to walk down a to put an automatic coupling out of gear, ght as well have a non-automatic coupler, ıple all the waggons you would otherwise ith it. But I think that if he were a guard ter, and had his choice of which of the two s he would work with, he would see reasons ring his opinion, and would be impressed e fact that it is much easier and more ex- us to walk the length of 30 or 40 waggons one of the couplings out of gear than it be to couple on every waggon he came to. are other advantages which the automatic can claim, and which "Rover" seems to ut of account, but I will reserve them for a occasion if needed. **W. F.**

17.]—THE remarks of "G. W. M." (27404) he point. Besides this difference of 5in., I e another 2in. might be added for trucks, s I have seen with the beam, forming or g the buffers, bent down on each end like ı. This clearly shows one of the great diffi- to contend with in making a coupling, as n. possible difference in height, allowance e made for at least 10in. play in coupling. leased to see "Rover" (27405) also agrees he primary importance of a standard buffer; , a new coupling is quite out of the question e buffer has been established of a standard

n't say my coupling is perfection (I don't it is possible to make a perfect one); still, ls the requirements. The remark regarding ng out the back of a carriage is, of course, ss, as the buffers would have to be crushed es before such a thing could happen. I quite see the force of the objection regard- ggons in a siding. If they are intended to pled on, they would be left with coupling- n place, if not, links would be put out of ; or, in my arrangement, the locking-piece e simply placed out of gear, and the link enter and leave without coupling. There en so much mystery about these couplings ng, that any light on the subject is interest- The majority of the "Nine Elms" contri- were highly unsatisfactory, and it would be to see drawings of a good simple automatic ıg in these pages. **Silke.**

RAILWAY BRAKES.

18.]—MR. KIERNAN (27401) can't change a 1in. pipe is only one quarter of the area 2in. pipe—everyone knows that; and if l of wasting his time trying to prove non- -for, after all, what has pressure to do with contents?—Mr. Kiernan would answer the questions put by "Loco.," we should all feel ened. Why are these questions shirked by iters who understand everything about the ı brake? Why?

Kiernan may put figures in any way he likes; b. air pressure will rush *out* of a 1in. pipe ess time than 15lb. vacuum pressure will *to* a 2in. pipe. It is a law of nature that it so. Then a pressure brake must get on a vacuum; this is borne out by every trial h the *two* systems have been subjected.

aps some of the vacuum people will be kind to enlighten my benighted mind as to the why the Midland dare not trust the vacuum brake down the Lickey incline of 1 in 37. The Westinghouse with perfect safety can be trusted, and works with every satisfaction down 1 in 25 for great distances on the Union Pacific Railroad, and on the Denver and Rio Grande, thus for ever silencing those who say it cannot be graduated. This is what the Westinghouse can do. We only need go to Lickey to find what the vacuum cannot do.

I am somewhat at a loss to know the meaning of "Lowmoor's" letter (27402). I rather think he is talking the sheerest humbug. Really, you have, say, two vacuum engines on a train; one driver (the first, say) is destroying his vacuum, the second is running with the ejector blowing. Why, of course, he would recreate the vacuum, and the train keep on running. It's all nonsense to say anything else. No doubt, "Lowmoor" has been in charge several times when two engines have been coupled together, and never found any difficulty in applying the vacuum brake, because the driver behind applied his at the same time. As to the rest, it's the merest bosh; they have quite recently got the Westinghouse brake on 50 cars in 1½ second. **Rover.**

CONTINUOUS BRAKES.

[27449.]—MR. KIERNAN (27401) remarks justly that I did not take into account the fact that the brake-vans are provided with automatic valves; but I think that I have proved, all the same, the inferiority of the automatic vacuum brake, as far as quickness of action is concerned. However, I have looked through my calculations again, and I find that the volumes of air to be admitted under the piston of the vacuum brake were much below what they should be, and that in consequence thereof there was no foundation in Mr. Kiernan's statement, that to put the vacuum brake fully it is necessary to admit less air in the train pipe than is required to remove from that of the Westinghouse, to produce the same result. Therefore, I beg to submit to the readers of the "E.M." interested in this question fresh and more complete calculations. Not having had the opportunity of hearing or reading Mr. Kiernan's lectures, it will be understood that all the dimensions given below may not be just those which are found in practice, but they are sufficient to prove what I have advanced before.

Contents of the Westinghouse brake apparatus:—

1in. pipe	3,770c.in.
½in. pipe	75c.in.
Triple valves	216c.in.
Total for 16 vehicles...	4,061c.in.

Under normal circumstances—that is to say, with a normal pressure of 75lb. on the square inch, there are stored in the above 5 × 4061, or 20305c.in. of air at atmospheric pressure.

Now, to apply the brake fully, we reduce the normal pressure by one-third. We, in other words, remove from the main pipe one-third of 20,305c.in., or 6,768c.in. We found in our previous calculations that the mean speed of the escaping air at 75lb. was 267ft. per second, when we assume for the pipe the dimensions given. We also found that to remove 15,080c.in. from this pipe it took 1½ seconds—therefore to remove only 6,768c.in., the time required will be $\frac{1{\cdot}5 \times 6768}{15080} = 0{\cdot}7$ second, a result which is below those obtained in practice, for reasons already given.

Now let us turn to the automatic vacuum brake. We have for the cubic contents of the apparatus:

Two-inch pipe...............	15,080c.in.
Cylinder connecting pipes	106 ,,
Space under pistons	14,448 ,,
Total for the 16 vehicles	29,634c.in.

With a vacuum of 21in. mercury, there remains in the apparatus $29{,}634 \times \frac{30-21}{30} = 5{,}890$c.in.—that is to say, to put the brakes fully on, we must admit in the apparatus 23,744c.in. of air at the atmospheric pressure, or 3½ times what we let out of the Westinghouse pipe. Now, in the pipe in question, the air will rush with a velocity of 130ft. per second, a velocity which is less than the one I had before, as here the vacuum is 21in. mercury instead of 24in.

The time necessary to put brakes fully on will be in this case, $\frac{23{,}744}{3{\cdot}14 \times 130 \times 12} = 4{\cdot}8$ seconds; nearly seven times the result found for the Westinghouse brake.

Now it is evident that the use of brake-van automatic valves will greatly reduce the time of application. But seven such valves would not make the automatic vacuum as quick as the Westinghouse, because the action of these valves is not instantaneous: a certain time must elapse before those nearest to the end of the carriages begin to work properly. In a train of 16 carriages there are not more than three brake vans, at least in this country. All this proves clearly that the best way to make an automatic brake quick in action is to adapt to it triple valves, or some sort of exhaust valves. The history of continuous brakes in this country is a disgrace to the majority of railway companies. Whereas, on the Continent and in America we see the Westinghouse brake introduced everywhere, or, in its stead, some congenerate forms of this system, we find in England, a country which is so much in advance of other nations in many respects, a regrettable obstinacy in keeping and adhering to systems which practice and theory prove to be far off the requirements of safe railway working. Of course, under usual circumstances, the automatic vacuum is efficient enough; but there are still some points with which it does not comply, the principal one being the quickness of action, and I defy Mr. Kiernan to render this brake as quick as the Westinghouse. In case of emergency, seconds are precious, especially when a train is moving at the high speeds which are customary in this country.

Practical data on this subject are still wanting, and official trials are the only means to obtain them. I do not know whether it is possible to brake fully a train of 30 carriages with the automatic vacuum system. Perhaps Mr. Kiernan would kindly answer this question. The trials at Burlington, U.S.A., proved the immense importance of simultaneity of action of all the brakes on a long train. **Ed. Gobert.**

7, Ducie-street, Longsight, Manchester.

[27450.]—I AM pleased to notice that both "Loco." and "Rover" have fully explained that the Westinghouse brake can be recharged without releasing the blocks from the wheels. There is no question that a vacuum pipe of 2in. diameter has a contents of four times as much as a 1in. Westinghouse pipe. It seems to me to be altogether wide of the mark to speak of pressures, because pressure can have nothing to do with space or contents; and even if it had, the point, I take it, is to get brakes "on," and an air brake is "on" before a vacuum brake.

Several objections have been raised to vacuum brakes, but Mr. Kiernan does not reply to any of them. None of your correspondents seem to mention that when the air is let out of the Westinghouse brake-pipe it does not blow to waste, but is now turned direct into each brake cylinder, which applies the brake in much less time.

I am at a loss to understand what "Lowmoor Driver" can mean. The Westinghouse, he says, is "an efficient train stopper," but not "a graduating brake," yet on same page there is evidence given that it *graduates* for 30 miles down 1 in 25! **Engineer.**

SOME EXPRESS RUNS.—VI.

[27451.]—LAST week Mr. Stretton mentioned the M.R. Company not trusting the vacuum brake down the Lickey incline. The trains are compelled to stop at both the top and bottom, involving a loss of about five minutes to the expresses. The run over the section quoted below I made in May last, No. 1299, and 10 coaches:—

		H. M. S.	Speed.	Remarks.
	Birmingham.........	3 14 42	—	due ...3.12
13	Blackwell ......arr.	3 33 20	—	
	,, ...dep.	3 33 35		
15	Bromsgrove ...arr.	3 38 18	—	
	,, ...dep.	3 38 24		
20	Post	3 45 20	—	
30	,, ...	3 56 20	54·5	
40	,, ...	4 7 5	55·5	
46¼	Cheltenham	4 15 30	—	due ...4.16

Trains from the South stop at Bromsgrove for a bank engine. Whilst I am quite aware that it would be unwise for the expresses to dash through at full speed, leaving the bank engine to run out after the train and catch it up as soon as the gradient began to tell, I see no reason for compelling the train to come to an actual stop just for a couple of seconds, as is the case now.

It would be quite sufficient if the trains were compelled to pass the station dead slow—say, five miles an hour. The bank-engine would then run out and catch the train at once, and there would be no possible danger, with some little saving of time—it makes a lot of difference whether an actual stop is made or not.

The same remarks apply to the N.W. at Tebay—there is no need to *quite* stop. At Euston, the bank-engine runs out after the trains all day long, and if speed was reduced as I have suggested, it might be done at Bromsgrove and Tebay too.

June 11. **Kappa.**

HAND SIGNALS FOR DRIVERS.

[27452.]—IN view of the accident at Harringay Park (27376), as described by Mr. Stretton for the benefit of "Nun. Dor.," I think you and your readers will agree with me in saying it is high time this practice was put a stop to wherever fixed signals are in use. I have now in my eye a case wherein a driver was fined seven shillings and sixpence for mistaking a hand signal at Skipton under very peculiar, though to him plain, circumstances It only requires a little firmness on the part of the. drivers, backed up by the support of papers like the "E. M.," to bring about a better state of working. **Rover.**

LATHE MATTERS.

[27453.]—Thanks to "G. W." for his description of the watch-lathe chucks. The system has been applied in America to small "engine" lathes up to 4in. centres. The chief advantage of the spring wire chucks appears to be that you get no overhang. I think that small screw on the inserted screw is unsuitable for securing a face-plate. Here I wish to confess that in spite of the care with which I have turned out the "sacred orifice" that takes the centres of my two lathes, grinding it out with a brass lap to get it round, and then correcting it with a scraper by hand; yet if the chucks I fit in there or the centres turn round, I always feel it. I cannot get that hole true, and I begin to think that it can't be done. If any of your readers will put in a long centre, or fit in a rod of brass, say 4in. or 5in. long, then turn it half-round, and try it, I think they will be unpleasantly surprised. All this puts one out of conceit with cone fittings, unless with the cone there is also some means of preventing the cones from going together in any but one angular position. Mr. Newall has written very wisely of cone fittings, and I should be much interested to know how he would true out the hole for centres in an unhardened mandrel. I suspect he will say you must mark your centres and mandrel, and put them in always the same way that you turned them up. As good as saying, you can't get the hole so true that you won't feel it if you turn the centre round. It was partly to obviate this difficulty that I suggested the wedge fastening on page 177, and the other principal reason is that by that plan you have the possibility of *trying the fit* without any screw to interfere with the fitting together or with the centralising power of the cone.

I hope that as "O. V." and "Bow" have been able to prove a slight theoretical defect in Niblett's apparatus, they will also be able to show how it can be obviated according to Mr. Pocklington's suggestion. Referring to the arrangement suggested by "A. F. S." for bringing up the treadle, I agree with "Lonley" that the friction of that eccentric would be fatal. But why not pass a band round it and a pulley hanging at the bottom of the spring?

I have the "proper screw-cutting lathe," referred to by "One Deeply Interested," but find it a clumsy thing for short screws in brass, and no use for wood: for such work I use the traversing bar, one of the devices he seems to despise.

I am much obliged to Mr. Seal for kindly criticising my variation on his design. If he finds it best to keep the cylinder hot, I suppose that must be so, though I don't see why. **F. A. M.**

MILLING, WHEEL-CUTTING, SLOTTING, &c., IN LATHES.

[27454.]—As soon as it was possible after my letter (27361) on above subject appeared in your issue of the 3rd June, I received communications from several tool-makers and others describing various attachments, all of which were ingenious tools each with its own special advantage. I had hoped to hear also from some private friends who had lost sight of me since I changed my residence, or whom I had lost sight of from their doing the same. I feel very much obliged to the tool-makers who have sent me descriptions of their various lathe attachments; but I shall only refer to those which do the work referred to in the title of this letter. The tool-maker I referred to in my letter of the 3rd June was good enough to send me a photo. of a very nice, compact, milling machine which reached me just after I had sent off above letter to you. As I was anxious to have a tool I could use on my lathe for milling work on the mandrel or between the lathe-centres, I wrote to him to that effect, and he sent me a photograph of his machine for milling from the slide-rests by the overhead, which seems a nice arrangement; but I could not see from the photo. how it could be applied to my slide-rest; but, in spite of this, it appears more like the tool I want than anything else I have heard of. Another tool-maker sent me a photo of a very nice attachment for doing the work comprised by the title of this letter; but as I wrote him it had to me the fatal objection of being driven by a pair of bevel wheels from the lathe mandrel—the lathe ceasing to be of any use but motor of the attachment. If one could afford to have a lathe on which it could be permanently fixed, I think it would be a valuable addition to many workshops, as it appears to be a similar arrangement to that attached to the end of his lathe and described in one of the early volumes of the Mechanic by "J. K P." I also received a drawing of a gear cutting machine from the Britannia Co., Colchester, which I fancy would have satisfied me if I had not previously been in communication with the tool-maker referred to in my first letter.

I have an attachment to my lathe for planing, which I got from Mr. Lee; but I found it a nuisance to mount and dismount, and have mounted it on a frame of its own with a special arrangement for driving by hand. It does very well for very light work, but is too springy to take a good cut; if you want it to work truly your cut must be a mere scrape. When I put it together I shall have a drawing made and send you.

Wm. Skues, M.D.

17, Linden-grove, near Peckham Rye.

THE CUSHMAN CENTRE PUNCH.

[27455.]—In Northcott's "Lathes and Turning," page 73, edition 1868, will be seen an illustration of centre punch, nearly the same as "Cushman." I made two from above book, a large and a small size; but it has since been much improved. I bought one two years ago with the indent punch held up by a spiral spring, so that at each stroke the punch touches and jumps back; they are dear. I could have made this tool for half the cost; it is constantly figured in tool catalogues. **Eos.**

THEORY OF MACHINES.

[27456.]—I would draw your attention to either an error of description or an oversight in the article in your issue of the 10th inst., "The Theory of Machines," by F. Campin, C.E., p. 334, in reference to the reversing motion, Fig. 49; in the 7th paragraph of first column, it reads:—"By varying the sizes of the wheels *g* and *e*, different velocities may be given for the different directions of motion."

The wheels named being simply idler wheels, cannot alter the speed, as they get their circumferential speed direct from the driver, and can only return the same circumferential speed to the driven wheel at the end of train, whatever their sizes may be, or however many wheels there may be to convey the motion, if driven direct from the same circumference. A train with an odd number of wheels runs the last one in the same direction as the first one, and with an even number of wheels runs it in the contrary direction. The driver and driven wheels being determined of a size proportionate to the speeds required, the intermediate ones can be fitted in any diameter or any number to suit the circumstances without altering the speed determined upon by the first and last wheels, direction being determined by the odd or even number of wheels in the train. **Saml. Stansfield.**

THE WATER OUSEL OR "DIPPER."

[27457.]—This interesting little bird of amphibious habits prefers alpine streams, and I always considered it shy of human intercourse until a late occurrence has proved the contrary. There is a rocky brook (or beck) near my house swarming with trout-fry and minnows; this is spanned by a timber bridge for a roadway, connected with a railway, along which heavy mineral trains of great length constantly thunder past, over a low iron bridge, shaking these two bridges and everything else in the vicinity like an earthquake. The station stands near, with great traffic, and continual shunting, smoke, and noise. Under this metal bridge a pair of water ousels, for some strange reason of their own, built a nest early in this season, which remained undiscovered till my boys (always hunting for rare eggs) espied it, with a brood of half-fledged nestlings therein. Though these were frequently handled and examined, it did not disturb the arrangements of the family, for the young were reared and have flown. I have now taken possession of the curious nest—externally an ugly mass of dry moss, bound together with dry grass and earth; it is very deep, and smooth inside. Near the bottom, *at one side*, is a second smaller nest of neatly-coiled grass and dry leaves; the object of this double arrangement seeming to consist in keeping out drip. The whole appearance of the outer covering assimilated with the heaps of drifted rubbish choking the channel of this streamlet, and nobody but a prying schoolboy was likely to think the lump contained a bird's nest.

During my wanderings in the sub-alpine range of Himalayahs, the water ousel was a common roadside companion. I have sat for an hour or more, while smoking the pipe of peace, to watch this playful little blackbird performing his natural feats of dips and dives. The mountain torrent is of the most formidable kind—"a hell of waters," as Byron calls such a spot. This outburst of melted snow has to be crossed by temporary bridges fourteen times in one stage of the journey! Such frail structures of trees and rocks are annihilated by every capricious rise of the flood, and you must wait till the volume of water diminishes, and another crossing is established. The ousels were fluttering and feeding in roaring rapids and surging pools, where no other living creature could swim; the haunches of a dead baggage horse, with one of the camp-trunks on his back, were visible in a foaming hollow between great rocks. A bridge had collapsed, and his melancholy owner (a tourist, like myself) bewailed the loss of £50 in silver coin and a supply of choice cigars as part of the treasure wrecked by the mishap, never to be recovered, except in possible fragments far away from the spot.

I think this nesting fact another confirmation of Darwin's observation that the habits and natures of birds are adapting themselves to the human advances in civilisation and their attendant inventions. Two years ago a blackbird reared its young in my conservatory. The nest was constructed in a tub of agapanthus. The birds did not fear me or the gardener, though our watering-pots frequently touched their bodies. We have many other curious instances here of similar abnormal familiarity in our feathered friends, who have only to fear the hostile house-cats, and seek our intimate protection. **Eos.**

ADULTERATED OLIVE OIL.

[27458.]—I quite agree with "Nun. Dor." that the adulteration of olive oil is not so easily detected as would appear on reading the article in the *Lancet*. Certainly a great deal of skill and experience is involved in detecting the adulteration of which this particular oil is subject to, and any person not well versed in the analysis of oils and fats would find it a very difficult operation indeed.

In the examination of olive oil for adulterants the specific gravity ought to be done, and account taken of the amount of free acid present, as this lowers the specific gravity. It should also be examined by the tests spoken of by "An Analytical Chemist," in his article on the subject in No. 1136, p. 384. In addition to these there are several other most important tests—viz., Hübl's iodine-absorption; Kolttstorfer's saponification-equivalent; Valenta's acetic acid test, and the fusing and solidifying points of the fatty acids. There are also several other important colour tests. I will give one which I have worked with every success; 5 per cent. of adulteration can easily be detected. It is that of O. Bach: 5cc. of the sample is agitated with an equal volume of nitric acid of specific gravity 1·30, and the colouration observed. The tube is then heated for five minutes in boiling water, and the effect noted. The tube is then allowed to stand for twelve or eighteen hours, and its appearance again observed. The following table gives the appearance of various oils at the different stages of the process described:—

Kind of oil.	After agitation with nitric acid.	After heating for 5 minutes.	After standing 12 to 18h.
Olive Oil......	Pale green	Orange-yellow...	Solid
Earthnut oil	Pale rose	Brownish yellow...	Solid
Rape oil	Pale rose	Orange-yellow...	Solid
Sesamé oil ...	White	Brownish yellow...	Liquid
Sunflower oil	Dirty white......	Reddish yellow...	Buttery
Cottonseed oil	Yellowish-brown	Reddish brown ...	Buttery
Castor oil......	Pale rose	Golden yellow...	Buttery

By the time the above-mentioned processes have been gone through some good idea can be formed as to what the adulteration is, after which it can be proved by special examinations.

I think these remarks will show that the detection of the adulteration of olive oil is not such an easy matter as the *Lancet* would have us believe.

As regards adulteration, in these days of keen competition, and when the demand is greater than the supply, resort is and must be made to adulteration. In the case before us, of olive oil, the high price is of course a great temptation; but, fortunately, we are able to grapple with it. It is, however, only comparatively recently that any really good work has been done in the direction of analysis of oils and fats, and what was looked upon as almost an impossibility a few years ago, is now regarded as a more or less simple matter.

Sheffield. **Henry J. Hardy** [illegible]

[27459.]—Arachis hypogæa, or "ear[illegible]tachio nut," in hot countries gives an en[illegible] return to the agriculturist. I found it a [illegible]munerative crop in India, though in Af[illegible]

The oil is very wholesome, and faultless ry: no better substitute for olive oil can It has been used extensively in British both internally and externally. Before ıme in this was a favourite oil for Argand it gives a clear flame, with little smoke. -seed oil, dearer than the last, but equal very purpose: the plant requires a long, er to yield a full crop of seed. Birds are enemies. Poppy oil. Here is a strange e seeds of opium poppy are devoid of or any other noxious principle! The e grains are sold in every petty supply ıghout India as a favourite addition to ff and other edible preparations; all lians like this. It yields much delicious equal to the two above mentioned sorts, cake," or residue of expression, is sought sweetmeat makers and cattle feeders. oil, or "sweet oil" of Hindoo grocers. yielding this staple crop is tall and pro- ousands of acres may be seen in a single My small field was much ravaged by a r, which was eagerly hunted by flocks of ous birds. (I reared some of the pest, and eath's head moths!) This is a cheap and oil in every way for any purpose of those ntioned, and the cake is greatly used for s by the poorer classes. I, too, ate it ıy from puddings and other Christian It is mixed with honey and preserved Iany Englishmen have shared my stock, ed it.

tter" and aromatic oils I need not men- s place. I could always get "real salad I liked, through Gallic friends in Cal- co-operated in a cask from Bordeaux, d it off in black quarts (soon used up in ookery!) **Eos.**

ING—TO "ONE DEEPLY INTERESTED."

—RIGHT you are; *but* that tool is not ed. You now stand on the line which I ı in "Screwmania" some years ago. hand-chaser which can be taken up like hand-tool, but which gives a true lead ıy attachments, gears, cords, discs, screw- Tow set to work with pencil and com- I think and plan as I have done any f times. Evidently the tool requires nce. The nearest thing to the desidera- I can conceive is some form of die stock. ıt be a certain *grip* of the work. Points ıswer. They give no lead whatever. The I think, embrace a good part of the cir- e of the work. Saw a nut in half, hold ıd-vice against a rod of wood revolving ıe, and it will be carried along and indent read. File, with a 3-square file, two or hes across the thread and the indenting ıe, to some extent, a *cutting* operation. a vice, screw into a hole drilled and the purpose a bit of nail rod. Put a the other end, and you make, in a rough ser; but it will not act on a rod over or rtain size—the size of the tap that made you get a hand tool of the chaser kind give a lead, and you can forge a tool form and give it a nicer shape, making ıble. But it is of too limited applica- ıce I have thought that a Y-shaped tool ıld do for several sizes of work might be ı a mortise in the two arms of the same being the shank), and that a pair of dies tted in these mortises, such dies being h desired, and that these acting upon two he circumference of the work would give ıt then how about inside screws, and how hold the fork accurately perpendicular? give this as a suggestion of the sort of ich at first looks promising; but I see its d can "heave half a brick at the stranger" as any one of our critics. And yet I feel Deeply Interested" does, that a hand tool e feasible. Failing a tool that is self- e always have to consider how to guide ool in the easiest, simplest, and most way. Niblett strove hard to keep to a er. It is purely such after the first stroke t still there is the extra fitting with its le drawbacks, specially the long bar. ıar in guides, what results? More stiff- accuracy. But we are one degree further hand tool. So far as I have studied the and few have studied it more) I can see yet equal to the traversing mandrel for and efficiency. With it we use the hand ınd simple, and though we have a screw are almost unconscious of it because in the way—no gears, cords, bar, or any- ıt then look at the cost; and again, how sands of lathe workers have only a plain nd need some guide contrivance! Verily, ıs *asinorum*, only I wish people would hrust the screw-cutting lathe forward, is wholly out of place. Who shoots partridges with an Armstrong gun, or cuts fretwork with a pit-saw? **O. J. L.**

THE DHAO.

[27461.]—THIS is the national weapon, the domestic and agricultural implement, of the Burmese and Assamese people. Homicide, harvesting, hut-building, hunting, and every possible cutting operation is performed with this half-knife, half-sword. In a vast region of virgin forest, no human being can quit the narrow village path without the means of mowing down the natural barrier of cable-like creepers and tangled brushwood, due to rich soil, fierce sunshine, and a rainfall of many months duration; hence, every native you meet either has the ugly blade naked in his hand or suspended from a sling of rattan across his shoulder in a rude scabbard of flat board and cane work. In all my rambles every one of my attendants slashed away ahead, and on either side of me, to facilitate my botanical researches, and in remote places (the hunting-grounds of savages, who announce their presence by a shower of poisoned arrows from an ambush) the plucky pioneer carried his loaded musket in his left hand while he cleared an approach with his right. The cunning wild man had found out the value of a dhao, though the barter of lethal weapons was prohibited by the local government; the savage obtained harmless digging hoes of wrought iron and cut out deadly arrows and spearheads from the ductile metal. On one occasion an avaricious frontier trader, tempted by the amount of bee's-wax and such jungle products offered for a lot of dhaos, parted with them surreptitiously. The horde of tiger-like miscreants returned a few miles towards their mountain retreats, pretending to go homewards, hid themselves in the dense forest, came back again to the vicinity of a thriving village, concealed themselves in a patch of reeds where they could watch the departure of all the men on the next morning, and then dhao in hand, crawled among the huts, where they slashed and killed every grown female, or child old enough to give an alarm, then carried off several infants, tied on their backs, as future slaves. One of these being too noisy, they subsequently slaughtered, and threw down in their retreat! This was only one of their many bloody exploits during '57 and '58, since which cross roads have been opened to intersect their line of approach and cut off escape. For clearing land and making a passage through those dark wildernesses of the N.E. frontier, there is no tool that can equal the dhao; they are manufactured wholesale in Calcutta for the tea planters, being used in preparing the forest lands for cultivation. It astonishes a traveller to see the strange operation of road cutting through virgin forest. The proposed route being chosen by guess (occasionally assisted by a pocket compass) the aboriginal guide mounts the tallest tree in a bee line two or three hundred yards off with a rude drum, which he beats briskly to show the way. Then three or four elephants are arranged in order, covering the desired width of roadway; a gang of labourers on the right and left hand, with a few ahead of the bulky four-footed pioneers, flourish their sharp dhâos; the drivers are similarly armed, so as to demolish the overhanging network of hanging creepers, and pendulous branches. At the first tap of drum, all hands, elephants included, exert all their strength to crash and smash, and cut every green thing in the line; it is very monotonous and fatiguing labour, only varied occasionally by the attack of bees or hornets, or an alarm of the "giant nettles." In the latter case the direction is changed, as neither man nor beast will face this vegetable enemy.

FIG. 1

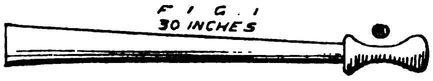
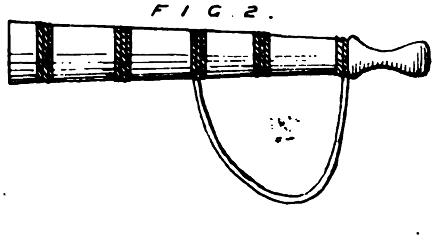


FIG. 2.



From three to six miles may be accomplished in a day, and these cuttings have to be cleared afresh every cold season, as they are choked up anew by the growth produced during the periodical rains. Rattans beset with fishhook spines crawl in lengths of 50ft long. *Dalbergia scandens*, over 100ft., strangles the timber trees; the gorgeous *Thunbergia grandiflora* attains equal length, smothering all its neighbours in an inextricable heap of foliage and flowers, in lands where man has rarely or ever trod the deep black soil, testifying to the decomposed vegetable strata of centuries.

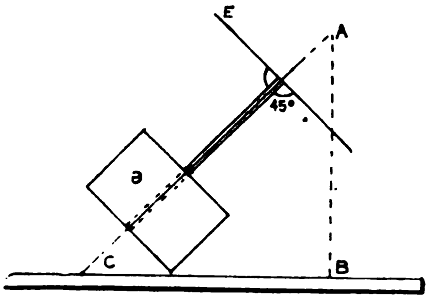
No. 1, dhâo drawn; No. 2, sheathed in flat wood one-sided plaited cane holders, and rattan sling. **Eos.**

COMMANDING THE SUN TO STAY STILL.

[27462.]— "F.R.A.S." has helped me wonderfully in understanding the kinematics of a heliostat proper. I wish this gentleman would also overlook the following hypothetical illustration, and kindly point out where I am wrong.

Supposing we have an American clock, and tilted it at such an angle that the angle formed by the axis of the wheel carrying the hour hand A C, and the normal A B is coincident with the degree of latitude of the place.

The above initials refer to the following diagram, where D is the clock and E the mirror.



Then looking in the direction of the wheel's axis, along C A, we should find it pointed directly to the polar star (assuming the clock had been set geographically north and south), whence the wheel's axis C A would be parallel with the earth's polar axis.

The mirror E would be rigidly fixed, intersecting the axis of the wheel C A at right angles, and, consequently, when the clock is set in motion it revolves the mirror, reflecting the incident solar fasciculus in one constant direction. Is this correct? The position of the mirror is my weak point. A diagram of a simple form of heliostat will oblige. I saw one at the "Inventories" made from an American clock; but, of course, did not understand its details. **Solar Radiance.**

HOW TO ADJUST A TELESCOPE EQUATORIALLY BY DAYLIGHT.

[27463.]—FINDING, as a constant reader of your paper, that there is a large body of astronomical readers and observers, it has occurred to me that a few words on the above subject from one who has had some little experience, single-handed, in mounting telescopes truly might be not only interesting, but also helpful to others, and perhaps novel to some.

I would say, at the outset, that the whole of the adjustments cannot be thus performed; but such a large proportion as to be practically all that take much time can.

Further, this method and these hints may help some who, like myself, have essayed to correctly place instruments furnished with a fixed spirit level which is incorrectly adjusted, and a fixed R.A. vernier which is also out of place, the worry of which none but victims know.

Taking as a summary the six adjustments enumerated in Chambers's "Descriptive Astronomy," which are generally acknowledged as exhaustive, and the instructions for which by starlight are there clearly given, I think it will be found that four, if not five, of the adjustments, one of which, Chambers states, "ought to be performed by the maker," can be satisfactorily and easily done by daylight. Most codes of instructions give as a necessary factor a "striding level," which, as a very expensive instrument and not often wanted, is an item that may, by this means, be satisfactorily dispensed with in favour of a good ordinary spirit level, that can be bought for 1s. 6d. or 2s.

The spirit level, then, is the means by which all is to be done.

First, with the dec. circle facing east, lay your level lengthwise on the body tube, and bring the bubble central. Read the declination vernier; repeat the operation with the circle west, and read the vernier again. Should there be a difference between the two, the half thereof will be the true reading; alter your declination vernier to the aforesaid half-way reading, and it will be correctly set. To make sure that the outside of the body-tube of the telescope is true, the operation may be checked both east and west of the Polar axis by taking the readings with the tube level pointing both north and south.

Next, to get the instrument level (which, if you have a fixed bubble incorrectly placed as mine was, may cause sleepless nights untold). When the dec. vernier reads the same with the bubble central when laid on the instrument pointing north and south, when it is both east and west of the Polar axis, the declination is then horizontal; or if the R.A. vernier be known to be true, the movable vernier that goes with the telescope pointing six hours E. or W., and the telescope itself pointing E. or W. and the level laid on it, the bubble stands central. When the dec. vernier reads 0, the instrument is also level then.

To place the Polar axis at its correct altitude, set the dec. vernier when east to the co-latitude of the place (in Dulwich 38° 33), and when the bubble is central on the body-tube both east and west at this reading, the Polar axis is then correctly adjusted. Of course, to do this, it is only necessary to raise or lower the latitude screw.

Finally, when, with the dec. vernier at the co-latitude of the place, the bubble is central on the tube east and west of the Polar axis, the then position of the movable R.A. vernier will be the true zero, or 0 hours point on the hour circle and the correct position for the index of the fixed vernier.

This is all that is necessary to be done with the level, and all that now remains to do will be to place the instrument in position by means of a star at transit; or, better still, by six-hour stars as described in the textbooks.

The five adjustments referred to will be found to have been all perfected, the only one to be performed by night being as before, the final placing in the meridian of the entire instrument.

In a reflector, any alteration of the large mirror will, of course, at once alter the readings of one or both verniers.

Al Fard.

BARNARD'S COMET (E 1887).

[27464.]—I SAW this comet last night. It is rather faint, but the aspect is somewhat peculiar, and differs from the usual telescopic comet. A bright nucleus equals 10mag., scarcely stellar, with a fan-shaped coma or tail fading gradually away on the N. side. It gave me the impression of a large comet very distant (very foreshortened). It was best seen with about 150. Diameter of coma about 2'.

June 13. **Herbert Ingall.**

LARGE SUNSPOT.

[27465.]—NOTWITHSTANDING the fact that the reputed sunspot period is now about at its minimum, there is at present on the sun's disc an extraordinary large spot, so large as to be distinctly visible to the unaided eyes. I first saw it on Wednesday last, June 8th, when observing the sun with my telescope, not having observed it for several days before. It was then well on the following edge of the disc, and I perceived at once, from its great size, that it would be visible to the unaided eyes, and on looking through a piece of smoked glass I saw it quite easily. I have also seen it in that way each day since, and it is still visible in the same way to-day, though of course, in consequence of the sun's rotation on his axis, it is now getting near the preceding edge of the disc. As seen in the telescope, it is very nearly a true circle in shape, both umbra and penumbra, and the umbra is not crossed by any visible bridges, though it certainly does not present one uniform black appearance, being apparently somewhat mottled—an appearance which I have never been able to distinguish so clearly in any sunspot before with the means at my disposal (3in. across). Close to the large spot, on the southern side, there was at first a group of six or seven very small spots, but yesterday three or four of these had disappeared or coalesced with their companions, leaving only three visible, and these very close together. There was only a very small spot north of the large one, at first just clear of the penumbra; but yesterday the penumbra appeared to have stretched out to a point in the direction of the small spot, and embraced it. Following in the wake of the large spot, but some considerable distance from it, another group of three or four small spots made their appearance on the following edge of the disc on Friday last. Altogether, taking the present display into consideration with other fine displays which have been visible occasionally during the past few months, it would appear as if old Sol were suddenly waking up from his period of minimum activity, and so it behoves everybody who is at all interested in the subject to keep their eyes on him.

Excelsior.

CURIOUS NOISE—EARTHQUAKE?

[27466.]—ON Wednesday evening last, at a little after 7 o'clock, I was somewhat startled at hearing a most peculiar noise. It began with a rushing sound as if a sudden gust of wind were shaking the trees. It being quite calm at the time, I looked in every direction, but could see no indication of the least disturbance. In a few seconds the noise changed to a very deep and subdued roar, and in a few seconds more ended with two or three distinctly separate sounds, with intervals of not more than half a second between each. It was quite impossible to judge from what direction the sounds came; in fact, there was something so peculiar about them that, although they were far from loud, I stopped to listen, and at once came to the conclusion that they were subterranean noises, and made the remark to one or two friends, who also heard them, that we must expect either an earthquake, or that we should soon hear of one having occurred elsewhere. I was certainly surprised to see that neither Thursday's nor Friday's papers gave any intimation of either noise or earthquake, so should be glad to know if any of your readers heard any unaccountable noise at the time mentioned. The report in Saturday's paper of the earthquake in Central Asia on Thursday morning at 5 o'clock, which would be within an hour or so of the time I heard it, quite confirms my idea that the noise was connected with a subterranean disturbance.

Wellington, Somerset. **W. S. P.**

PITCH STRIKER.

[27467.]—IN answer to "One Deeply Interested" (letter 27394), I beg to say that several weeks' absence from England must be my excuse for not having noticed and replied to his former communication to which he refers. I cannot understand why he "naturally inferred" either "that I had something much better," or "could design something." Greenwood himself has "got out a better tool" than the one which is the subject of this query, and even of these better tools he says, "Though a novelty in the trade, they will be of little service to a turner well up in the art of cutting screws by hand; they are not all that I could wish them for the amateur. Having introduced the subject in my book, I felt in a manner bound to get out a better tool, and the above is the best I could think of for self-leading screw tools."

It is too late this week to make drawings for publication in the next issue of the ENGLISH MECHANIC; but I intend forwarding correct drawings of the pitch striker which originated this query, and also of the more recent self-leading tool referred to above. As it is possible that some one else may reply in time for publication with this letter, I shall wait the appearance of the next issue before sending off any drawings.

Goolwa.

WORKSHOP SCRAPS—GLUTEN.

[27468.]—THIS very simply-prepared adhesive substance, as I described many years ago in our "E. M.," is largely used by cabinet-makers and carpenters in India, under the Persian name *Nushisht*, meaning *sitting down*. It certainly *sets* rapidly and firmly, and is superior to glue for many delicate purposes. I think I once described a very highly-finished imitation book, the very best possible resemblance, made by a young carpenter in my employ. It has the appearance of a thick volume, nearly 1ft. long by 3in. or 4in. thick, and 6in. broad, of camphor wood, backed and cornered with ebony; inlaid on each board, an ornamental inlaid escutcheon of ebony and ivory; silver plate engraved with initials. The woodwork is beautifully put together and held by the gluten. Hinges and silver spring secure the lid. When it was finished I gave a light touch with a rasp, and some sprinkling on the parts respresenting the closed pages. I then lettered the title of this sham book by carving in large printer's type, "Letters of a Lady," trying the experiment of colouring some gluten with china vermilion, pressing it well into the hollows of the carving, and when hard, rubbing the letters smooth with pumice stone; finally, a coat of transparent varnish over everything. The work is as sound and handsome as when made 14 years ago, excepting two or three small pieces knocked out of the title by wear and tear of travelling. A companion envelope case, with several compartments, much inlaid work, with feet of ebony and ivory, is made of the same materials as the letter box, and is put together with the same adhesive. Of course, all paper kept in these receptacles has a pleasant odour of camphor, communicated by the wood, and is insect proof. Gluten is made thus: Put a quantity of new and pure wheat flour into a piece of muslin; tie the cloth loosely with string, take it under the tap of a soft-water cistern, let go a gentle stream on the flour, rub and squeeze gently till the water runs clear; then open the cloth, place the gluten on a clean board, beat with a small dry mallet, and turn it over continually till tough and stringy, like birdlime. Use quickly, as it hardens soon.

Eos.

CENTRES FOR SOFT WOOD.

[27469.]—I AM sorry my centres are not old-fashioned enough to please "A., Liverpool." To
understand sketch, imagine two ordinary cen
instead of ending in the usual point, let there
small cylindrical extension, then the point.
the live centre have in addition two prongs.
"idea" is (1) to prevent a large bit of soft
flying away from the centre when the g
catches a knot or projection; (2) to keep
always centred, no matter how far the centre
pushed in; (3) to allow work to be removed
replaced any number of times without running
of truth; (4) to allow a piece of soft wood
fixed for turning by slight pressure from
poppet. The centres are, of course, of "a
usual shape," otherwise they would not have
inserted. To make live centre, take a piec
square steel, forge one end to a lozenge shape
other to a cone; cut (with hack-saw) or file
two deep nicks in the end of the lozenge, tur
cone to fit chuck. Then turn up a cone bet
nicks, as in sketch, and finish prongs with file,
you will find your work well repaid. Tempe
hardly necessary; if anything, it should be bl

Silk

Technical Education in America.—
following comments by the *Electrical Revie*
New York, may be read with benefit by those
are so anxious to promote what they call "techni
education." "A few weeks more, and a new ar
of young electrical engineers enter the field
practical life. They know formulæ and theori
by the page, and can design machinery of ma
descriptions, sometimes making a mistake not
common among old engineers—that of trying
put two pieces of metal in the same place. T
less the real knowledge, the more one is apt
think of one's attainments. So much must
accomplished in a technical course of three
four years that a part is done hurriedly.
practical steam engineer of high reputation
remarked that he had rather face a man with
shot gun, bulldog included, than a recent gradu
with a steam indicator. This feeling—and it is
general one—is not due to jealousy, but to a def
ciency and corresponding self-assertion in practi
matters, on the part of the beginner. This year
graduates ought not to expect leading positions
once. They can learn more in humble places, a
their mistakes are far less likely to disturb oth
or injure their own reputation. In electri
engineering more than in any other profession,
is now called upon to design new machinery a
apparatus. There is always a cheap and simp
design, and many expensive and impractica
ones. Practical experience in the workshop o
will fit one to select out of the many the m
suitable and cheapest method of manufactu
Just as a dynamo builder must know something
current and electromotive force required for th
lamps or motors, so a manufacturer needs a kno
ledge of all that pertains to electricity, if h
machines and other products are to be commercial
successful."

VULCABESTON is the name of a new article, i
tending to combine all the valuable qualities
asbestos and Indiarubber. It forms a substa
of the toughness of horn, although it can be ma
of any degree of flexibility; it is a non-conduct
of electricity, and stands the severest test of aci
steam, gases, etc. One of the most important u
of the new article is as a moulded piston r
packing ring, made to fit any sized rod or stuffi
box, and to be sprung in place with a slight pressu
one or more rings being used as desired, and formi
a perfectly tight steam joint. These rings do no
wear the rod, and they are self-lubricating. Th
first set made of these rings has been in use ov
eleven months, in a Hartfort, Conn., manufacto
on an engine run at 280 strokes per minute, a
is still in perfect order. Vulcanised asbestos pis
rod packing in the form of flexible rope, of all siz
will not shrink or blow out, and is especially
adapted for use on locomotives and ocean steame
and in other places where loss of time in repacki
is of the greatest consequence, and when the u
of ordinary steam packings would, consequently
be entirely inadmissible. In consequence of i
great strength and durability, it can be used where
ever metallic packings have heretofore bee
necessary.

A PAPER on "Magnetic Torsion of Iron Wire
was read before the Physical Society by Mr She
ford Bidwell. This is an account of experi
made on the twisting produced by sendi
current along magnetised iron wires, an
author shows that Widemann's planati
these phenomena—by assuming a differer
molecular friction at the polar and lateral su
of magnetised molecules—is unsatisfactory.
wires were magnetised longitudinally by me
a solenoid in the axis of which the wires were
pended. To obtain consistent results it was fo
necessary to demagnetise the wire between
observations. This is done by reversing currents
gradually decreasing strength, a simple
arrangement of rheostat and commutator devi
for this purpose was exhibited.

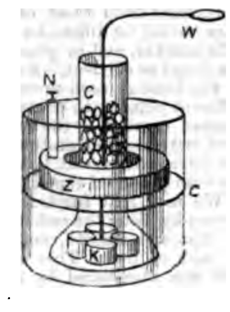
ES TO QUERIES.

*nswers, Correspondents are respect-
mention, in each instance, the title
s query asked.*

monium.—In reply to "Queen"
no use in repeating my previous
ference to this query. I should
place the broad reeds with reeds
, as the latter seem more suitable
nt. The fault is not due to the
ngues. I come to this conclusion
the evidence given by the querist.
ly something wrong with the in-
only a personal examination will
the broad-scale reeds ought to
the narrower ones; but I hold the
former kind of reeds require
pallet apertures, and also more
required by the reeds of narrower
en" would like to know what a
be like in a good harmonium, let
get to hear an Alexandre instru-
lexandre harmonium the bass is
I do not mean to infer by this
re instruments are the only har-
ossess good basses; but I simply
class of harmoniums in which he
o find a good 16ft. bass. In some
lower notes of the Bourdon
ost indistinguishable, being little
ste of wind, with but little result.
ell-made harmoniums such is not
sub-basses in American organs do
out as rich in depth of tone as
The reeds often get the blame,
es in another direction. I cannot,
y far into the subject in these
ueen" thinks the fault lies in the
ngues, he can send the 13 Bourdon
I will set them for him, free of
satisfy him on this point.—G.

timation of N and PO_4 in
)—If you require an approximate
the following is an easy and rapid
pends upon the fact that when
with $CaCl_2$ the nitrogen of the
nd of the ammonia is liberated as
able of containing about half-pint
a narrow delivery tube bent twice
One limb, rather the shorter of
ir-tight through the cork, and is
the end to prevent escape of gas.
nds nearly to the bottom of the
l very narrow short tube is also
he cork, and serves for the escape
cork is introduced. The longer
ery tube dips into a tall graduated
ask is half-filled with a solution of
ne grain of guano is weighed in the
test tube containing a few shot to
ight. This tube is let down on to
the solution in the flask, the cork
e short tube closed with wax. The
o upset the tube of guano, when a
equal to the N evolved is driven
duated tube. The cylinder mean-
d to bring the two liquids to one
plug is removed and the liquid in
allowed to run into the cylinder.
iquid is accurately measured, and
for temperature and pressure; or
nent can be made with a known
nonia, when, if the temperature is
n experiments, no correction need
ad of measuring the liquid driven
tus may be arranged so that the
by adapting a flexible tube from
e small end of a burette, standing
water. The burette is raised as
ted, and the volume read off. If
give fuller details and sketch of
more accurate method is the com-
da lime. The ammonia may be
nined by expulsion with milk of
's method), collect in acid and
ali, or weigh as platino-chloride.
acid, mix 1 part with 1 of sod.
pot. nit., ignite, dissolve in HCl,
ness, take up with HCl dil., filter,
xcess, then acetic acid until phos.
d, add acetate of uranium, filter,
nite, and weigh as uranium phos-
).—SM.

). Batteries.—I extract the
Preece and Sivewright's tele-
I do not remember seeing a sketch
Halske's battery in the "E. M.," I
ith the following explanation, I
uite clear:—A is a glass vessel, K
opper, to which is connected the
V. Over K stands a tube, C, of
ain, having its lower part widened
into this put the crystals of the copper sulphate. The glass vessel is packed as far as C with paper pulp, which in its preparation has been treated with sulphuric acid, and work up into a homogeneous glutinous mass. This is well pressed down, and on it the zinc cylinder Z stands, having a neck N to which the copper wire from the next cell is attached. These cells are used upon the Indo-European line between London and Teheran. The Baltimore is a modification of the Daniel, and has a glass tube reaching nearly to the bottom of the jar for the purpose of supplying copper sulphate. The Eagle battery has a containing vessel of lead, which acts as the negative element, zinc being used for the positive.—WM. ROWLAND HART.



[62236.]—**Sulphuric Acid Bulbs.**—In thanking "F. I. C." for his reply to my query, may I ask him to inform me how the "bulb with a little neck" is made?—A. B. C.

[62269.]—**Turkish Baths (U.Q.)**—(1) A furnace constructed of firebrick, inside joints made with fireclay about 18in. by 4ft. 6in. long, and about 4ft. from firebars to top of furnace (inside measurements), then following the furnace you will require a hot-air chamber same height as furnace, and about 8ft. long, the way from furnace to this should be 8in. by 18in. Then flue round the rooms as far as possible. The furnace and flues should stand 3in. or 4in. from wall of room, and near the floor ventilators should be placed to admit pure air from the outside of building; but you do not say if your hot rooms are to be on a level, or one on top of the other; and also would like to know if the rooms are below or on a level with the roads. You will also get more heat than you require from a furnace of the size given above, with careful firing. Coke is the best fuel to use, the flues will then go longer without cleaning, and as little coal should be used as possible. This should only be about once a week, for the fire should be banked up with cinder-ash and coke-dust at night, with all dampers nearly closed. Then as to amount of coke, I should think one ton per week would be sufficient. I have made a chaldron of coke last a fortnight; but the two rooms were slightly smaller than yours. In reply to your (2) it will depend on the cost of water in your district; in the east of London, I believe it is 6d. per thousand gallons, and as you know the size and number of baths, you can soon arrive at the cost per bath.—BOOTLE.

[62323.]—**Engine Governors.**—I think "Wood Butcher" had better consult the indices, or look on page 159 of the present volume. At any rate, if he wants information he should put a definite question with details of the engine. It does not matter whether it is used for wood or other turning, and as to a "1in. steam pin," some explanation is necessary.—J. T. M.

[62324.]—**Gas-Engine.**—Why not apply to the makers, or procure the specification of the patent?—C. R.

[62325.]—**Joint.**—Yes, asbestos sheet is very good for making joints with flanged pipes. It does not require soaking in oil or water; but the flanges should be bolted together carefully.—NUN. DOR.

[62328.]—**Burnished Plated Goods.**—The directions asked for by "A Perpetual Subscriber" have been given many times; and in this case it would evidently be useless to repeat them.—A. W.

[62337.]—**Air-Pump Valves.**—If by air-pump is meant the pneumatic pump, no doubt the material which "looks like green oiled silk" is exactly what it looks like.—NUN. DOR.

[62338.]—**Removing Surface of India-rubber.**—Remove with glasspaper; but it is not necessary—a mere wipe with a rag is sufficient provided there is no grease on it. If not successful, wash the surface with mineral naphtha.—SAML. RAY.

[62348.]—**Hydraulic Leathers.**—"G. L. C." will find a sketch on p. 227, No. 946, which should be sufficient guide for him. He should get the best oak-bark tanned leather and soak in soft water. There is no secret about the matter, and he ought to be able to invent any "dies" he may require for himself.—SAML. RAY.

[62344.]—**Hand Bells.**—Why not get a set from the pianoforte-makers, of felt-covered hammers. The only way to repair a cracked bell is to braze it; the alternative is to run a saw cut down the crack and drill a small hole just beyond the limit of the crack.—C. K. P.

[62351.]—**Boat Varnish.**—Copal is the varnish generally used by boat builders, and it is, as a rule, applied with a brush. It is not necessary to remove the old varnish; but it is advisable to get as smooth a surface as possible, and for that reason the old stuff is often removed. A quick-drying copal varnish, such as can be bought in Long Acre under the name of carriage varnish or rubbing varnish, is the thing to use.—SAML. RAY.

[62353.]—**Loaded Dice.**—Easy enough to load dice, surely; but not so easy to find members of the Juggins or Mug family nowadays to be sucked in by them.—SAML. RAY.

[62358.]—**Length of Emery Cloth Sheets.**—This querist can have emery cloth of any desired length, but they are not found in commerce except in the ordinary square-foot size, for the simple reason that they are not wanted. No doubt if querist asked for addresses of manufacturers he would get them, and find the makers willing to make anything he wanted.—NUN. DOR.

[62361.]—**Statues in St. Paul's.**—"G. F. Q." asks what certain letters mean over statues in the dome of St. Paul's. Question really is, Are there any statues in the dome, and if so where?—OLD CHAIN.

[62368.]—**Bellows Query.**—This question simply depends on the quantity of air delivered in a given time, and is simply a "sum." Without attempting to make any calculation, which the querist can do for himself, I should say that a double-action 24in. bellows was as powerful as an ordinary 36in. pear-shaped bellows; but it is simply a matter for calculation, and if any of your readers feel inclined for arithmetic they will probably answer the "Amateur Blacksmith."—E. G. M.

[62396.]—**Purification of Mercury.**—I have heard of electrically purified mercury, but I cannot see what advantage electrolysis possesses over distillation. I may be wrong; but it seems to me to be merely a dodge to extract more money from the pocket of the unwary dentist, to whom this mercury is specially recommended.—SM.

[62406.]—**Speeding Leval Separator.**—I have now got my separator running at 6,400 revolutions, and find that Mr. Bull is quite correct; the tone when at full speed is G sharp. This seems to me a peculiar fact, considering that the mass of metal is different in each machine. Correspondents have been so kind in answering my queries, I am tempted to ask another. The power of the horse is transmitted by means of a large spur wheel and pinion working outside the house, and a large spur wheel working on the shaft which leads into the house, and which drives another small pinion; on the shaft of this a large pulley is keyed driving the "intermediate," which again has a large pulley driving the separator. There seems to me to be in this arrangement a great loss of power, which I should like to save. I suppose, owing to the conditions of a horse-gear, the first transmission of power must be by toothed wheels; but I should like to know if I could save anything by substituting pulleys and belt for the second pair of toothed wheels. Of course, there is a vast distance between the 2½ revolutions per minute the horse makes and the 6,500 of the separator, and no better arrangement may be possible; but being only an amateur I cannot be sure of it.—DOCTOR MEDICINÆ.

[62437.]—**Photographic.**—My experience of mercuric intensification is quite different from that of "Solar Radiance." I do not find that the image is strengthened "proportionally" but the reverse, so that "entering into the discussion deeply" would be waste of time. 2. Alum is not recommended by me to toughen the film, but to thoroughly eliminate the silver compounds.—B.SC., Plymouth.

[62437.]—**Photographic.**—I would beg to refer "Solar Radiance" to a letter of mine on "Intensification," which appeared in the "E. M." of August 27th, 1886, page 580. If the statements I made in that letter are correct (and I have never seen them questioned), then "B.Sc., Plymouth," is correct in saying that intensification is the proper treatment for the negative in question. It may be correct to say that intensification strengthens the image *proportionally* in the negative; but if correct, it is only correct in a certain sense. At any rate, when we come to the print taken from the negative, the result is certainly not a proportionate strengthening of the lights and shadows. The result of intensifying a given negative is to produce greater contrast in the lights and shadows in a print derived therefrom; and it is possible with certain negatives to carry intensification so far, that by the time the high lights are sufficiently printed, the shadows will be so black that all detail in them is lost, and this even though the details in the shadows appeared pretty fairly in the original negative, and still more distinctly in the intensified negative. If I have made this clear enough, "Solar Radiance" will perceive that there is no need for thinning the transparent portions of his negative. I quite agree with "Solar Radiance" that this is an important point, and one that is not generally understood; indeed, I have met with one photographer who said he never practised intensification because it intensified the shadows as well as the high lights! This appears to be "Solar Radiance's" difficulty; and I would again refer him to my former letter, where he will find a rule for intensification which I think will be of use to him.—J. MILLER.

[62441.]—**Luminous Paint.**—If Samuel Ray will kindly refer to my answer to this query, he will see that the substance to be painted is glass, consequently it would never do to put neutral base on first, as that would prevent the luminous paint showing through the glass. When wood is to be painted, neutral base is put on first, then luminous, then over-varnish. The neutral base not only neutralises any injurious effects arising from any former paint on the wood; but also helps to reflect any of the luminous rays that might otherwise be absorbed by the wood. I may also mention that I am personally acquainted with Mr. Horne.—WM. ROWLAND HART.

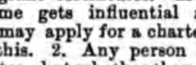
[62444.]—**Bills of Sale.**—The Statute of Limitations would give twenty years from the execution of the bill of sale, presuming it was a deed—that is, a document under seal—and presuming it contained a covenant to repay the money. This period would not be affected by the presumed absence of registration. But the twenty years would run from the last payment of interest, or of running an account, if either of these events happened.—FRED. WETHERFIELD.

[62463.]—**Registration.**—No advantage could be gained by the registration of a "Society for the Promotion of Church Music" under the Companies Acts. It gives no standing, and confers no right whatever to grant certificates. If the society in course of time gets influential and numerous enough, they may apply for a charter, but it is not easy to get this. 2. Any person or society can issue certificates; but whether they are of value or are utterly worthless is a matter of opinion or reputation. 3. I have no experience of the "Literary and Scientific Institutions Act, 1854"; in fact, I was not aware of its existence. 4. The fees of registration are to be found in the Acts. 5. A "Deed of Constitution" should rather be named "Memorandum and Articles of Association."—B.SC., Plymouth.

[62470.]—**Wheels without Flanges.**—No doubt if engines have eight or ten wheels, one pair can well have no flanges; but in the New South Wales engines there are only six wheels, and the middle pair without flanges. Does Mr. Gobert think that is safe? I do not.—LOCO.

[62471.]—**Railway Query.**—If the train consisted of 23 vehicles of 12 tons each, the total weight would be 276 tons, and, taking friction at 8lb. per ton, it would require an engine to exert a force of 2,208lb. in order to put such a train in motion on the level.—CLEMENT E. STRETTON, Consulting Engineer Amalgamated Society of Railway Servants, 306, City-road, London.

[62484.]—**Coil Core.**—In electrical science there is, I think, scarcely anything so little understood as the action of the bundle of iron wires used for the core of induction coils. As in statical electricity a higher charge can be given to a body if it has near it some other body in which it can induce a charge of an opposite nature to its own, so in magnetism a piece of iron will become more highly magnetic if it has near it another piece of iron in which it can induce an opposite polarity. Thus, if we have a piece of soft iron (*a*) surrounded by a coil of wire conducting a current of electricity, a certain amount of magnetism will be produced in the iron *a*. If, now, we bring another piece of iron, *b*, into contact with the end of *a*, then more magnetism will be produced in *a*, because it has something in which to induce an opposite polarity to its own. The wire will also offer more resistance to the passage of the current, and we may go on *ad infinitum*, adding other pieces of iron, as *c* and *d*, and with each additional piece increasing the magnetism *a*, and also increasing the resistance of the wire to the passage of the current from the battery. The induced current produced by the reaction of the magnet upon the wire will be greater in proportion as the magnetism of *a* has been increased by the proximity of the pieces *c* and *b*. Now to apply this to the coil machine: If, instead of the bundle of wires, we place within the coil a thin iron tube, and inside of this another similar tube, the first tube will show at one end, say, north polarity. The second tube will show south polarity induced by the first tube, and a third tube will show north polarity induced in it by the action of the second tube, and so on *ad infinitum*; so that this series of tubes, although strongly magnetic, will have no distinctive polarity, because each tube has a polarity different from those on each side of it. These tubes would be difficult and expensive to fit one within another, and in practice a bundle of iron wires is found as efficient. But as with the tubes so with the bundle: each successive ring of wire is of a different polarity to those on each side of it. The induced current in the coil being produced by the magnetic reaction on the wire, a much greater induced current will result, because a greater magnetism has been produced than if the iron were in one piece. We may still further increase the magnetic influence by filing the ends of the bundle of wires quite flat and smooth, and applying to each end a flat disc of iron. This action of the bundle of wire was discovered by me about 40 years ago. I have no doubt it is known to many others, but I have never seen it mentioned in print.—PEN-Y-VAN.



[62495.]—**Photography—Vague Formulæ.**—Those of your readers who replied to this query on p. 328, may be interested in the following from the *British Journal of Photography*; but I hope that they will not dispute as to which one "managed to escape blunders of a most egregious description":—"Our contemporary, the ENGLISH MECHANIC, recently printed a letter from a correspondent asking the meaning of the expression, 'a ten per cent. solution,' a form of words whose liability to misunderstanding we have before alluded to in these pages. It is, however, quite evident that, whatever practical skill and theoretical knowledge many amateurs and others are possessed of, the knowledge of the application of elementary science to tables of weights and measures is by no means general; for on reading the replies to this particular query we note that, though six correspondents have rushed to the rescue, one only—and he dismisses the subject in a few lines—has managed to escape blunders of a most egregious description. The subject is by no means an unimportant one, and we will, therefore, make a few practical observations upon it very shortly." No doubt the observations will be highly interesting when they appear.—P. J. L.

[62500.]—**Lathe Bands.**—For some time I have used cotton band ¼in. diameter on a 3in. Britannia Co.'s No. 13 lathe, joining it with what sailors call a "long splice." I thus avoid the "thud" of the hooks (of gut bands), passing over the small speed cone; but my greatest comfort has arisen from the use of a tightening or "taking-up" pulley. By a light tightening pulley (running against the slack side of band), almost any strain can be put on the band, and the band can be readily shifted from speed to speed without making one anxious as to whether the band will be exactly the right length for any pair of grooves; but the shape of the groove is of very much greater importance than the diameter of the band. The grooves are nearly always made too flat, or open, and it is very hard to convince oneself in turning them that they are not getting too deep as we work. The groove should be of an angle of 45° M, and this will be found to hold well with scarcely any injury to the band, whether it be ⅛ gut or 6in. rope.—T. F. S. T.

[62502.]—**High-Speed Electro-Motor.**—It may interest "Electrician" and others to know that all the electric lamps (incandescent) in the four main courts of the Newcastle Exhibition are fed from Parson's high-speed engines and dynamos, or rather, steam-turbines and dynamos combined. They are each running, I believe, at about 9,000 revs. per min. I think there are 17 machines in all; but several are spare ones, in case of a breakdown.—G. RALPH, Newcastle-on-Tyne.

[62502.]—**High-Speed Electro-Motor.**—I am much obliged for the information given by correspondents. Would Mr. Bottone kindly describe the principle of the form of motor he recommends? I have looked through some of the later volumes of the "E. M." without finding a description of this form. The work would not be heavy, and would be quite uniform. The axis of the armature must be truly vertical, as the machine driven (about 40lb. weight) would be attached to upper end of spindle, the armature, shaft, and machine being practically one piece revolving vertically. I think a portion of the weight might be taken off the end-bearing by a magnetic arrangement acting in a direction opposite to gravity. Would this arrangement be likely to economise power?—SCHNELLIGKEIT.

[62510.]—**Violin Repairing.**—"Solar Radiance" should have his violin taken entirely to pieces and rebuilt. If this is done by a man who understands the business, the tone will be as good or better than ever. The jarring on the string is probably caused by the side linings blocks being loose. I had my violin rebuilt in th manner and it turned out first-class. With respe to the cost, that depends upon whom you employ if you send it to a "West-end shop" the charg would be about twenty-five shillings, whereas working repairer would be glad to do it for a thir of that price. I had mine done by a man known i musical circles as "Bermondsey Craven," and i cost me eight shillings. I would forward "Sola Radiance" Mr. Craven's address, but I have un fortunately lost it.—OLD KLOTZ.

[62516.]—**Tangent Galvanometer.**—Why no test the accuracy as you wind the coil, or make preliminary experiment? This is easily done b connecting the ends of a long enough length o covered wire to the terminals of a constant battery and then note the deflection with 1, 2, 3, &c., turn round rings, until the deflection reaches 60° or 70° Of course, the current must be run through th whole length of wire, whether there is only on turn round ring or twenty; and the remainder o the wire must be kept out of the way of the galvanometer. The tangent of the deflection should increase proportionally with the number of turns My experience is that with a ring of diameter fiv times length of needle there is an error of 3° whe the deflection has reached 47°. Also that with ring eight times length of needle in diameter th reading up to 40° deflection is as correct as I could read off. A ring twelve times length of needle i diameter is generally considered practically correct I have used a stout brass wire; but a strip of bras which forms a zone of the sphere, having th needle for its centre, is theoretically better. Th mean diameter is also more correct with a stri than with a wire. With respect to the multipl coil, it depends upon how weak your current i and of what potential. You could make the in strument very much more sensitive by winding 10 turns of No. 28, providing that the resistance (sa 16 ohms) would not be a serious addition. If you wa to calculate the strength of your currents in ampère from the reading of your galvanometer, it is usef to remember that in England a single ring 7cm diameter should deflect a tangent galvanometer 4 when the current is about 1 ampère; hence, a rin 35cm. diameter would, perhaps, be more conv nient than a 36cm. ring. A deflection of 45° woul correspond to 5 ampères, and since the tangent 45° = unity it would only be necessary to multipl the tangent of any other deflection by 5 to get th current in ampères. Also 5 turns of wire on th multiple coil of 35cm. diameter would give a d flection of 45° with an ampère current; hence, turns would give the same deflection with just on fourth of an ampère, 100 turns the same deflecti with one-twentieth of an ampère. The reading when using the multiple coil would, therefor want dividing by whatever multiple of 5 th there are turns on the coil to get the current ampères.—A. N. S.

[62519.]—**Length of Throw for 5in. Lathe.** I think S. Grey will notice that I took the to throw when I gave 4in. and 4½in.; whilst the oth correspondents measured to the centre of crank the usual way, I adopted your way of reckoni Can "N. D. F. P." give us the weight of his Holt apffel wheel?—not 140lb., I'm sure; I shou think that much too heavy. 50lb. for a 4in. lat and 80lb. for a 5in. would be about my idea; b if with trav. mandrel, not more than 70lb.—F. A.

[62519.]—**Length of Throw for 5in. Lath** —Practically the only way out of the difficulty to sell the shaft and get a new one. You mig use a back lever on treadle shaft, such as so American lathes have; provided you can bring t shaft nearer the front. In your case the lev would have to be longer than the treadle is fr front to back, so as to shorten the rise. The thr of no lathe-shaft should exceed 3¼in. My 4½ lathe has a 1¾in. throw, so 2¼in. ought to be qui enough for a 5in. lathe.—A. F. SHAKESPEA Lüttichaustr. 14, Dresden.

[62523.]—**Harmoniums.**—As the very b reeds that can be procured can now be purchas for 12s. a set of 61 notes, it is hardly worth t querist's while to entertain the idea of maki harmonium reeds, and I do not think it would p the querist to attempt the job, and very f persons would have the patience to give instructi for making reeds. The best advice I can g "Musical" is to recommend him to purchase reeds and not attempt to make them, and it is a the best policy to buy the best reeds (Esteve's Turban's), and the price is certainly very reasona —G. FRYER.

[62524.]—**Gas Cooking Range.**—If, as "H don" says, the enamel chips off his range, and t is by one of the best makers, the best thing he do is to send to the maker for plates to replace faulty ones, which will be done without charge. certain small percentage of enamels will give in use, and every maker is liable to this. "best" makers supply other plates without cha so that "Hendon's" objection is not a very serious one. When an oven has been once used, the lining cannot be enamelled with any certainty, and the best way is to give the oven an occasional coat of limewash inside.—THOS. FLETCHER.

[62531.]—**Photographic.**—Too much ammonia may have been used in the developer; this would cause a yellow stain. Try ferrous oxalate developer, and you will get quick printing negatives without any stain.—J. LATIMER.

[62531.]—**Photographic.**—I think that the fog or yellowness of which you complain is rather produced by over-development than by anything else. The make of plates, however, may have something to do with it, so if other remedies are unavailing you might change them. If you wish a fine pearly-grey colour I can recommend a soda developer, such as Eastman's. Any formula which has sodium sulphite in it in addition to soda carbonate will do. If sulphite is omitted the action is rapid, and yellow negatives result. With this developer bromide is rarely needed, as the sulphurous acid in the sulphate is an energetic restrainer. Eastman's developer with a *quick*, not a *forced*, development will give negatives which resemble those produced by ferrous oxalate. I think you ought to vary your *pyro* according to exposure. For a normal half-plate I take 6 grains, for under 2 to 4 grains, and for over-exposure I have used 12 to 13 grains before getting printing density. I append the formula for a good soda developer (Eastman's):—

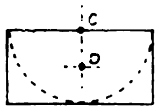
Water (boiling)	16fl.oz.
Sodium sulphite	8oz.
Sodium carbonate	4oz.
Pyrogallic acid	1oz.

Take 1 part in 4 for use. For under-exposure add saturated solution carbonate of soda, for over add 10 per cent. solution potassium bromide. I prefer to keep the pyro dry and add it in proportion of 3 grains to oz. of diluted developer. I hope these suggestions will be of use.—AMATEUR.

[62534.]—**Machine for Slicing Fat Bacon.**—Would not the "Slashing" slicer do (price one guinea) that was shown at the Colonial and Liverpool Exhibitions by Frederic Bapty, Greenwich?—T. F. S. T.

[62540.]—**Photographic.**—With the lens described, which works at $\frac{F}{40}$, an exposure of 2sec. ought to be sufficient for open landscape at this time of year. The fault may be in the development; under-development, or too weak a developer will cause flatness of image.—J. LATIMER.

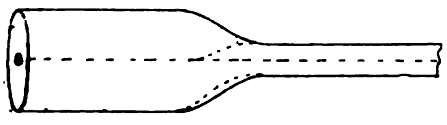
[62544.]—**Half-Round Bits.**—Select steel of section shown in sketch. About ½in. at one end



must be bent up to admit of making the centre C; this end forms the cutting part. The other end is centred at D. For a 1¼in. bit the steel should be 1⅛in. by ⅝in. or ¾in.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[62544.]—**Half-Round Bits.**—I make all the larger sizes in the same way. For a 1½in. gauge D bit get a piece of best 2in. octagon steel, warranted to harden well. Commence by beating down the edges of angles at a mild heat for 3in. or 4in., and work down the long shank, leaving it at least ½in. thick, as smooth as possible, and as

HALF ROUND BIT



straight as an arrow from boss to tip; reduce in the lathe to a size above proper gauge for final finish and fit; with half-round file shape the curves of neck; with large flat file the semicircular part, which must not exceed 1½ diameter of circle. I make mine by the accompanying diagram; thorough annealing without burning, I may mention.—EOS.

[62545.]—**Moths.**—Wrap each article in paper, and see that it is well folded close at all points, so that the female moth (the one that flies about—the "silver-fish" is the male) cannot get at the cloth to lay her eggs. Even newspaper will do if there are no holes in it, or open joints or slits.—T. F. S. T.

[62546.]—**Lunar Drawings.**—This is the way I make my lunar drawings:—If the region to be sketched is simple—i.e., not containing many details, I simply mark on my sketch-book the chief objects of the contour, taking care, by eye estimation, to have them at proper distance from each other and from the centre. I next join lightly these objects by a pencil mark, and then carefully examine if the aspect of the figure corresponds to that of the object to be drawn. Nearly always I am obliged to make corrections. When I am satisfied with the general resemblance, I perfect the contours by adding smaller objects, craters, mountains, peaks, salient and entering angles, &c. I then come to the interior objects, and give to each its proper place and proportions. If there is time I now go over the whole region, carefully watching for the most minute objects I can detect. Some of these require long watching, and many others are often only suspected. To this part of the work I attach the greatest importance, because the real value of a drawing is measured by the number of true details it contains. We must never lose sight of the fact that the smallest objects we can detect from here are still large on the moon, and that it is only among these faint objects we can reasonably expect to find changes. If the sketch is to have a shadow, this is done the very last, on account of its fast rapidly-changing form. When the object to be drawn is large and complicated, I first select the most central object, and, taking it as a centre, I determine the angular positions of the chief objects on the walls by means of a "wire" in one of my eyepieces, and the position circle attached to the eyetube of my telescope. I then compare the distances of these objects to the centre by means of a micrometer of my own making and finish as above. This, of course, requires much more time; but it becomes less and less necessary as the eye acquires the capacity of estimating distances more correctly. I use ordinary paper, pen, and ink, and if there are shadings, they are done either with fine lines or with an ordinary pencil. These sketches are correctly copied in a book as soon as possible—the sooner the better—and it is from this book my drawings sent to "Ours" are made. The dimensions of the sketches are regulated by the amount of details they are to contain. These must be neither too crowded nor too wide apart. There is a tendency to make drawings too small; but a large outline, with simply a blank inside, or nearly so, seems to me very odd. We all need to learn. I hope, therefore, others will answer this query.—C. M. GAUDIBERT.

[62549.]—**Electric Kite.**—In the first place, silk is a bad conductor of electricity; next, how could a kite revolving upon a central axis be made to assume the angle requisite for its ascent, and of what use would its revolving be as relates to the attraction of electricity from the clouds? Finally, is he not well aware that this would be an excessively imprudent and dangerous experiment? I would suggest that instead he might erect a tall pole in some field, attach to this a copper wire with a pointed top to it, and leave a break of, say, 1in. in said wire at, say, 6ft. from the ground, and when lightning seems to be about, to watch the result and report progress.—A., Liverpool.

[62549.]—**Electric Kite.**—Your kite is too small to carry its string; you can make a really good one with Tussur silk stretched on a frame, English shape, about 6ft. or 7ft. long or larger. The natives can draw the finest wire in the world. Very slender copper wire inserted in the twist of the kite string is better than the uncertain condition of a wet line (this is soon dried in the air). When I was a schoolboy our lecturer let go a monster electric kite covered by several sheets of the *Times*, the line armed with stout brass wire. When high up it was fastened to a post, and before long there was a grand smash by a discharge. They are dangerous toys.—EOS.

[62551.]—**Compress Pad.**—A man need not necessarily be a truss-maker to turn out that very simple pad. A toy-maker, one of those small shops where scientific playthings are constructed, would copy it well from that illustration and description in "E.M." Are you quite sure about your injury? Is it so named after medical examination?—EOS.

[62553].—**Printing White Enamel Dials with Names and Numbers.**—A good many processes have been proposed and patented for effecting this. The most successful I know of is the following:—The design or inscription to be imprinted upon the articles is engraved on a copper plate. This is coated with a preparation containing the coloured enamel to be used. A sheet of prepared paper is then placed on the copper plate, and the whole subjected to the action of a press of which the surfaces are heated. The paper on which the design is now printed, is stripped from the copper plate, and made to adhere to the article to be ornamented. Soaking the paper in water allows it to be taken off, the design remaining on the article, which is baked, so as to fix the fusible pigment on the coat of enamel. Designs of any kind can be printed in this way. Another method, which is very reliable, when it is only required to print one or two letters or numbers on an article, consists in using indiarubber stamps. The stamp is coated with an adhesive compound, of which oxidised turpentine is the main constituent, and then impressed on the article. Powdered enamel is then dusted over the imprint, the excess wiped off with cotton wool, and the article baked. This method succeeds best with flat or only slightly curved surfaces. I think it well to say that printing processes only pay where large numbers of identical articles have to be produced. The copper plates are expensive, and a good deal of experience is required. Where only a few articles are wanted, it is best to do them by hand, using the same method as that employed by painters on porcelain. Should Enameller wish to know cost of plant, and where to get it, let him advertise his address in the Sixpenny Column, and I will write to him giving the name of a manufacturer in Staffordshire, who supplied many of the Continental enamellers besides myself.—COPPER.

[62556.]—**Midland Engines.**—I give some dimensions of engine No. 1757 called Beatrice, a given in the official catalogue. Diameter of engine and stroke, 18in. by 26in.; diameter of coupled wheels, 7ft.; working pressure, 160lb. per square inch heating surface: firebox, 110sq.ft.; tubes, 1,150sq.ft. = 1,260sq.ft.; water capacity of tender, 3,250 gallons; coal space, 4 tons. Hoping the above will meet "Loco.'s" requirements.—R. Y. J. E.

[62559.]—**Wooden Platters.**—Use sycamore or holly for these, and make plankways, as they are not so liable to split or warp.—T. C., Bristol.

[62558.]—**Enamels.**—I fear that the subject on which "Viator" asks for information is not one of those which would be of general interest to the readers of the "E.M." A complete description of the process used in enamelling hollow ware, of sheet iron, or of cast iron, would occupy more space than the Editor of our excellent paper might be able to spare. Enamelling iron is one of the most delicate processes I know of, and the causes which give rise to failures and produce goods of second quality are innumerable. I may tell "Viator" that if he intends to manufacture this kind of goods he must be prepared for a great deal of hard work. Unfortunately, there are no books on the subject—at least, of any practical value. Most enamellers are simply working empirical recipes, and find from time to time that matters go wrong with them without being able to determine where the discrepancy lies. I speak feelingly on this subject, having manufactured this kind of goods for several years at the rate of twenty tons monthly. Enamels are in reality boro-silicates of alkaline and earthy bases, to which any colouring oxide may be added, or which may be rendered white and opaque by the introduction of a certain quantity of anhydrous oxide of tin. Enamels vary considerably in composition, according to the metal they are destined to cover, those for cast-iron melting at a much higher temperature than those for sheet iron. Several coats are often required; but in all cases the metal must be first covered with a glaze, which enables the real enamel to adhere. Enamel, as it is usually made, would not adhere to the metal without this intermediate coating, which is generally termed "masse" on the Continent. I think it well to mention that on the composition of this masse, and its proper firing, depends the ultimate success of the whole process. I have been able to produce masse which would adhere firmly to a sheet of iron, even after it was bent double. There are two ways of applying the enamel to the articles to be coated: either by dusting it over them in a powdered state, or by immersing the goods into liquid. The furnaces used are what are called muffle furnaces, the goods having to be protected from the contact of reducing gases during the baking. The furnaces are of large size, and have a sliding door in front. The articles coated with enamel, and thoroughly dried, are arranged on a grating, which is placed in the furnace. The heat cannot be too great;—In fact, the more quickly enamel is fused and glazed, the better and the stronger will the article be. With cast-iron, the time of baking will depend a great deal on the weight of the articles;—in the case of wrought iron from five to thirteen minutes for each coat, according to heat of furnace and hardness of enamel used. The men in charge of the fuanaces estimate the time required by the colour of the grating which supports the articles, and seldom make a mistake. With reference to vessels for batteries, many attempts have been made, but with indifferent success. Very nearly all enamels are dissolved, more or less, by mineral acids, and the coating is thus destroyed. Besides, the smallest pinhole in the enamel will allow the acid to act upon the metal beneath, and cause the whole coating to strip, at least in a great many cases. I made, however, some years ago, some large photographic developing dishes, and these were quite successful. The only difficulty I had to contend with was to get the edges well covered with enamel, so as to leave no iron surface exposed, which would have had an action on the photographic solutions. I hope the foregoing may be of some use to "Viator." Should he wish for more information, and should our Editor be inclined to spare the space, I shall be most happy to assist him. I am not sufficiently convinced that the subject has interest for the majority of "ours," otherwise would have sent a series of articles describing the processes in all their details.—COPPER.

[62561.]—**Turning Wood Boxes.**—There are special tools for such work, cheaper to buy than to make. Go and see them in use at a turner's shop.—Eos.

[62563.]—**Steam.**—The total heat is reckoned from melting point of ice = 32° F. Regnault's formula of total heat of steam of a sensible heat of T° F. is 1082 + ·305 T. This gives a total heat of 1173·84° in the case of steam at 308°; but as the feed is supplied at [illegible] above melting point of ice, the steam receives [illegible]. The engine disposes of [illegible] of steam per stroke in one way or another, and as it makes 48 single strokes per minute, it uses [illegible] per minute. Therefore, [illegible] = the heat units used per minute, and as each unit is equivalent to raising [illegible] high the total supplied to the engine = [illegible]. The engine develops [illegible] = [illegible]; so the efficiency is—

[illegible] = about [illegible]

You will see that tables are not required for this, as pressure has not entered into the question directly.—T. C. Bristol.

[62564.]—**Finger-Board of Violin.**—[illegible] who wants to [illegible] of his violin, might try Le Page's glue, sold in three or four degrees of strength, by Richards, Terry, and Co., [illegible], or, better still, perhaps, Chase's liquid fish glue, sold by the London Paste Co. [illegible] Works, New [illegible]. This stuff will hold nearly anything. Thoroughly remove old glue before trying to make a new [illegible].—T. F. S. T.

[62564.]—**Finger-Board of Violin.**—There ought not to be any difficulty in glueing on the [illegible] of proper glue properly prepared, be properly used. Take good Scotch glue, put it in sufficient cold water [illegible] the day before it is to be used [illegible] make [illegible] [illegible] only [illegible] from one [illegible] without something [illegible] [illegible] as a piece of hard wood [illegible] [illegible] [illegible] [illegible] glue used [illegible] of pressure [illegible] the [illegible].—A. [illegible]

[62564.]—**Finger-Board of Violin.**—[illegible]

[illegible]

[62571.]—**Smoking.**—A very common complaint, arising from torpid liver and indigestion in cold wet seasons. Take two or three simple rhubarb pills during the day, or a teaspoonful of pyretic saline early in the morning; wash the mouth daily before and after meals with dilute "Condy's Fluid"—one teaspoonful to four parts water.—Eos.

[62571.]—**Smoking.**—Yes: there is a thoroughly effective means of preventing the tongue getting sore by smoking—don't smoke. But, lest "Sore Tongue" should think I am merely joking, I would most earnestly warn him of the danger he may incur if he continues to cause the sore. I have heard of two cases in which cancer was brought on in this way, and in one, at any rate, after a repeated operation of cutting away part of the tongue, death resulted.—T. F. S. T.

[62574.]—**Force of Outlet Steam.**—What does this query mean? It will discharge as many pounds weight of steam per minute per square inch of area of outlet as there are pounds pressure above atmosphere in boiler.—T. C. Bristol.

[62575.]—**Bluing Varnish for Steel.**—Take dammar varnish and Prussian blue in the following proportions:—Varnish [illegible], Prussian blue [illegible], mix [illegible] thoroughly, and apply with a camel-hair brush. Makes a splendid appearance if carefully done.—E. St. Mary Church, Torquay.

[62577.]—**Brazing Band Saws.**—This query has been repeatedly answered in the "E. M." The best way is to heat a heavy pair of tongs red hot, and clamp the ends of the saw between the heated surfaces. I should not use a gas blowpipe for brazing band saws.—THOS. FLETCHER.

[62582.]—**Photography.**—The lenses will be of equal rapidity if the same stop is supplied with each is used, that is a stop having the same relation of aperture to focus as [illegible]. But the stops will not be the same size, the lens of longer focus having larger stop apertures.—[illegible].

[62582.]—**Photography.**—The time of exposure will not be the same. Under the same conditions a lens of long focus requires more exposure than one of short focus, but the long-focus lens will give the better picture of the two.—[illegible]

[62582.]—**Photography.**—Certainly [illegible]. To get the same speed the diaphragm must bear the same relation to the focus in the one as in the other [illegible] the measurement from the stop [illegible] between the [illegible] [illegible] will require stop of [illegible] diameter [illegible] [illegible] will have to be [illegible]. Better [illegible] Captain Abney's "Instruction."—[illegible]

[62586.]—**Tour in Norway.**—[illegible]

[illegible]

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "Sm." has answered 62090, "Bootle," [illegible].

[illegible]. Aluminium Steel, p. 137.
[illegible]. Register Paper Roll, 137.

[illegible]. Watch Pivoting, &c., p. 231.
[illegible]. Weighing Machines, 231.
[illegible]. Hand Bells, 231.
[illegible]. Barbotine Work, 231.
[illegible]. Bobbin Making, 231.
[illegible]. Phosphorus Manufacture, 231.
[illegible]. Mirror Galvanometer, 231.

QUERIES.

[illegible]—**Gas-Lighter.**—CLARKE'S PATENT.—Will some kind reader inform me how to connect this up? In taking it apart I omitted to notice, thinking it was a battery, but find it is a small induction machine. Also what the tinfoil that is wrapped round some insulating substance in tube is for? Is it a Leyden jar?—A. G.

[illegible]—**Dead Black on Brass.**—There is a [illegible] in use just now, and sold under the name of Dead Black Varnish, in which turpentine and vegetable black is used. Can any of "Ours" kindly give the recipe for it?—[illegible]

[illegible]—**Welding Hot and Cold Iron.**—In Vol. [illegible] "T. S. A." makes mention of welding hot iron to cold iron. If such a thing is possible, will someone kindly give directions for doing it?—H. P.

[illegible]—**Body Falling from Space.**—It was stated in Sir W. Thomson's lecture at the Royal Institution [illegible] that a body falling from space, such as a star, can only acquire a velocity of 612 kilomètres per second. Can any of your able correspondents say why this is so, and give formula for calculating it?—A. MOORE.

[illegible]—**Daguerreotype.**—I wish to take a daguerreotype, but do not know what exposure to give. The books say three to thirty minutes, for a plate prepared with [illegible], was usual; but one would need to know what kind of lens and stop were used. Would such a plate take about fifty times the exposure of an ordinary "Ilford" plate?—[illegible]

[illegible]—**Engines for Screw Steamers.**—I see [illegible] in engineering papers, that the centre line of the engines of [illegible] does not coincide by some inches with the centre line of the vessel. I should feel obliged if one of "Ours" would inform me whether this is customary in screw steamers, whether it is the fact that the centre line of screw shaft is to one side, or only the centre line of cylinder covers; if so, why, and what calculations are necessary in this connection?—[illegible]

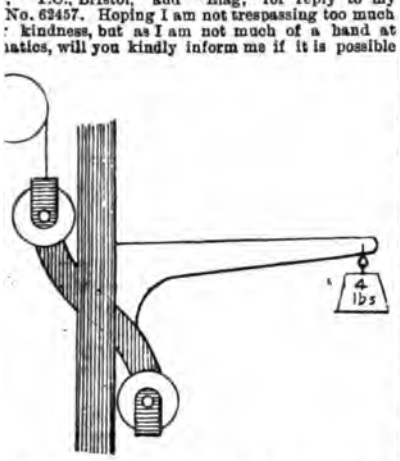
[illegible]—**Water Filtration.**—Will some reader [illegible] would much help in [illegible] water that is impregnated with peat, also what [illegible] would be necessary in surface feet [illegible] gallons per hour of filtered water? And if [illegible] is necessary or advisable?—[illegible]

[illegible]—**Shop Dynamo.**—To MR. BOTTONE.—I [illegible] shop dynamo of Mather-Hopkinson [illegible] having the [illegible] and pole pieces [illegible]. The armature, a laminated [illegible] pole pieces contain the [illegible] as those in the machine described [illegible] the same gauge and quantity [illegible] necessary alterations?—[illegible]

[illegible]—**Turbines.**—I have lately been interested [illegible]. Would some of your correspondents [illegible] information on this subject? As [illegible] power from a given area. Also [illegible] which to strike the radii [illegible] buckets and guide blades. The [illegible] given in "Molesworth" [illegible] are not so easy. I should [illegible] I have just made, the [illegible] be struck from a point on [illegible] is correct then [illegible] compasses to half [illegible] as given in "Molesworth" [illegible] number to the [illegible] 24. Is this [illegible] in "Molesworth" [illegible] when buckets are above [illegible] in Fourneyron turbines; his rule is [illegible] size of wheel, which number [illegible] a very close fit in a [illegible] size of wheel, it ought [illegible]. Also how would [illegible] of opening in turbine, as the width [illegible] being determined by rule, the depth of [illegible] of the quantity of water [illegible]. I am aware that Fourneyron [illegible] and so, perhaps, [illegible] be obliged if your correspondents [illegible] would give me some information [illegible] especially those with [illegible]. I want practical [illegible]. I don't want it buried [illegible]. I may add I have no chance [illegible] machinery, and being away from [illegible] back than [illegible]

[illegible]—**Electrical Connections.**—Would any of [illegible] inform me how I could arrange [illegible] apart (separately) [illegible] signal back from [illegible]? And what battery power e required for same. Is there any rule to find power l according to length of wire.—G. N.

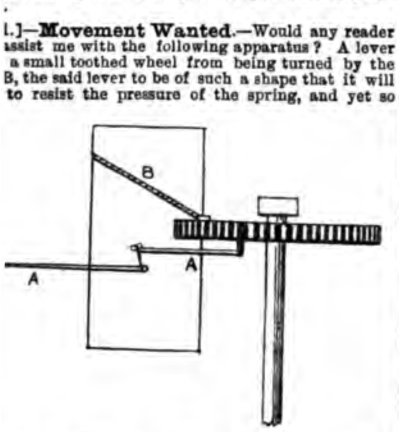
).]—**Leverage.**—Many thanks to Mr. Francis , "T.C., Bristol," and "Elag," for reply to my No. 62457. Hoping I am not trespassing too much : kindness, but as I am not much of a hand at natics, will you kindly inform me if it is possible



on this principle twice that of the descending ? If I arrange the guide pulleys according to this ll it increase the hoisting power and run freely ? of truck and lever 2lb. (including 4lb. weight 6lb.) between guides 1in., diameter of guide pulleys d 6in. apart from centre of axles.—JOHN W. R.

).]—**Steam.**—What amount of cubic feet in would an engine of description below use per hour and engine)? High pressure cylinder 14in., low e cylinder 24in., revolutions per minute 70, d horse-power 120in., boiler pressure 90lb.—A.

l.]—**Movement Wanted.**—Would any reader assist me with the following apparatus? A lever a small toothed wheel from being turned by the B, the said lever to be of such a shape that it will to resist the pressure of the spring, and yet so



e at its free end that an upward movement of will disengage the other end from the wheel, and e spring to pull the wheel partly round say ten I would be very grateful to any one of your readers uld help me with the above difficulty.—HYDRO.

2.]—**Carbon Wire.**—What is 1·00 carbon wire, sed in the paragraph from *American Engineer*, And how many feet was "the whole length of ?"—E. L. G.

3.]—**Seth Thomas Clock.**—Can any clock- tell me whether it is possible to alter a Seth perpetual calendar clock so that it will not make a noise ticking? I find it quite impossible to do rary work with it in the room, and yet the calendar ceedingly useful that I should very much like to going. Is there any other escapement that could ted to it, and if there is, what would it cost to have k altered ?—SIX YEARS SUBSCRIBER.

4.] — **Repairing Cornish Boiler.** — Will rother-reader give a few hints on putting a patch t end of small Cornish boiler, at bottom of front? gle iron ring turns inwards towards tube, and there in. of room between tube and outer shell, and I get to hold on rivets. Patch is wanted 2ft. long. KSMITH.

5.]—**Force of Blow.**—What is the force of a n pounds produced by a body weighing 70lb., through the air horizontally at the rate of 15 n hour, striking a stationary object? Also please le for finding answer.—C. W. W. B.

6.]—**Dutch Language.**—How do Dutch pro- ui, as in Uitgang?—WEALD.

7.]—**Small Scale Photography during ege of Paris.**—During the siege of Paris, as e knows, letters, &c., were photographed on an ely minute scale, and the resulting photo. de- d (as a film one would imagine) by means of carrier . Wishing to make some experiments in this f photography, I have sought information, and other sources have consulted about twenty of the umes of the ENGLISH MECHANIC; but all to no . Can anyone give any information as to process ed and general method of procedure? No doubt d be interesting to many readers beside—F.C.T.

8.]—**Pronunciation of the Irish GH.**— the correct pronunciation of the Irish gh? How, ance, should Lough Neagh be pronounced? Ac- to the geography books and general English usage is always silent; but according to Foster's "Physiology and Analogy," it should be pronounced like the Welsh and Scotch guttural ch, only "with voice," as Dr. Foster expresses it. I always pronounce Donaghadee with the gh guttural, and it seems easier to say than by making it silent, but is it right? In a word like Drogheda I can understand the gh becoming so soft as practically to become silent; but I am quite ignorant on the matter (as I find others), and therefore come to the "E. M." Perhaps some Irish reader will explain.—F. C. T.

[62609.]—**Leaky Flume.** — We have a flume for carrying water across a hollow for irrigation purposes, being about 900ft. long, 10ft. wide, and 2ft. deep, built of red wood, and we have difficulty in keeping it water-tight; have tried oakum, but to no effect, as whenever ditch breaks above and flume dries, the oakum comes out of all crevices. Could anyone give us any advice on the subject, as to what would be best to line it with? At the same time, what would be cheapest and most durable. I have forgotten to mention that the thermometer here sometimes is as high as 120° in shade during summer.—GUYBON J. CHAMBERS.

[62610.]—**Lancaster Oval Bore Rifle.**—My rook rifle strips the bullet in firing, so that patches of lead cake on the inside of the barrel. How can these patches of lead be removed? Are they due to the bullet being too large for the bore, or are they the result of the system of boring?—LANCASTER.

[62611.]—**Steam Launch Engines.**—I am told that small high-pressure engines, with piston speeds not much less than 800ft. per minute, are more economical for small power launches than are compounds. The explanation offered is, that in each stroke of the high-pressure engines the clearances are filled with exhaust steam, compressed (owing to valve proportions) up to or near boiler pressure, and if compounding were adopted there would not be enough exhaust left to make this possible, and the loss by filling up clearance with fresh steam would nullify gain due to further expansion. I don't see this, and would be grateful for information and typical example.—SHINY BOOTS.

[62612.]—**The Dynamo.**—On page 72 of Mr. Bottone's book he says, "Coupling up one single lamp to the dynamo presents too great a resistance, so that no light is given off," &c. I find that my dynamo, which is shunt wound, will light one lamp much better than four or six, and with the insertion of a "shunt" I get no current. Will he kindly explain the wherefore of this?—ORMOND.

[62613.]—**Thermopile.** — Will Mr. Bottone kindly describe the thermopile that he mentioned on page 280, of May 20th, Reply 62401, as I should like very much to make one? I have tried to get the back number he mentioned, but it is quite out of print. Will he kindly say what volts it gave, and what ampère, and what c.p. I might expect with Shippey's battery lamps, if I heated it with one or more Bunsen gas burners, burning eight cubic feet of gas per hour each? Please give measurements.—THERMO-PILE.

[62614.]—**Solder for Silver, and the Best Soldering Medium for Silver.**—Will one, or some, of the kindly disposed correspondents of "Ours" please tell me how solder for silver is made? Also what is the best flux to use when soldering silver articles with the blowpipe?—W. H.

[62615.]—**Electro-Magnet.**—Will any reader help me out of my difficulty? I have a horseshoe electro-magnet, which with my battery will lift about 10lb., which is not sufficient for my experiments. Is it possible to get a better result by unwinding the magnet and making two smaller ones with the same wire and attaching them together, north pole to south, and *vice-versâ*, using the same battery? If so, what will be the approximate result?—AMATURE.

[62616.]—**Snake Bites.**—Will "Eos," or some other reader, tell me what is the best treatment for venomous snake bites. Is the poison in all snakes the same?—QUIS EST.

[62617.]—**Noise in Gas Meter.**—Will some kind reader of "Ours" who understands gas meters name a remedy for a wailing noise at each revolution of the drum? It is most annoying to hear such sounds which, in the still hours of the night are heard as if magnified. I use a wet meter, cast iron.—W. HOSKEN.

[62618.]—**Dynamics.** — What is the horse-power developed in a fly-wheel 9in. diameter, and 40lb. weight (all at circumference), revolving at 600 revolutions per minute? A solution will oblige.—SCHNELLIGKEIT.

[62619.]—**Orguinette Music.**—I have a quantity of orguinette music, and English concertina notes. Will any of your numerous readers inform me if it is possible to use the notes, for an orguinette, and how to arrange them?—J. T.

[62620.]—**Keybeds.**—I have a large number of keybeds to make in small pulleys, bore ⅜in. to 1¼in., and 3in. to 4in. long. Could any reader kindly give description for making a machine for cutting them, with sketch?—H. H.

[62621.]—**Fast Paint.**—Is there any fast paint that will resist the action of boiling soap, for painting the insides of large iron cisterns into which boiling soap is run and cooled?—H. H.

[62622.]—**Cement.**—Could any reader give me a receipe for a cement for uniting flat work to a face plate on lathe when it cannot be held by screws, &c.?—PUSS.

[62623.]—**Clock and Sun-Dial.**—Would "E. L. G." kindly send drawings with the direction to make this dial horizontal and vertical as promised?—B. R.

[62624.]—**Tennis Court.**—Will some of your readers give the relative expense of forming an asphalte and a concrete court, also experience as to wearing?—J. I.

[62625.]—**Water Gauge Glasses.** — Could some reader give a description of a handy way of cutting the glasses for water gauges for boilers? I understand cutting them with a file, but it is a very slow process.—A STOKER.

[62626.]—**Telescope.**—I require a good telescope to enable me to read the colours of ships' signal flags at distances up to about 14 miles, and an inverting eyepiece for use with the same instrument for inspecting the moon and planets. Can any of your readers kindly suggest the most suitable powers for the purposes named?—W. JAMES.

[62627.]—**Faulty Gas-Burner.**—I occupy offices over a warehouse, and burn gas from the same service, also off the same main pipe which supplies the whole building. I instructed my gas-fitter to put me in two Argand burners over my central office table: they gave an excellent light, but they fluctuated up and down to such an extent at times that it became wearisome to the eyes. "Water in the pipe, sir," said the fitter, and proceeded to disconnect every pipe, blow through them all, and put a few siphons (as he called them) in, and tried it again: result as before. "Try a Wenham lamp," I said. This I have up now, and, if anything, is worse than the Argands. The most extraordinary part of the affair is that there are Wenham lamps under my office burning perfectly steady. There is no water in the pipes I am satisfied, and the fault is not in the meter, for I have had that changed. Can any of our readers who are gas engineers solve this difficulty?—JOHN SHELDON.

[62628.]—**Critical Velocity of Rotation.**—Can anyone give me the formula for calculating the critical velocity of rotation of a symmetrical revolving body? What I mean is this: Is there a formula for computing the greatest rotational velocity a body may attain without flying into pieces? This question has been suggested to me by the fact that grindstones, when rotated too fast, break into pieces. This, of course, is due to the centrifugal tendency overpowering the force of cohesion. Now is it possible to mathematically state the greatest speed we may give a body (I only refer to symmetrical ones) so as not to cause its disintegration.—PHILOMATH.

[62629.]—**Equatorial.**—Being about to construct an equatorial mounting for an 8½in. reflector, I should be very glad of advice as to which is the easiest form for an amateur to make, whether Browning's pattern, Grubbs, or the form illustrated in "Ganot's Physics." I have no opportunity of seeing a properly made one, so should also be glad of any information as to the size of the different parts. The tube is of iron, and weighs complete with mirror, &c., about 40lb. I intend making it entirely of metal, as I have access to suitable tools, lathe, &c., and may mention that I have made one for 4½in. telescope, which answered very well—after a design of my own. Should the divided hour-circle be clamped to the hour axis and revolve with telescope when following a star with screw motion, or is it stationary? If the former, should the worm act on outer edge of hour-circle?—W. S. P.

[62630.]—**Substitute for Small Glass Bottles.**—I am wanting to fit up in small quantities (ounce say) fluid carbolic acid to include in packages of other ingredients. Will some reader kindly say if there is anything cheaper and less bulky than glass bottles and corks, and where obtainable? Where in England can the paper bottles, spoken of in May 27th issue, p. 120, be obtained? Any reader willing to furnish information not admissible in "Answers to Queries," will find my address in "Addresses" column.—CARBOLIC.

[62631.]—**Call Bell to Acoustic Telephone.**—I have a good deal of trouble in calling attention by knocking, and want to fix electric bells to same and shall be obliged for a few hints. The distance is about 500yds., but the wire is very fine. What length of cotton covered wire should I have on the bobbins for magnets of bells, and how many small Leclanché cells will be required? And what is the best method of connecting same?—TELEPHONE.

[62632.]—**A Platyscopic Pocket Lens.**—What is it, and, if a compound lens, how is it built up, and in what respect is it better than a common pocket lens? How are the eyepieces for use with the micro-objectives constructed of the new optical glass made? I refer to those that are stated to give about the same amount of amplification, with the objectives, as the objectives without any eyepiece.—A CONSTANT PERUSER OF ENGLISH MECHANIC.

[62633.]—**Amalgamating Gold.**—What part does electricity play in this? How is it applied, and what is the theory of its action? In some recent processes—Molloy's for instance—I have heard that a dynamo is used, and would be greatly obliged to anyone for practical details. A list of books on the subject would also be acceptable.—IONA.

[62634.]—**Leather Stain on Cloth.**—Can anyone say what will remove from grey cloth the stains caused by the leather straps of a knapsack, plus perspiration? Benzine and ammonia have failed.—MATHETES.

[62635.]—**Winchester Repeating Rifle.**—Have any accidents been reported from weak breech mechanism? The full force of the explosion is received by a simple breech pin, which in its turn is held rigid by a linked elbow of steel. If the small pin which holds the elbow were to snap, the whole of the breech mechanism would give way, and the head of the firer be in danger. With 40 grains of powder, the strain is not much; but I should like to have a practical gunsmith's opinion as to whether charges of 76 and 85 grains are well within the capacity of this rifle.—WINCHESTER.

Metallic Cement for Stone.—The following metallic cement for repairing broken stone was, according to Professor Brune, of the School of Fine Arts, used in the restoration of the colonnade of the Louvre, of the Pont Neuf, and of the Conservatoire des Arts et Metiers. It consists of a powder and a liquid. The powder.—Two parts by weight of oxide of zinc, two of crushed grit, the whole intimately mixed and ground. Ochre in suitable proportions is added as a colouring matter. The liquid.—A saturated solution of zinc in commercial hydrochloric acid, to which is added a part, by weight, of hydrochloric of ammonia equal to one-sixth that of the dissolved zinc. This liquid is diluted with two-thirds of its bulk of water. To use the cement, one pound of the powder is to be mixed with two and one-half pint of the liquid. The cement hardens very quickly and is very strong.

English Mechanic
RLD OF SCIENCE AND ART.
RIDAY, JUNE 24, 1887.

COPICAL ADVANCES.—XIX.

Royston-Pigott, M.A. Cantab.,
.R.A.S., Memb. Roy. Coll. Phy-
Fell. Cambridge Phil. Society;
Fellow of St. Peter's College,
ge.

tions, Ancient and Modern.

H Wollaston and Fraunhofer
) both discovered dark lines in
ffraction spectrum, it was not till
they were recognised as hiero-
f an unknown language teeming
icant meanings. It was Kirchoff
red them with the diffraction lines
by terrestrial bodies which, if in-
displayed brilliant fine lines in
ositions where sunlight displayed
k lines. Kirchoff thus furnished
a for interpreting not only solar
ose emitted by planets, nebulæ,

pendous discoveries made with
spectra before long stimulated
fforts to apply the new analytic
microscopic advances. It was
fore prisms were applied also to
scope. The Browning - Sorby
is capable of displaying the
diffraction spectra of human
though only a single blood
presented, 1-3,000th of an inch
.[*] An instrument which can
rius *sodium*, *magnesium*, *iron*, and
slit 1-300th of an inch, convey-
of light to a set of prisms, may
ise minute microscopic objects
r of 1,000 diameters.
the most delicate objects ever
the D lines of common salt. Mr.
nade for M. Gassiot an instru-
ted to Oxford.[†] We saw this
p into brilliant lines separated
terval of one 4-millionth of an
n the centre is seen a very much
indicative of nickel, which is ten
r in breadth than the interval
ed.
ost curious fact that telescopes
of sets of prisms of considerable
w here is a case where a slit in
1-300th of an inch is magnified
ms into a diffraction spectrum
the actual enlargement being
40,000 times nearly.[‡]
lorious and exhaustive researches
fer on diffraction spectra, and
ards invented by Sir J. Herschel,
l at first sight but little left to
ut the microscope, I suddenly
pened up a new vista of dif-
f unexampled beauty and
Fraunhofer embarked on his
ith a telescope magnifying a
t 41ft. away, with a power of
microscope, as glasses went on
y powers rose at last to 1,000
with great perfection of defi-

then that microscopic diffrac-
of *known objects* revealed their
racery and accuracy of form.
iments were commenced about
rkened room. In scrutinising
rformance on double stars, dif-
s, alas! are too often wholly
y inclement skies or tremulous
icroscopic system of exploiting diffraction is independent of the weather if brilliant artificial light is employed within doors and at night, or sunlight by day.

(*a*) My first observation of a microscopic diffraction ring from an artificial star 10ft. away gave (25 years ago) the cue for a long research. The star was miniatured[*] as perfectly as my means then allowed. This miniature was then observed with a variety of power. *A large spurious disc appeared accompanied by a single bright broad ring.* In order to determine the size of the spurious disc, I constructed a plate with a very accurate series of punctures (blackened with platinum chloride) in pairs, gradually widening, thus producing double stars of various intervals when placed before the lamp 10ft. distant.

(*b*) *One pair exactly produced large spurious discs in contact.* This gave me data for calculating the precise spurious expansions of the minute apertures. The diffraction ring was absurdly broad, though bright. Here was a new fact for microscopic diffraction.

The questions occurred: Was this expansion due to diffraction only, or also to uncorrected aberration? The glasses then employed in miniaturing and observing were discovered to be afflicted with grave optical errors, though then unsuspected.

(*c*) Subsequently Messrs. Powell and Lealand converted "a very fine" 1-16th into an immersion 1-20th; also a "fine" 1-8th. Employing the 1-16th immersion to miniature the flaw doublets, a drop of distilled water being attached to the fronts, I was amazed with the apparition of a fine double star, separated by an intensely fine black division in place of *large* spurious discs in contact; *the new discs, however, were still spuriously large.*

(*d*) The lamp and apertures were made gradually to approach the microscope; the image discs began to separate. It was evident that the precise distance at which they first divided gives for different glasses a measure of residuary aberration. If, now, the small spurious discs could be imagined to diminish to points, the limiting value of the lateral aberration would give 1-52000th of an inch,[†] an error fatal to the observation of any body smaller than this. With these immersion lenses all the illuminated apertures or artificial stars appeared sharply cut and planetary, surrounded with a very true black ring, supplemented by accurately formed diffraction rings, which enlarged and glowed with prismatic colours both within and without the sharpest focal image, forming concentric intersections, displaying coloured pencils passing either to or from their finest point of focal combination where colour should be destroyed. These diffraction spectra were most surprising to me. Of course, the diffraction spurious discs were still about four times larger than a true miniature.

(E.) It then occurred to me that a ready method of showing whether the observing microscope was *over* or *under-corrected*, was a great desideratum. (1) Removing the front lenses at once displayed the signs of over-correction. (2) Replacing them and withdrawing the back combinations produced the signs of under-correction.

Wire gauze was then placed before the lamp (10ft. away).

(1) *Over Correction.*—The image no longer resembled gauze at all. Strange appearances above the best focus and a nebulous fog below it, declared the signs of *over-correction.*

(2) On the contrary, *under-correction* was declared, by fog above and false images below, the best focal image.[‡]

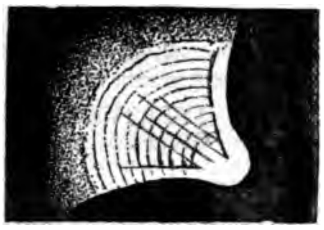
It was immediately seen that with the complete glass working the "screw collar" developed precisely similar effects—false images above or below the best focus. It follows that when an observer is viewing a compound object, he will produce false images above or below the best focal plane, according as the glass is *over* or *under-corrected.* These I have named *Eidola.*[*]

A great variety of objects were thus by miniature examined; gauze 80 meshes per inch. Goldleaf[†], by transmitted light, displays apertures extremely minute.

Splendid diffractions are given by glittering particles of mercury illuminated vertically by a prism. An ivory thermometer scale engraved 24° per inch with fine lines about 1-1000th thick, beautifully illustrated these points.[‡] Even when everything was most carefully corrected, any well-defined structure always displayed false images on each side of the best focus—i.e., above or below.

It follows from these experiments that when a structure consists of two super-imposed strata in such close proximity as to come within the optical limits of the *eidola*, the false images of the lower stratum are liable to be confused and commingled with the true images of the upper stratum, when the objective is *over-corrected*, and, when it is *under ctrrected*, the false images of the upper are confused with the lower true images of the lower stratum.

This was lucidly demonstrated by using a closely-folded gauze before the lamp, when of course two layers of gauze were finely imaged, displaying very occult phenomena of diffractions, especially when assisted by my "aberrameter" fixed behind the observing objective, and armed with centra and peripheral stops, giving almost every degree of angular aperture to the observing microscope. The diffractions peculiar to each central beam or peripheral zones could thus be examined with rapidity and be reproduced with certainty.



The diffractions attending a minute particle of mercury placed in sunshine have been used for a very long time as tests. There arises an oblique diffraction burr. Dr. Goring and Pritchard used this burr in constructing their primordial achromatic glasses. The former spent about £80 or £90 in the construction of a fairly good *one-inch* objective by Tulley.

My system of miniaturing introduced new elements of scrutiny. The globule was reproduced in miniature on the stage, and the celebrated *burr* at once gave up its secrets. (A more advanced term, *coma*, became fashionable.) This mercurial burr under oblique illumination with a high power showed the nature of the diffraction with unmistakable accuracy as in the figure, which, after all, is a miserable production for testing the finest glasses. Diffraction rings, both for telescopes and microscopes, have maintained their incomparable value now for above half a century. New heliostats will also be described in due course, of surpassing brilliancy of effect, without the necessity of a darkened room in bright sunshine. Remarkable mercurial burrs are omitted in this article.

(*To be continued.*)

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kes, F.R.S.

size would inclu le about 2,500 miles of

[*] By using objectives as condensers.

[†] In my paper on "High Power Definition," *Tr.* Roy. Mic. Society, Dec., 1869, 1-50,000th was given.

[‡] Ascertained by reducing the objective aperture by rotating diaphragm placed at the back of the observing objective.

[*] *Philosophical Transactions* R.S., p. 597, Vol. II., 1870.

[†] Many of these perforations, much less than 1-50,000th of an inch, so small that no human art could accomplish them.

[‡] A fine 1-16th miniatured the ivory scale perfectly.

IMPROVED PLATES FOR TRANSPARENCIES.

IN photography there is a peculiar charm which very few other pursuits offer in the hands of its numerous followers and experimenters. There is always something new cropping up. This gives an extra interest and pleasure to its devotees. The novelty may not be of much importance—a simple change in a well-known method, or a new combination; but it offers new effects, which please. One of these minor changes has been carried out by Marion and Co., of Soho-square. For some time past this firm have been producing plates for transparencies, known under the name of Cowan's chloride plates. The emulsion has now been coated on ground glass; thus beautiful effects can be got by contact printing from negatives either of portraits or views. Glazed into windows, or shades for lamps, or hung against the lights, the effects are most pleasing, and photography appears at its best. The architects, house decorators, and builders should certainly turn their attention to the great possibilities for decorative purposes that these transparencies offer. This firm has also recently perfected the well-known Britannia plates, so much used for making negatives. Marion's new factory at Southgate, a very large and spacious erection, is entirely devoted to the manufacture of plates and other photo novelties. The Britannia plates now manufactured there have been greatly improved, the coating of emulsion is far thicker than ever on the most expensive plates, and they have the much-desired quality of vigorous negatives, whilst securing all the delicacy necessary for the full printing of half tones. England, at any rate, stands pre-eminent in the production of photographic novelties and processes, and whilst there are enterprising firms to assist in the working out of new ideas and to popularise them, there is every probability of the continuance of this satisfactory state of things.

MAYALL'S IMPROVED PHOTOGRAPHS.

SO much has appeared recently about photographs in colours and photography in natural colours that it may be of interest to give the real nature of the processes adopted. We have already (p. 334) given the details of one of the processes, and now describe that of Mr. J. J. E. Mayall, which has for its object the production of permanent photographic impressions, coloured or uncoloured, on any suitable material. It is unnecessary to explain to our readers that the real "photography in natural colours" is as far off as ever, and it is satisfactory to note that the misleading description has been dropped by one of the syndicates or companies which recently attracted attention by its aid. In Mr. Mayall's invention a negative is taken preferably by electric light, from which a positive is printed on paper, porcelain, or other suitable material, prepared as follows:—

For paper, a weak solution of gelatine and lactate of iron in about the following proportions, is used—viz., two grains of fish glue or isinglass to one-sixteenth of a grain of lactate of iron in 1oz. of water, the whole being boiled, and subsequently filtered. The paper, after having been immersed for about three minutes in the above solution, is dried and smoothed; which may be done by placing it between blotting paper, and submitting it to a slight pressure. Then float the paper thus prepared for about two minutes in a bath composed as follows — viz., to about 1oz. of albumen (preferably that taken from fresh eggs). four grains of chloride of sodium, half a grain of bromide of potassium two minims of glacial acetic acid, and one drop of a concentrated solution of some derivative of silex, or of hydrocarbon, of which salicylic acid is very suitable; the whole must be beaten up into a frothy mass, and allowed to settle for about 12 hours. Any tints may be given to this mass by adding the desired colour dissolved in a saturated alcoholic solution in the proportions of about one minim of alcoholic solution to about 4oz. of the albumen solution above described, and one minim of meconin, or *its derivatives*; the whole is then beaten up *and allowed to settle. After floating*, the paper *is dried by slow heat and ironed* on the back to make it perfectly dry and smooth. A bath is prepared of nitrate of silver and nitrate of soda and free ammonia in the proportions of about 1oz. of water to 40 grains of nitrate of silver, 10 grains of nitrate of soda, and three minims of free ammonia, and, when pliability of the paper is desirable, 5 drops of glycerine per ounce of bath solution are added. The paper is floated face downwards on this bath for about two minutes, and then dried in a dark room, after which it is fumigated in an atmosphere of ammonia for from three to five minutes, and is then ready for printing upon in the ordinary way. The prints, after fixing, must be soaked in a weak solution of sulphuric acid to expel any trace of the hypo-sulphite of soda, and well washed. The printed impression in a moist state is then mounted face uppermost on a piece of glass or skeleton frame, and when dried, the desired colours are dabbed on by suitable means and slightly stumped. The dabber found suitable for this purpose is a pad of fine cotton wool pushed through a glass tube so as to protrude therefrom, and cut square and even at the end. This cotton wool must either be renewed for each colour, or a separate dabber kept for each colour. After the colours have been applied, the paper is rendered impervious to moisture by dressing its back and front with some such substance as white wax or paraffin or camphor, the print being sufficiently warmed for the purpose of the application of the wax. The colours must be stronger than are required for the final effect. The picture is then sprayed over or subjected to an atmosphere charged with a weak alcoholic solution of salicylic acid or some derivative of silex or hydrocarbon, paraffin, or of any preparation of fluorine dissolved to set the colour, and then it is subjected to the action of finely-powdered soluble glass by placing a powdered silicon in a suitably-closed chamber provided with shelves and fitted with bellows so as to blow the silicon powder into a cloud. The coloured picture is put on one of the shelves to catch the fine dust of the silicon for a very few seconds, after which it is taken out of the chamber. The picture (face downwards) is then laid on a plate of glass coated in the following manner:—After having rubbed the glass with a dabber of any suitable material, as a ball of cotton wool covered with leather charged with powdered silicon, it is coated with collodion to which is added one drop per ounce of salicylic acid, and when dry recoated with gelatine and salicylic acid in about the proportions of one drop of acid to 1oz. of gelatine. After drying, the surface of the print is moistened with some hydrocarbon, such as paraffin or kerosene, to which is added a few drops of salicylic acid in the proportion of about two drops of salicylic acid to the ounce of hydrocarbon, and, when sufficiently moist, the picture is well pressed down upon the gelatine surface and allowed to dry in a warm atmosphere, after which it is stripped from the glass, and when mounted on card, porcelain, or other desired material, produces a permanent and finely-coloured photographic picture. If it is desired to have a brilliant picture it is necessary that the entire process above described should be conducted without any delay or intermission in the various portions of the process, and in an atmosphere of increasing temperature, as if in the process the print is allowed to become chilled a dull appearance is the result, which dull appearance may, however, be sometimes preferred. For printing on porcelain and such-like material, Mr. Mayall coats the material with collodio-chloride of silver, or carbon tissue, or the albumen solution above described, the subsequent treatment being the same as that described for paper. The colours employed are ordinary colours in a dry state ground up with phenic acid, and silicate of potash or kerosene, and silicate of potash in alcohol in about the following proportions—viz., one ounce of dry colour to 60 grains of phenic acid, and 20 minims of silicate of potash, or 60 grains of kerosene to 20 minims of silicate of potash. In the above manipulation care must be taken to exclude all organic matters other than what are above described.

THE total production of pig iron in the United States during 1886 was 5,684,543 gross tons, as compared with 4,044,526 tons in 1885. The pro[illegible] in the latter year was, however, under that of the four previous years.

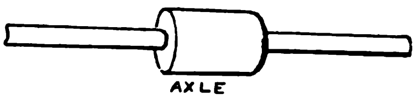
SIMPLE EXERCISES IN TECHNICAL ANALYSIS.—XXII.

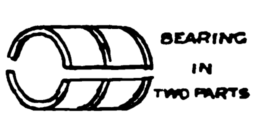
BY AN ANALYTICAL CHEMIST.

Lubricating Oils (Special Tests).

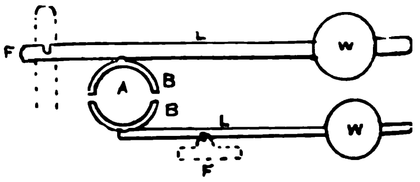
(301.) THE tests described in preceding papers furnish useful information regarding the nature of a sample; but do not determine which of a number of oils equally satisfactory so far as these tests are concerned, would prove the most economic lubricant in actual use. Nothing short of a mechanical test in imitation of the conditions existing in the workshop can determine this; and for this purpose oil-testing machines have been constructed. Those designed by Messrs. Ingram and Staper and Prof. Thurston are the two best known. They are fully described in most works which treat of lubricating oils, and more particularly in a price list published by the manufacturers, Messrs. Bailey and Co., of Salford. These machines are now generally used by railway companies, and others who use large quantities of oils, and as any intelligent man can make the test, the services of the analyst are usually dispensed with. On the other hand, analysts who examine a large number of samples must, and do, provide themselves with one or other of these machines; but as they are high-priced, and require gas or steam for motor power, there are but a few analysts whose practice is so extensive as to justify the initial outlay.

The first-mentioned machine, although it has some defects, gives very useful results. A short description of the main features of the machine will enable my succeeding remarks to be more clearly understood. It consists (1) of an axle about 3ft. long, near the centre of which is an enlarged part about 6in. long. It is driven at one end by a belt, while at the other end a counting apparatus records the number of revolutions; (2), a detachable bearing in the upper part of which a thermometer is screwed.





This bearing fits exactly on the enlarged part of the axle, and is held in position—above and below—by means of two levers, as shown in the sketch. The levers pass through the weights, so that the latter may be shifted towards or from the bearing, and so diminish or increase the pressure on the axle. By this means the conditions existing in light and heavy machinery may be imitated.



A, axle; BB, bearing; LL, levers; WW, weights; FF, fulcra.

The oil is tested in the following manner:—The detachable bearing is first removed and freed thoroughly from oil or dirt by rubbing well with a cloth soaked in a mixture of alcohol and ether. The enlarged part of the axle is cleaned in the same way. The lower half of the bearing is then placed in position. A drop of the oil to be tested is let fall on the middle of the rubbing surface of the upper half of the bearing, which is then tilted until the oil has run from one side to the other of it in the direction of the length of the axle. [illegible] oil must not be allowed to [illegible] edge, or it may subsequently [illegible] The bearing is then [illegible] the weights are [illegible] correspondin[illegible] whi[illegible]

(c) the time at which the experiment The machine is then set running at of about 2,000 revolutions per minute, stopped until the temperature of the marks 200° F. on the thermometer. ne at which the experiment ends and nber recorded on the counting apparatus ered in a book, and from the figures btained the "rise of temperature," the revolutions" made during, and the occupied in making, the experiment culated. The "total revolutions" and me" increase or decrease as the quality il—the higher these numbers the more ic is the oil.

temperature at starting need not be the same always, for heat is so rapidly ed at first that the revolutions for the degrees rise would not sensibly affect lts.

in calculations have then to be made mber of revolutions for each degree of temperature and the number of revo- per minute are easily obtained. The indicates the economic value of the oil, er its frictional resistance. The results, abulated, or set out on squared paper, early the comparative values of different

recommended that at least three tests be made, and the average of the three This entails an expenditure of time our which it would be well, if possible, l.

little extra care the several tests may le to compare more closely one with , and one test may answer instead of The makers of the machine recommend o or three drops be taken. This is, no a way which, for simplicity and readi- nnot be surpassed. But strictly com- e results cannot, obviously, be obtained way. A better plan is to use a drop of imately uniform size and weight for st. The actual weight may be deter- y finding the weight of the drops which m the dropping instrument immediately and after the one used in the test, and the average of these as the weight of p tested. The results could then be cal- for a definite or standard weight of oil alf a grain. The advantages of this will be evident when it is recollected eat is the number of revolutions obtain- m a small drop.

f the above method is not acceptable experimenter, there is another which s but very little additional trouble. A g instrument is made from a piece of d about ⅛in. in diameter, one end is l in a flame, and at 2in. from this end a is made with a file. The rod is dipped oil to the depth of 2in., drawn gently the fifth drop weighed. This weight obably be between 0·4 and 0·5 grain. the same method is carefully followed ne, the weight of oil tested will practi- e the same, and the results obtained from ive tests will compare favourably with ther.

her a single test or the average of three n, the oil is finally left on the bearing following morning, when the machine as before till the temperature reaches hr. Some oils work freely after stand- hers do not. This latter is due to a n the oil, known as "gumming." An ving a strong tendency to gum should recommended. The makers advise that achine does not run freely some fresh uld be added. For obvious reasons, I o ease the levers a little until the bear- t warm. Then the experiment proceeds he previous day. Care must, however, n that the bearings are not injured for f oil. The machine should be at once if a whistling noise is heard.

sure accuracy, an oil of known quality invariably be tested immediately before the [illegible] under examination; for it [illegible] ms that, owing to the y of the bearings, the long intervals—during s been frequently used— ame oil.

lts are selected from a shew clearly what may concerning the

No.		Time. Min.	Revolutions per min.	Total Revolutions.	Temp.		Rise of Temp.	Revolutions per degree of temp. raised.	Remarks.
					From.	To.			
1	No oil........	16	560	8961	56	200	144	62	Made this test for a special purpose. Injures machine.
2	Mineral oil..	7	1130	7913	70	205	135	58	S.g. 867·1. Light oil of low viscosity. Very poor lubricant.
3	Do.	237	1265	299950	66	200	134	2238	S.g. 874. Fair lubricant.
	(2nd day)	25	1236	30920	60	200	140	221	
				330870					
4	Do. (pure)	278	1212	337044	65	200	135	2496	A good lubricant.
5	Do. (part)	230	1216	279688	66	200	134	2087	Contained a large proportion of mineral oil.
6	Do. (small)	180	1185	218393	62	200	138	1546	Contained a small proportion of mineral oil.
			(Experiments not continued on the second day.)						
7	Do. (Crane's)	55	1054	57980	60	190	130	446	Constant at 170° F. for 40min.
	(2nd day)	150	1117	167020	60	195	135	1241	(Not finished).
8	Do. Do.	143	477	68294	59	203	144	474	Rose to 187°. Fell to and constant at 180° F. for some time. Same oil as No. 7.
	(2nd day)	50	484	24233	53	200	147	165	
				92527					

In the foregoing table the number of "revolutions per minute" is important, because it furnishes a rough idea of the frictional resistance of the oil. The lower this number the greater is the resistance, and the less suitable is the oil for light machinery. The "revolutions per degree of temperature raised" is also important, because the higher they are the more economic is the oil.

In testing an oil with this machine it may always be observed, although, so far as I know, it has not previously been published—(1) that the temperature rises rapidly at the beginning until it reaches a certain point; (2) that it remains constant at this point for a considerable time; (3) that when it subsequently rises above this temperature, the rise, in unmixed oils, is uninterrupted until 200° F. is reached; (4) that the temperature at which an oil remains stationary is different for different oils; (5) that mixed oils may have two or more stationary temperatures. It would appear from this that oils have certain temperatures at which their efficiency as lubricants is seen fully developed. At first the heat produced by friction is greater than the loss from radiation; at the constant temperature these just balance one another; and subsequently the heat of friction exceeds the loss.

After the constant temperature is passed the oil appears to be worked out, and it may fairly be assumed that if a sufficiency of oil were present this temperature would not be exceeded. The oil is not worked out completely, however, for a large number of revolutions can be obtained next day without further addition of oil. This point of constant temperature may be made of practical importance.

In experiment No. 2 the oil was so thin that the metallic surfaces must have been in actual contact. Unless an oil has sufficient body to prevent this, it is valueless as a lubricant for machinery of any weight, although it may possibly be useful for the lightest kinds of machinery.

Experiment No. 1 was made for the purpose of determining whether this particular oil used in experiment No. 2 was of any value whatever for machinery of this weight. It will be observed that the total number of revolutions obtained was greater when no oil was used; but this may be due to the fact that the machine took about twice as long to make the same number of revolutions, and the loss of heat was therefore twice as great. Such an experiment cannot be recommended for repetition, as it is likely to injure the machine.

Experiment No. 3 shows that the oil is a fair lubricant with less viscosity than usual, and therefore very suitable for light machinery.

Experiments 4, 5, and 6 show the comparative results obtained from a pure mineral oil, an oil with a large, and another with a small, proportion of mineral oil.

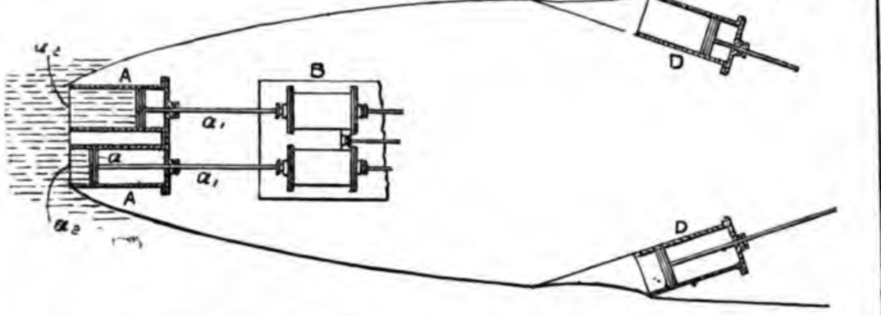
No. 7 shows a good sample of Crane's mineral oil. Intended for use on heavy machinery, the viscosity is high (see revolutions per minute).

No. 8 gives an important result. It was made before No. 7. The machine was, in the former experiment, driven at the rate of about 480 revolutions per minute. This, owing to the length of time required for the experiment, was deemed insufficient, and it was argued that if a given quantity of oil gave in both cases the same total number of revolutions, the time required for a test would be less than half as long if the speed of the machine was raised to 1,200 revolutions per minute. This did not turn out to be the case—a fact which, I think, can only be accounted for on the assumption that friction is less at high than at low velocities.

(*To be continued.*)

MARSHALL'S METHOD OF PROPELLING VESSELS.

A METHOD of propelling steamships and boats, which also provides for rapid stopping and steering, has been recently patented by Mr. H. J. Marshall, of Linslade, Bucks (No. 7537, 1886). The main idea of the invention will be understood from the diagram, which represents the propellers. The patentee in carrying his invention into effect uses two types of cylinders and pistons, one pointing aft, the other pointing forward. The former type constitute the propellers, and the latter the repellers. Their combined and co-related action effects the steering. In the diagram, A A are a pair of stern propellers worked by their own engine B, to the pistons of which the pistons *a a* of the propellers are coupled direct by means of the piston rods *a'*. At each inward stroke of a piston *a*, the water follows it into its cylinder A, from which it would be ejected by the return stroke of the piston, if it were not for the resistance of the volume of water outside the vessel. Inasmuch as the piston therefore cannot displace the water, its energy is expended upon the vessel of which it forms an integral part, and the vessel is moved forwards accordingly. In the diagram the patentee shows a pair of propellers working alternately, but he wishes it to be distinctly understood that he may employ any number arranged in equal capacities on each side of the centre line of the vessel. A duplex and connected arrangement of propellers might be found advantageous, as the outward thrust of the one would be materially assisted by the return stroke of the other, owing to the pressure derived from the depth at which it would be working below the surface of the water. The propellers should be placed as low as possible in the vessel, although it is not necessary to the success of the invention that the open mouths a^2 of the propeller cylinders should be aligned with the motor cylinders, inasmuch as the propeller cylinders may be fixed in any convenient level, and communication kept up with the outer volume of water by serpentine or bent pipes. Of course it is obviously preferable that the mouth of the propeller and the propeller should be on a common level. The engines may be fixed closer to the propeller than they are shown in the figure. In fact, one feature, involving a great practical advantage, is, according to the patentee, that the adoption of the invention almost necessarily abolishes the familiar long screw shaft



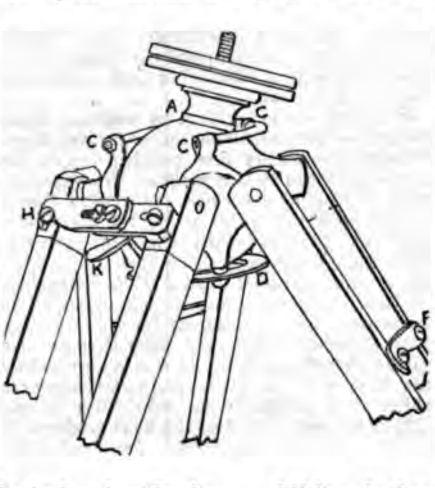
with all the attendant risks and expenses. Watertight bulkheads may be constructed to inclose the space occupied by the propeller cylinders, or other equivalent devices may be adopted to isolate the space occupied by the propellers from the hold, or to close the mouths of the propellers whenever such closure might be required for any purpose. Reversing propellers, constructed throughout on the same principles as the propellers described above, are placed in the bow. The steering of a vessel fitted with this invention is effected by working the port propellers and the starboard repellers, together or vice versâ.

The propeller and repeller cylinders are shown of a circular cross section, but this shape may be varied as may be required. For instance, in the case of a shallow draught vessel, the section may be rectangular and wider than deep, or oval. By this means great effect would be produced, with more compact construction than if circular cylinders were employed. The patentee also illustrates the application of his invention to rowing boats, and summarises its advantages: The financial losses and vexatious delays arising from the breaking of screw-propeller shafts and propellers, or partial or total loss of propeller blades, would cease. The annoyance and occasional mishaps arising from the lift of a vessel taking the propeller blades out, or partially out, of the water, and so causing the engines to race, would be averted. The piston propellers would possess the great advantage of working in a solid body of water, as against screw-propellers or paddle-wheels working in broken water, and in an unfavourable current set up by the motion of the vessel. By having the piston propellers and repellers on either side working independently of those on the reverse side, a vessel could be kept on any desired course in the event of a breakdown of the steering-gear or rudder occurring. Therefore, vessels could be constructed with the usual steering arrangements, so that there would be absolutely nothing outside the outer skin of the vessel exposed to damage. Should it be necessary to suddenly alter a vessel's course, it could be effectually done by working the propellers and repellers on opposite sides. Many collisions would thus be avoided, owing to the greater control over a vessel, and a higher rate of speed could be maintained than is now—in certain atmospheric conditions or in crowded waters—considered prudent. It will, therefore, be seen that the enormous power of the engines would be available for stopping a vessel or altering its course, a most essential condition, seeing the prevailing tendency to construct vessels with an ever increasing go-ahead speed, but with no corresponding stopping power. The patentee enumerates other advantages, which, however, will suggest themselves.

AN ADJUSTABLE CAMERA STAND.

A NEW form of adjustable photographic camera stand, recently invented and patented by Mr. J. Brown, of Belfast, is shown in the illustration. A sphere of wood, A, provided with a projection and screw for the attachment of the camera, has fitted to its surface three metal cups, C, C, C. These are held in position against the ball by a ring, D, to which their lower ends are loosely jointed, and by a spring, E, connected to their upper parts and pressing them against the ball with sufficient force to allow of its being moved with moderate friction inside the cups in order to point the camera in any desired direction. The cups C are provided with projections, having conical pins, on which the legs of the stand fit in the usual way. Two of the legs are held in place by the usual hooks, as at E. The third is provided with an adjustable tightening hook on clamp H, so arranged that when the camera has been pointed to take in the exact view desired, it may be instantly fixed in that position by turning the small eccentric lever K, which shortens the hook H, and thus clamps the three cups firmly on the ball.

The inventor claims for the stand great ease and quickness in pointing the camera in any direction, even vertically, upwards, or downwards (while instead of the usual trouble of shortening, lengthening, or shifting the legs about on the ground, one has only to see that their points are placed where they will not slip), and also great rigidity when clamped into position. It is useful for all outdoor work, and especially for rough ground, or on board yachts or boats. It is made by Mr. Collins, of Cochrane-street, St. John's Wood.

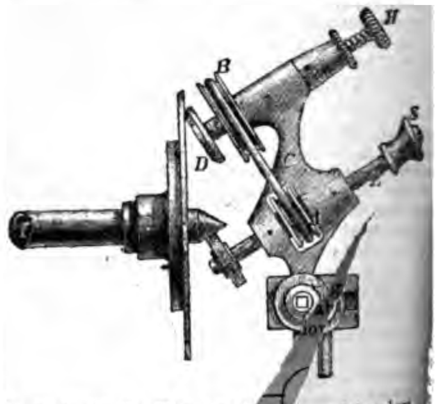


HARDENING METALS.

THE old receipt books and our back volumes contain a number of preparations which are supposed to have some potent influence in hardening metals, especially steel; but it is not often that these mysteriously potent powders or dips are patented. One famous recipe, which has doubtless been sold to many young blacksmiths, contains directions for adding to the water in which the steel is quenched so much spirit of nitre, spirits of hartshorn, white vitriol, sal ammoniac, alum, salt, and hoof parings, and no doubt if the young workman failed to attain success he would attribute it to having used the wrong proportion of one of the ingredients of the mixture, which one would think must have been invented for the benefit of druggists. However, if skilled tool-makers smile at these funny receipts, they will probably be surprised to learn that Herr C. Beckstein, of Reutlingen, Germany, has actually taken out a patent in this country for an "improved powder for hardening metals," which is prepared in the following way:—Insects known as cochineal (*Coccus polonicus*) are, by means of boiling water, released from the colour or dyeing material contained in them, whereafter 100 kilos of such prepared cochineal are mixed in a vessel with 212½ kilos of phosphoric acid and 32¼ kilos of nitrogen in organic substance, and evaporated, after which the mass is brought into a drying room till dry enough to be powdered, when 50 kilos of soot are mixed therewith. The metal is hardened by means of this powder in the following manner:—The metal (sheet iron) to be hardened is placed in an iron box and inclosed in more or less of the powder, according to the thickness of the sheet. When the box is filled, it is hermetically closed by means of clay and placed in the heating furnace and left for a longer or shorter time, according to the thickness of the plates. It would be interesting to know exactly what is meant by so many kilos of "nitrogen in organic substance," because that involves the accompaniment of something not mentioned in the specification, and the insects are presumably of special breed, for the cochineal is usually known as *Coccus cacti.* As to the cost of this powder, nothing is stated; but probably it can be used over and over again.

FRICTION - DRIVEN CENTRE GRINDER.

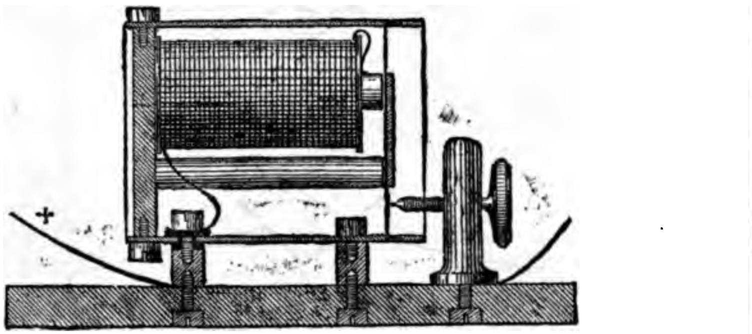
EVERY lathe-hand knows that it is quite a job to turn up lathe-centres true, because the quick speed necessary when turning up the joint is too quick for turning up the large end. It is also difficult to turn them up straight and smooth. Most men finish them by filing. No matter how fast the lathe runs, or how careful the man is, he cannot file them so that they will run dead true, and they will be out of round, causing the dead centre to wear the working centre away. By using a centre grinder the centre can always be kept true and round. This grinder has no belts to be attached, and all the running bearings are covered so that the fine emery cannot cut them away. The hub of the shive-pulley B runs in the frame C. The friction-wheel shaft D slides in and out of the hub of shive-wheel B. The shive-wheel A is fastened to a sleeve in which slides the emery



wheel spindle E. The wheel is moved in and out by the knob S, which is ma e so that it does not revolve with emery-whee spindle. The friction wheel has a rawhide fac . It does not require to have the friction whe l forced hard against the friction plate. It mig t be assumed that considerable pressure was req uired, but a very slight pressure is sufficient. There is an abundance of driving power in the fr ction; in fact, materially more than is required. For attaching this grinder it is only necessary to fa ten the friction plate to the face plate by drilli ng and tapping two holes in face plate, put th e grinder in tool post the same as a turning tool, se it to the proper angle by moving emery wheel alon the centre, lock carriage on the screw and brin friction-wheel against friction plate. The th rust screw is to adjust friction wheel for long or short centres. These grinders are made by the Energy Manufacturing Company, 1,123, South Fifteenth-street, Philadelphia,Pa.—*American Ma chinist.*

ZIGANG'S ELECTRIC TRUMPET.

DESPITE the low price the ordinary
bell, it may be asked ether it is not
ble to substitute for the tter a still
apparatus, and one less c y and of
general application than classical
bell. It is an apparatus this kind
presented in Mr. Zigang's ric trump
herewith. The apparatus
2¼in. in length and 1½in.
terior of which is fixed
An armature is placed o
latter, and a regulating
platinum point serves
rupter. The mounting a
paratus may be understood



[illegible]

e. It takes but two Leclanché elements
l electric bell variety to cause it to
agreeable musical sound, of which the
ntensity may be varied by regulating
r tightening up the vibrating plate in
This characteristic musical sound
the apparatus being used for domestic
aphic purposes, where there is need of
ing different calls without having re-
dicators. It might also render service
ays, tramways, boats, &c., in all those
there is need of a signal insensible to
less abrupt motions of the object under
lly, the possibility of transmitting the
bet and certain conventional signals by
its of the electric trumpet being applied
smission of signals to an engine room,
ere noise prevents the use of a tele-
Electricien.

STEREOSCOPE AND ITS APPLICATIONS.*

ighth meeting of the British Associa-
for the Advancement of Science,
38, a paper was read by Prof. Charles
, accompanied by an instrument
of it, which involved in so high a
elements of novelty and intrinsic
alue, that it was received with most
nifestations of pleasure and surprise.
of the paper was, "Binocular Vision,
rument for illustrating its Phenomena,"
was called by him a stereoscope. The
corded the paper and the instrument,
portance attached to it, can be most
d before you by an abstract from the
of that body, giving the opinions of
ntative men, as follows:—"Sir David
ared that the members could scarcely
the very brief and modest account
of. Wheatstone, of the principle and of
nent devised for illustrating it, of its
uty and generality. He considered it
nost valuable optical papers which had
ted to the Section. He observed that
in connection with the law of visible
monocular vision, it explains all those
of vision by which philosophers have
perplexed, and that vision, in three
received the most complete explanation
Wheatstone's researches. Sir John
haracterised Prof. Wheatstone's dis-
ne of the most curious and beautiful,
plicity, in the entire range of experi-
s."

ough the instrument, as is apparent,
t be of great general interest outside
ientific circles, its application seemed
bout with limitations, that it hardly
become a popular instrument. But
me time Daguerre made the announce-
is great discovery, which not only
e field of application of the stereo-
ringing within its range many sub-
ously hopelessly excluded; but in
ent development so completely sup-
d Wheatstone's discovery, by its cheap
on of pictures of all objects, of
l accuracy, that the stereoscope be-
entific sensation of the day, and found
to the parlour as well as the study.
to have acquired for itself a per-
e in almost every intelligent house-

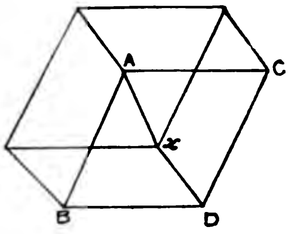
atment of this subject this evening, it
he best disposition of the time at our
be made by considering, first, rather
he principles underlying and explana-
nstrument, and then as many of the
teristic applications as the time may
ncidental discussion of theoretical con-
nd disputed points, as they may pre-
ves.

I have given Prof. Wheatstone's paper the prominence I have because the whole subject seems to develop most naturally by inquiry into his merits in this connection. What, then, was his discovery? What is his claim? I think I can safely say that it is broader than the simple invention of the instrument, which he called a stereoscope. It was the conception which preceded the instrument, which suggested it, which, in fact, demanded it, and called it into existence, that had the prime element of novelty in it. What, then, in brief, was the state of knowledge and the theory of vision at that time? The physical explanation of vision by the formation of a distinct image of external objects upon the retina of the eye was entirely satisfactory. The eye, optically considered, was regarded as a camera obscura, with the retina as the ground-glass. This instrument has become so common to-day, by the rapid spread of amateur photography, that familiarity with it may be assumed without further explanation. There were, to be sure, some remaining difficulties to be explained away, but they were often manufactured, and rather physiological or psychological in character. The notable one, how inverted retinal pictures can occasion erect vision of objects, is closely related to our subject by the law of visible direction, alluded to by Sir David Brewster, which explains it—a law which, simply stated, is that visible points are referred back to positions in lines along which the light from them finally strikes the retina, or that we see points in the direction in which light from them strikes the retina. But the consideration of vision with two eyes introduced new complications and perplexing questions peculiarly its own. Having two eyes, each evidently receiving its own retinal picture, we nevertheless receive but a single impression, or we see the object single. How, where, when do these two impressions fuse into one? But on further consideration the difficulty in intensified. The retinal pictures in the two eyes are not identical, but in the nature of the case must be essentially different—as different as the drawings of an object made from two different points of view, as distant from each other as the interocular distance. It is certain, then, that our clear, unconfused single mental impression exists in spite of the dissimilarity of the retinal pictures of the two eyes. But upon still further investigation it is found that not only does no confusion result from these separate dissimilar pictures presented to the mind, as it were, at the same time, but, what is still more remarkable, that from these dissimilar retinal impressions, and by reason of their dissimilarity, no doubt, we have more definite perception of external objects. In whatever way explained, the fact was indisputable that there results from this dissimilarity of retinal impressions such a perception of distance, and, consequently, of form, that it seems, as some contend, an added direct perception of distance, and not the result of an unconscious judgment, based upon additional data furnished by the two eyes. There can be no physical explanation of this seeming fusion of dissimilar retinal impressions, and the resulting additional perception. It must be clearly physiological or psychological, or both.

We cannot with one eye open, with certainty, bring the tips of the index fingers together at arm's length, or snuff a candle. Indeed, we often find ourselves almost with a feeling of a loss of clear vision when we are obliged to estimate distance without being able to bring both eyes to bear upon the same point. It is clear now, I think, that no picture of an object, however [illegible] in drawing, or faultless in all [illegible]
infallible in
object it
eyes, tw
[illegible]
d.

the drawing. This is another of those statements readily acceded to, but hardly accorded its full practical importance, especially in this connection. To impress it more decidedly, I will bring before you a few illustrations, which also have an additional interest of their own. In his treatise on the stereoscope, Sir David Brewster devotes considerable space to what he styles "a very remarkable illusion," a "puzzling phenomenon," to which his attention was first called by Prof. Neckar, of Geneva. The diagram (Fig. 1), he remarks, was

FIG 1



o drawn that A should appear nearest the spectator, and the face A B C D foremost, and x furthest from him. But he says, on looking at it repeatedly, the apparent position of the rhomboid is changed, x and its face will appear in front, and A and its face will appear more remote, and give the solid a different inclination. You can cause A or x to come to the front, or to recede, at will. Now this results from the simple fact that the two solids are represented by the drawing. Sir David says it was drawn so that A should appear in front. That may be so, but there is nothing in the drawing to justify the statement. Had the artist intended x to appear in front, he would have drawn precisely the same figure. In reviewing this book some years ago, this puzzle recalled some early ones of my own, and I suppose of almost any boy entering upon solid geometry. But doubtless you all see first the solid with A in front. This I would explain by the fact that that solid appears in a natural position, fully supported; whilst the other solid, represented when x is in front, is is an unnatural, unsupported, I would almost say impossible, position. That solid that has the most usual position is first suggested, and I have no doubt that this particular diagram arrested the attention of Professor Neckar, and afterwards of Sir David Brewster, simply because of the accident that it represents two solids differing so widely in this respect. I have simplified this in the diagram (Fig. 2), to which I will call attention again in another connection. In either of the diagrams it will require very little effort to cause either of the squares to appear in front of the other. There is no reason, in the nature of the case, why one should appear in front rather than the other.

FIG 2.

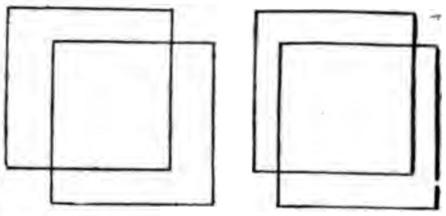
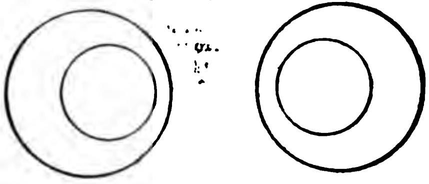


FIG 3



But it might be said that a monocular picture of the object itself upon the retina of a single eye should also be capable of this two-fold interpre-
[illegible]—that in looking at an object with one eye
[illegible] receive no infallible impression as to its
[illegible] do we. But in most cases the
[illegible] by other circumstances renders
[illegible] other than one. But if
[illegible] this difference in
[illegible] speak, of the two
[illegible] minimum, we
[illegible]ved. The

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* from a lecture by Prof. [illegible]
delivered before the Franklin Insti

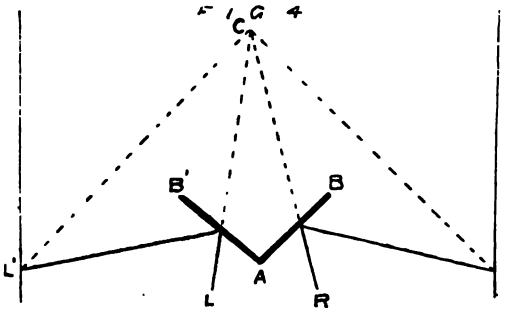
else, and yet it is a photograph of a mould I hold in my hand. What is true of the photograph is equally true of the retinal impression formed by the object on one eye. When looked at with one eye, with the head immovably fixed at the distance of several feet, it will invariably and persistently appear as a relief, and I think simply because objects of the kind are far more frequently met with in relief than as intaglios, and we cannot emancipate ourselves from the effect of this circumstance. Both eyes, however, soon settle the true character of the object. It is possible that one accustomed to work in plaster, as familiar with moulds as the casts made from them, could see it as readily as a mould as a cast.

It may be admitted that this superiority of binocular over monocular vision, and the essential conditions of it, were recognised before Prof. Wheatstone's paper was read; but he seems to have been so impressed with these facts that it occurred to him, as there is no reason to believe it occurred to anyone before him, that if he could, by any means, reproduce the conditions of binocular vision by means of flat drawings, he could also produce the irresistible impression of solidity of form—that is, if he could, by any means, simultaneously produce in the two eyes retinal impressions of such a degree of dissimilarity as an object would produce when looked at with both eyes, a perfect binocular illusion of the object would be produced. If, for example, he could present to the left eye the picture of the frustum of a cone as seen by that eye, and at the same time the picture of the same frustum to the right eye as seen by that eye, as in the diagram (Fig. 3), the same effect of perception of complete relief should be produced as by the presentation of the object itself. But he did more; he demonstrated experimentally and conclusively the correctness of his reasoning. But an apparently insurmountable difficulty is encountered in any attempt to look at the same time at one picture with one eye and at another with the other eye. It lies in the fact that, as we see but one point of an object with greatest distinctness at a time, we direct both eyes invariably to the same point, and thus in passing from point to point roll the eyes inward if to a nearer point, outward if to a more remote point. In other words, we direct the optic axis to that point, and cause its image to occupy the place of most distinct vision in each retina. At the same time, we accommodate the eye—adjust it focally to distinct vision of this point.

It is this play of the optic axes, this variation in the angle formed by them, or, if you please, the muscular effort required to produce it, in turning from one point of an object to another, that, in some way, seems inseparably connected with our infallible binocular perception of distance. Whether by reason of it, this perception is original, antecedent to experience, according to the so-called *nativistic theory*, or whether it is dependent upon it simply as upon a peculiar criterion of judgment, and is wholly the result of experience, according to the *empiristic theory*, has been a matter of great dispute. No one has more clearly enunciated the latter theory than Bishop Berkeley, whilst on the other hand Sir David Brewster has as warmly disputed it. Now, although closer investigation forces to the conclusion that simple play of optic axes will not wholly account for binocular perception of distance, yet the great preponderance of opinion is in favour of the view that this perception of distance is not primary, but is an unconscious visual judgment. It would hardl, repay to give much time to the discussion of this point. I will simply call attention to a fact that seemed almost conclusive to me upon investigation of it some years ago.

New-born infants not only have no perception of distance, but seem to have no tendency to move their eyes in concert. As a rule, they appear cross-eyed, without, however, a decided in-squint or out-squint, but rather with a peculiar working of the eyes, resulting from want of concert in their movements. This vanishes after a short time, and the unvarying habit of convergency accompanies the acquisition of perception at a distance. [Any argument against this view from the analogy of the lower animals must be received with great caution. Many of the lower animals possess only monocular vision on account of the position of the eyes, which precludes concerted use. The absence, too, in almost all lower animals of a retinal area of most distinct vision removes the incitement to concerted action of the eyes. The argument from the young of birds, by Adam Smith, seems to have more weight conceded to it by Sir William Hamilton than it merits, especially when it is remembered that most birds, other than the carnivorous, have their eyes so situated that they cannot be used in concert. They may be often observed to turn the head and look steadily with one eye at an object, making a purely monocular study of it.]

FIG 4



Now, when we look at a stereograph in ordinary *vision, both eyes look at the right-eye* picture or *left-eye picture at the same time.* The axes intersect in a point in the plane of the paper, and, at the same time, both eyes are accommodated to the plane of the paper, so that when we require the right eye to look at its half of the stereograph, and the left eye to look at its half, at the same time, we call for a violation of this consensual habit of convergence of the axes and accommodation of the eyes to the same point; for whilst the eyes would be accommodated for distinct vision to the plane of the paper, the point of intersection of the axes would be more remote, if indeed, as we shall see after awhile, they intersect at all. But, whilst this dissociation of invariably associated optical adjustments is difficult, it can be accomplished by anyone with some effort and some patience, and when, upon looking at a stereograph, the effort is successful, the picture springs out into inimitable, almost magical, relief, as we have reason to believe first happened to Wheatstone.

But Wheatstone devised an instrument to aid in presenting the dissimilar pictures to their respective eyes at same time without this violation of habit. Optically it is extremely simple in principle. In the diagram (Fig. 4), L' and R' are similar points in the left-eye and right-eye pictures, L and R the left and right eye, and A B and A B' plane mirrors. The rays of light from R' will enter the right eye as if proceeding from C, and those from the similar point L' enter the left eye, as if from the same point C, and accommodation and convergence of the axes will be to the same point, when these similar points of the two pictures are looked at. As it is generally stated, the instrument superposes the two pictures. Now, there are many instruments by which this superposition, so to speak, may be accomplished. Refraction suggested itself to Sir David Brewster instead of reflection as employed by Wheatstone. He devised the form of stereoscope now in general use, which the word suggests to most persons, in which lenticular prisms replace the mirrors, thus affording not only a more compact and convenient instrument, but one that permits both pictures to be mounted upon the same card as in the ordinary stereograph. There are many other stereoscopes in great variety, all interesting, many of them curious; but, as a rule, they only serve to demonstrate that the same effect of superposition can be produced in still another way. There is, however, one adjustment of the ordinary stereoscope, of very decided value, but which is invariably wanting. It is an adjustment of the lenses to the variable distance between the eyes of different individuals, and at the same time to the slight variation in distance of similar points in stereographs in the market, or, if they are properly mounted, we might say to their breadth. Much of the dissatisfaction and want of comfort in the use of a stereoscope in many cases is due almost exclusively to this want of adjustment to the interocular distance of the individual, accomplished by sliding the prisms nearer to or further from each other. Although this addition would be comparatively inexpensive, there seems to be so little popular demand for anything beyond the simplest and cheapest forms, that they are not kept in the market even after advertised. One recently devised by Prof. Le Conte Stevens (see p. 233, Vol. XXXV., No. 895), having this adjustment, and many others valuable in its employment for investigation, I regret to say, cannot be obtained from a leading firm which has largely advertised it.

(*To be continued.*)

PYROGALLIC ACID AND ITS USES IN PHOTOGRAPHY.*

BY DR. T. W. DRINKWATER.

THE first point that strikes me is the misnomer "pyrogallic acid," for what we know as pyrogallic acid is not an acid, but an alcohol. Some time ago, reading a short article on development in one of the *Yearbooks*, I was amused to find how the writer strongly insisted on the acid nature of pyro. He was trying to prove that all ou
ment was really acid development—that
how much alkali we used, we also ha
excess of acid before it would act
being either citric, sulphurous, or (save t
pyrogallic.

Without stopping to consider the ra
views on development enunciated by th
must say that it is a *reductio ad absu*
seeing that the argument is really bas
being a body, and having the properties
whilst in reality it is of no such natu
gallol, as it should be more correctly t
longs to the same group of organic co
carbolic acid—also misnamed, by the
are both alcohols derived from benzine

C_6H_6.	C_6H_5OH.	$C_6H_3 3O$
Benzine.	Carbolic Acid.	Pyrogallic
		C
		H

Scientific chemists are fond of specu
the arrangements of atoms composing
and in the benzine series we have even
suppose atoms are arranged and con
with another in such a way that each e
has the same relation to the other.

Now it is possible, assuming our th
correct, to prophesy how many bodies
duced having the same formulæ, and
phecies stand more chance of being fu
those of a sporting prophet on the Derb

These theories have been proved to
and many new bodies have been discove
sequence, which might otherwise ha
notice. Such bodies are described i
language as isomeric. Theoretically,
pyrogallol, we find there should be
bodies having the formula C_6H_3, 3OH.
three bodies have been isolated, and in
closely resemble one another. I thin
field for experiment and research opene
could these bodies act as developers?

I have broken the ice a little myse
with any satisfactory results as y
because, owing to *flitting*, like many ot
season, my dark room is not, I am a
light-tight as yet, and as my experime
not in smoke, but in fog, I am at a loss
attribute it to developer, light, or a com
either—combined, of course, with the
of working always connected with new

As regards the names of these other
pyrogallol, phloroglucinol, hydroxyqui
say they all act as developers; that i
reducing agents.

During the time I have practised p
pyrogallic acid has undergone two tran
—one in form, the other in price. As
I amused myself and tortured my f
photography, and I well remember ha
out of two weeks' pocket-money
wanted to indulge in pyro. If I remem
I paid sixpence for about thirty gr
leaving school I gave up the art, for I
time nor could I carry the enormous
paraphernalia about with me when a
few years ago, however, I could not
returning to the old love, and commenc
ing up the elements of modern dry-
graphy. I must admit that when I f
bugbear pyro was the favourite d
thought of the expense, but soon disc
what I formerly bought by the grain,
purchase by the ounce without any
fortune to back up the expenditure. I
luxury of purchasing a whole ounce
then found that along with a transf
price there was one in form. What I pu
boy was more compact and less feather
we are now familiar with. Formerl
was made by heating gallic acid (hence
name) until it lost carbolic acid. Con
price at which it is now sold, I cannot
it is made in this way in the present d
made some inquiries as to the Germa
which pyro is made, but cannot pro
finite or reliable information; the proc
be very much a secret. There are
ways of making it artificially, but onl

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* A communication to the Edinburgh Photographic Society.

ind, would account for the cheapness of the present-day article. As thus:—

$$\,_{6}H_3OHClKSO_3 + 2KOH = C_6H_3 3OH + KCl + K_2SO_3.$$

Vhether this is the method adopted I cannot say, ut of one thing I am certain, that it is not made rom gallic acid.

All bodies allied to carbolic acid—or the phenols, s they are termed—have the power of absorbing xygen to varying extents. Phenol turns red on xposure to air; pyro turns brown. In chemical anguage they are reducing agents, some more owerful than others. Now, what we call de'elopment consists in reducing the salts of silver o the metallic state after they have undergone ome change by light; what that change is I do ot think any of us can say. The latent image is t present an unexplained mystery. That the hange is wholly chemical I do not believe. Be hat as it may, a reducing agent applied to an xposed plate has the power of reducing to the etallic state those portions of the silver salt hich have received the actinic rays. Used by self it acts with great slowness, but in presence f an alkali, which absorbs the halogen set free, he action is rapid.

In the chemical laboratory, we use pyro to bsorb oxygen in gas analysis, always in alkaline olution.

As you all know, the question of which alkali to se is a somewhat vexed one. Chemically speakg, I cannot see that it matters which alkali is aken; the final result is much the same, although he one developer may produce that result quicker han another.

We are all apt to overlook the fact that a process hat succeeds with one man will not do with nother. I should say, let each one use the alkali hich suits him best, and with which he gets the est results.

As to the unhealthiness of ammonia I am doubtul. The small quantity given off during development I cannot bring myself to believe is hurtful, otwithstanding all that is said to the contrary. I am acquainted with chemical works in which mmonia fumes are constantly present, and in hich the workmen are healthy enough. In my wn laboratory I have frequently had more mmonia flying about than ever I had in my dark oom.

My experience in the matter may not be of much alue, but I have tried all the three alkalies, and n develop equally well with either. Soda alone, owever, with me gives a red tone, which is rather isleading when judging of printing value.

One thing I never do—that is, keep pyro in lution. To my chemical mind it is impossible to ep it in solution for many seconds without ange taking place. When the brown colour is veloped after absorbing oxygen a number of mplex bodies are present, including acetic acid, rbolic acid, &c. Both of these bodies act as strainers, besides destroying a large quantity of kali. In fact, the sulphurous acid is the most werful restrainer I know of. I have saved over posed plates with a solution of sodium sulphite turated with sulphurous acid gas, when I do not nk I could have done anything with bromide. sulphurous acid is as unstable a body as pyro. nds to become sulphuric, or the sulphite to phate, and after that stage the solution is useless. I always use pyro dry, and nothing will ever ke me change except the introduction of an to unknown preservative. For professional otographers using large quantities of pyro it may matter so much; but to my fellow amateurs I se that they should avoid solutions of pyro.

ow, a word or two as to the other compounds ed to in the earlier part of my paper. oglucinol: I procured a small quantity from ine compound, and attempted to use it as a loper. It began to develop a picture without alkali, but almost immediately fog appeared. could not use ammonia with this body withit undergoing change, but the new substance uced will act as a developer. In my only riment fog was produced at once; this proves it has the power, and I have no doubt careful riment would show us a method by which it t be used. Hydroxyquinol, the other body red to, I have not had time to make, but I d say that it was even more powerful than r of the other two forms.

ow, I will ask you to observe one thing mely, the close relationship between these dies:—

H_6 (benzine) C_6H_5OH (carbolic acid) $C_6H_4 2OH$ = hydrokinone or quinol.
$C_6H_4 2OH$ catechol,

und in the the autumn leaves of the Virginia creeper.

$C_6H_3 3OH$ pyrrogallol.
$C_6H_3 3OH$ phloroglucinol.
$C_6H_3 3OH$ hydroxyquinol.

PERCENTAGE SOLUTIONS AND WEIGHTS AND MEASURES.*

LAST week we promised to make a few observations on the subject of the mixing of percentage solutions, a topic with which questions of weights and measures are inextricably interwoven. Our attention was drawn to the subject by a number of letters in our contemporary, the ENGLISH MECHANIC, in reply to a querist who asked the meaning of the expression a "ten per cent. solution;" he had been told to take a "ten per cent. solution of chrome alum," and he asked, "Does this mean 10oz. alum in 100oz. of water, or 10dr. in 100dr., or 10gr. in 100gr.?" The same question, in other forms, is doubtlessly being constantly put by other experimenters; repeatedly have we ourselves been called upon for an explanation. As we stated last week, this querist was replied to by no fewer than six correspondents, which number included the names of at least one well-known authority, yet with one exception all made such erroneous statements in their replies as will form an excellent text whereon to expound this most simple, yet evidently confusing, matter.

The first reply is vague; the second says, "A ten per cent. solution is one to ten." Wrong. The third is also vague at the outset, and soon gets hopelessly wrong and at sea—"10 grains alum in 1 ounce water means 10 grains in 480!" The fourth is all wrong; he says, "If you take 10 parts water to 1 part chromic alum by weight," &c. He fails to comprehend the point. Number five says, "There is nothing vague about a ten per cent. solution of chrome alum. It means 10 parts of alum in 100 parts of water." This is evidently wrong, though the latter part of the letter shows a glimmering of the truth. Finally, the last letter states that in "photographic formulæ apothecaries' weight is always implied unless otherwise specified," a statement which is clearly erroneous, while still more glaringly so is it to say, as the writer does, that 10 drachms in 100 drachms is the same as 10 ounces in 100 ounces.

In trying to arrive at order out of this chaos of explanation, evidently typical of the state of mind of a large number of people, let us first explain what a ten per cent. solution does mean. It cannot be termed a strictly scientific expression; but by common usage it means, when applied to a solid dissolved in a liquid, a solution containing one-tenth of its weight of the particular solid. When applied to a mixture of two liquids it is usually understood to mean a liquid which contains a tenth of its volume of the specified liquid.

Thus a quarter of an ounce of a ten per cent. solution of chrome alum would mean a liquid which contained the tenth part of one hundred and nine and three-eighths grains of chrome alum. A pint of a ten per cent. solution of alcohol in water would mean a solution containing two "fluid ounces" of alcohol.

Now the confusion of terms makes its appearance at this stage. Photographic formulæ, except for a few nice calculations, such, for example as those needed in emulsion making and a few other directions, do not call for very exact measurements, as is instanced by the only recently forsaken "drop and pinch" formulæ for development; hence a somewhat slipshod mode of description is liable to be adopted. In practice no great harm perhaps is done, but the moment that exactitude of terms is asked for it is seen by our quotations how difficult it is to obtain it.

We have no purpose at this stage to enter into a discussion of the large question of the advantages and disadvantages of decimal *versus* other systems of weights and other measures; we must take the British system as we find it, and endeavour to explain its apparent anomalies, though, once understood, they are simple and easy of application.

The unit of our system is the grain; upon it all other dimensions are founded. Thus there are 437½ of these grains to make the ounce of commerce, which only have photographers anything to do with; the troy ounce containing 480 grains only refers to the precious metals and precious stones. Nitrate of silver is sold by the commercial (techni-called avoirdupois) ounce. From this ounce we get the pound weight, which is equal to 16oz. Confusion begins to grow interestingly intricate here. Everyone knows there is a troy pound and an avoirdupois pound, each having its own number of ounces, also varying in weight as described; but if the grains figures only were remembered no difficulty need arise. The troy pound has 5,760 grains, the avoirdupois pound 7,000 grains—all grains, it is understood, being alike, whatever denomination they are connected with.

Perhaps if this were the only difficulty the true figures would soon be committed to memory, but, unfortunately, the capacity-measures tend in the opposite direction. The imperial gallon is a measure of a space which, when completely filled with water, would hold exactly 10lb. weight, or 160oz. The 160th part of a gallon, therefore, is a "fluid ounce"; but as a fluid ounce of water is equal to a weighed ounce, the first half of the word is usually dropped, a course which often leads to misconception when fluids heavier or lighter than water are in question. But the most unfortunate confusion of all consists in the divisions of the ounce. We have recalled the respective weights of the troy and the avoirdupois ounce, and here it may be mentioned that the ounce formerly used by apothecaries and by the chemist and druggist contained the same number of grains as the troy ounce—480; hence, whenever the division of the fluid ounce into 480 minims was called to mind, the majority of those referring to these divisions jumped to the conclusion that the minim and the grain were identical. This, however, it will be plainly seen they are not, for a minim of water is the 480th part of an ounce containing, not 480 grains, but 437½ grains. Our readers who are not quite familiar with this point would do well to think it well over; they are not likely to forget it again. An ounce weight and an ounce measure of water (at suitable temperature and atmospheric pressure) are identical, and either contains 480 minims or 437½ grains of water.

Let us in conclusion go back to the percentage question. If an ounce of chrome alum be dissolved in a small quantity of water, and, next, the solution made up in bulk to measure half a pint—that is, ten "fluid ounces," then every fluid ounce will contain a tenth of an ounce weight of chrome alum, but a fluid drachm will not contain a tenth of a drachm of alum; for if the latter term be employed at all (it was omitted over twenty years ago in the British Pharmacopœia) it means the eighth part of the apothecaries' ounce of 480 grains. But this term should be entirely discarded, and thus one form of confusion be avoided. We cannot but think the retention in our legal weights and measures of terms of similar name but different signification most unfortunate. It is the true cause of all this confusion.

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* From the *British Journal of Photography*.

HOW TO SHARPEN A PLANE IRON.

THE simple art of sharpening a plane iron is supposed to be understood by every mechanic, but there are hundreds of men who cannot do a creditable job in this respect. The common tendency is to round off the under part of the cutting edge of the tool until it gets so stunted that the tool strikes the work back of the cutting edge. To do the job correctly, we will begin at the beginning, and grind the tool properly. First, the kind of wood to be cut must be taken into consideration. Common white pine can best be worked with a very thin tool ground down even to an angle of 30°, provided the make of the tool will allow it. Some planes will not, for the iron stands so "stunt" or nearly perpendicular, that its grinding causes a severe scraping action, which soon wears away the tool. In such cases from 45° to 60° is the proper angle for plane irons, and this, too, is about right for hard-wood planing.

Determine the angle you want on the plane iron, and then grind to that angle, taking care to grind one flat bevel, and not work up a dozen facets full of monkey faces and cat noses. If the stone be small, say 12in. to 18in. in diameter, the bevel will be slightly concave like the side of a razor, and this is a quality highly prized by many good workmen. In grinding take care to avoid a "feather edge." If the tool already possesses the right shape—that is, if it be just straight enough across the edge, then grind carefully yet boldly right up to this edge, but not grinding it entirely off. The time to repair a mill or a machine is just before repairs are needed, and the time to stop grinding a tool is just before the old bevel is all ground off. No matter if the part of the old bevel left be not over 1-100th of an inch, that is enough to prevent a feather edge, and can be easily reduced on the oil-stone.

Should the tool need any change of shape, such as the grinding out of a nick or a broken place, then put the edge of the tool against the stone, and bring the tool to the desired shape before touching the bevel. If the bevel is ground away until the tool be brought to its shape there will be any amount of feather edge made which will trouble greatly in getting the exact required shape of tool. Before grinding let the cap be set back about ⅛in., and there fastened securely. It will answer for a guide to grind by, and the tool can be readily brought to shape if any nicks are to be ground out. After grinding remove the cap, and wipe clean both the cap and the plane iron, then put a few drops of oil on a good, clean oilstone, and whet up the plane iron.

Let the iron lay perfectly flat upon the stone, with a tendency only to bear harder upon the edge of the bevel than upon the heel. Move the iron back and forth upon the stone as fast as your skill will allow, taking care that the heel of the bevel is not lifted from the stone. As you become proficient in whetting an iron, the heel may be lifted from the stone about the thickness of a sheet of

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CARRYING CAPACITY OF WIRES.

W … carrying capacity of those … which every day … engineer in the fam, … 1890, he is … widely at … important …

… the above results … with a recent series of practical experiments and measurements in this direction.

Table II. shows at a glance that the larger wires must necessarily become unsafely heated. For instance, a No. 0 wire, carrying three amperes per square millimetre in a heated engine room, or in an outside temperature of about 100° F., if made of the best copper, would show about 168° F.

But if we were to substitute copper of, say, about 90 per cent. conductivity, or a portion of the conductor has a sharp bend, an elbow, or a twist, by which condition it has lost part of its conductivity, it would not only become painfully warm, but intolerably hot, and blister the hand that grasps it.

And again, a glance at the table shows that the increase of temperature is proportionally greater in larger than in smaller conductors, which at once suggests that while some universal rule is asked for, this one fails of general application.

What is needed is some law which will make the ratio between the heating effect of the current and the cooling surface of the conductor a constant.

The Swedish rule in this regard, is by far the best. Table III. … the safe carrying capacity … will … a given current … temperature above 10° C. …

… University. …

… oxide. … periods … Subsequently … of electricity … measured. … less than 11 … converted into … higher proportion … Berodie or by the … when similar … but not so high … Tait, who, however, … and the exact value … in consequence of … acid that they used …

Quantitative … —Inasmuch as … introduced into the … paper prepared from … yellow and then … unsightly, an estimate … present becomes des… diamine imparts … paper containing … with paper prepared … order to make this … to be examined … reagent, and the … standard papers … As then the … paraphenylenediamine … quantitative, these … and estimated by some … such as iodine. A few … as examples.—*Journ …*

TIFIC SOCIETIES.

ICROSCOPICAL SOCIETY.

ding meeting of the session was held
th inst. at King's College, Strand,
the Rev. Dr. Dallinger, F.R.S., in

onations to the society was read, and
the meeting voted to the donors,
specially called to a new work on
graphy," by Dr. E. C. Bousfield,
d an ingenious table of exposures;
ond edition of Dr. Crookshank's
acteriology," the enlarged scope of
icated by extracts read from the pre-
a lithograph print from Dr. P. H.
a number of microscopic objects, all
s shown by the same magnifying
original drawing was made by Dr.
ll Holmes, and was given by him to
arpenter, C.B.
ad a letter from Mr. Dreyfus, late a
council, and who was now residing
accompanying a notice of the 60th
ng of the Society of Naturalists and
be held at that place from the 15th
September next. The objects of the
strictly scientific and not commer-
dance usually numbering about 3,000,
imated that a cordial welcome would
y of the Fellows of the society who
to attend.
rookshank exhibited a series of culti-
ro-organisms, and called attention to
unusual circumstance of being able
a typical series all growing at the
Many of the kinds exhibited were by
rably familiar to those who were in-
uch subjects; but there was one or
particular interest about which he
ew words. He had sometimes drawn
he fact that the chromogenic bacteria
loped their colour only on the surface
, but a specimen now shown formed
to this rule. It was interesting as
t *Spirillum* which had been cultivated
d being a chromogenic *Spirillum* had
colour in the depths of the gelatin
he general rule. Another specimen
Bacillus figurans seen growing upon
f the gelatin. When first described,
were sceptical as to the fact of a
loping such a symmetrical pattern;
ow be cultivated quite easily, and he
ppy to supply anyone interested in
ith material from which it could be
ometrically as in the example before
lso showed a micro-organism which
l to cause the swine fever—or, rather,
las—in Germany. It was to be noted
any there had been many cases of
, and that a different organism had
associated with it there from the one
and recognised as the cause of Dr.
fever. So far as he, Dr. Crookshank,
e to make out, they were not identical,
form being an extremely minute
ning only a cloudy appearance, and
e similar to mouse septicæmia. He
e was good ground for regarding the
as distinct from each other, the
n being swine erysipelas as distinct
ever. He also exhibited an example
obtained from putrid fish, which
markable phosphorescence frequently
fish was decaying.
ent complimented Dr. Crookshank on
le series which he exhibited, illus-
partment which he had made so much

an exhibited a number of series
he anatomy of spiders, worms, &c.,
en made by Mr. Underhill, of Oxford.
ther remarkable specimens of section
ounting, in some instances from 30
tive sections having been obtained
e spider. Some drawings taken from
e also exhibited.
nt, referring to a drawing of a longi-
n through a spider, showing all the
u, asked if the section from which
en was included in the series ex-

an said that this drawing was not
y one section, but was a composite
ded to show the internal structure as
e examination of a great number of

id that though bringing microscopic
e Society seemed like "carrying coals
," he had ventured to bring some
Actinomycetes from the jaw of an ox;
imen from the Royal College of
seum of the jaw showing what the
The effect upon the animal was to
urs in the jaw, and the disease occa-
d so as to affect the kidneys, intestines, and other parts of the body. The organism consisted of a number of spheres, each having a structureless centre, round which large numbers of *Actinomycetes* were arranged very much in the same way as pins might be stuck on a round pincushion. The inflammatory new formation was very much like what occurred in the growth of tubercle or syphilis. The disease could be communicated by inoculation to other cattle, and also in the same way from man to the rabbit. The sections were prepared by staining first with a magenta solution, which selected the micro-organisms, and afterwards with a watery solution of methyl blue, which stained the tissues.

Dr. Crookshank said, with regard to the disease referred to as existing in man, his own view was that there was very little ground for supposing it to be the same as that of the ox. The bovine disease was very clearly marked, and could hardly be mistaken; but he might say that although clinically the two forms of disease might appear very much the same, the fungus which had been found in man differed very materially in its microscopic features from that obtained from diseased cattle. The new method of staining these objects with magenta picric acid would be found very effective; he had tried a great number with success by using orcein and then gentian violet.

Mr. Crisp read a circular which had been sent descriptive of a new glycerin-immersion objective, in which the following statement was made:—

"Their experiments and experience prove glycerin to be a much better medium than water or oil. Water necessitates the microscope being used almost upright, and soon evaporates. Oil requires great care in manipulation and loss of time in cleaning off after use—*glycerin is free from these objections*. It will remain three or four days limpid and free from evaporation, and only requires cleaning off with a camel-hair pencil dipped in water, and the lens dried with blotting paper. This objective has more brilliant definition, deeper penetration, and a greater working distance from the object than any others of its class at much higher prices."

In this statement was crowded as many optical and other errors as could well be compressed into the space. A glycerin-immersion objective was necessarily non-homogeneous, and could not therefore be compared with homogeneous immersion objectives. As it must have a lower numerical aperture, it could not have "more brilliant definition," while glycerin was more (and not less) difficult to use and clear off the oil, and was more subject to atmospheric influences.

Prof. Rupert Jones and Mr. C. D. Sherborn's paper "On the Foraminifera, with especial Reference to their Variability of Form illustrated by the Cristellarians," was read.

Mr. G. Massee gave a résumé of his paper "On the Genus *Lycoperdon*," illustrating the subject by drawings upon the black-board.

Prof. Bell said that the Fellows of the Society would probably remember that in the course of last winter he took the opportunity of describing what he had been able to observe in the case of some diseased grouse which had been sent to him for examination. Within the last few weeks the disease, whatever it might be, had been killing grouse in considerable numbers on the moors in the south-west of Scotland, though it did not appear to prevail to any great extent elsewhere. In the month of May last he received some of these diseased grouse in fairly good condition, and he examined them very carefully to see if he could discover any cause of death, because on the former occasion the tape-worms were all that could be found, and these did not seem sufficient to cause death by themselves. The first grouse which he examined this year were fairly well nourished, and again the tape-worms were found; he looked carefully, as before, for the small round worm (*Strongylus*) mentioned by Dr. Cobbold, and again he found it to be absent. In this case, however, he found the intestines were inflamed and gorged with blood; not finding anything further, he wrote to say that they should be examined by a pathologist rather than by a helminthologist. More recently he had received from Sir William Wallace a grouse which was in a most emaciated condition, there being hardly anything of it but skin and bone. He examined this, and again found tape-worms, and also Dr. Cobbold's *Strongylus*. This being so, they had now three sets of grouse which had died from disease; but the only actual fact before them was that the grouse were dead. In the case of the first, though there were tapeworms, there was no evidence that they were the cause of death. In the second case, the birds had died from inflammation of the intestines, the cause of which was not quite clear; and, in the third case, they died of *Strongylus*. It would, therefore, appear that what was called "grouse disease" must be either more than one disease, or it must be a disease which could kill the victim in different stages. He was himself disposed to think that there was more than one cause of disease; but up to that time there was no diagnostic sign internally to show conclusively what those causes were. The gamekeepers were a class who were popularly supposed to know a great deal about natural history, and they said there were certain outward signs which were sure indications that birds were affected by the disease—they were, however, not comparative anatomists, and perhaps their science generally was to be received with some reserve. Taking as an instance the case of the ptarmigan, a species closely allied to the grouse, it was found that in winter it had a very large number of feathers upon its feet; but as the spring advanced it lost many of these in a natural way. The gamekeepers said that losing the feathers from the feet was a sure sign that the bird was diseased; but as all kinds of grouse more or less lost these feathers about that time of year, this indication of disease fell to the ground, and it had to be admitted that there really was no definition of grouse disease which was acceptable either to the pathologist or to the helminthologist. The action of *Land and Water*, in proposing to send diseased grouse to M. Pasteur for examination had caused great excitement in some quarters; but he would venture to say that, as it was impossible to keep these wild birds healthy in confinement for any length of time (after undergoing the journey from Scotland to Paris) the conditions would not be favourable for the formation of an opinion of great value. What he suggested to the owners of moors was that some professed bacteriologist should proceed to the affected districts and examine the matter on the spot—at their expense, not at his own.

The President said the Fellows would probably remember Prof. Bell's remarks upon the subject last winter, and his exhibition of the actual tape-worms which he had then found. They would not fail, therefore, to be much interested by his additional very practical and interesting series of remarks.

Mr. Grenfell's paper on "New Species of *Scyphydia* and *Disophysis*" was read.

ROYAL METEOROLOGICAL SOCIETY.

THE concluding meeting of this Society for the present session was held on Wednesday evening, the 15th inst., at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. W. Ellis, F.R.A.S., President, in the chair.

The following papers were read:—

(1) "Amount and Distribution of Monsoon Rainfall in Ceylon generally, with remarks upon the Rainfall in Dimbula." By Mr. F. J. Waring, M.Inst.C.E. The principal feature in Ceylon as determining both the amount and distribution of rainfall is a group of mountains situate in the south central portion of the island, equidistant from its east, west, and southern shores. The south-west and north-east Monsoons in Ceylon may be said respectively to blow steadily from May to August inclusive, and from November to February inclusive. In March and April, and in September and October, the weather is more or less unsettled, and no regular Monsoon or direction of the air current is usually experienced. After giving details of the rainfall at 25 stations, the author concludes by remarking upon—(1) The effect of the mountain zone in determining the amount and distribution of the rainfall. (2) The apparent gradual veering of the rain-bearing currents of air as each Monsoon progresses. (3) The relative insignificance of the south-west Monsoon as compared with the north-east Monsoon in inducing rainfall. (4) The cause of the large general rainfall of the north-east Monsoon throughout the island generally as compared with that of the south-west Monsoon. (5) The influence of the gaps in the external ring of the mountain zone, and of the central as well as the other ridges in it, in determining the amount of rainfall within the zone and in the neighbouring districts outside it.

(2) "Note on a Display of Globular Lightning at Ringstead Bay, Dorset, on August 17th, 1876," by Mr. H. S. Eaton, M.A., F.R.Met.Soc. Between 4 and 5 p.m. two ladies who were out on the cliff saw, surrounding them on all sides, and extending from a few inches above the surface to 2 or 3ft. overhead, numerous globes of light, the size of billiard balls, which were moving independently and vertically up and down, sometimes within a few inches of the observers, but always eluding the grasp. Now gliding slowly upwards two or 3ft., and as slowly falling again, resembling in their movements soap bubbles floating in the air. The balls were all aglow, but not dazzling, with a soft, superb iridescence, rich and warm of hue, and each of variable tints, their charming colours heightening the extreme beauty of the scene. The subdued magnificence of this fascinating spectacle is described as baffling description. Their numbers were continually fluctuating; at time thousands of them enveloped the observers, and a few minutes afterwards the numbers would dwindle to perhaps as few as twenty, but soon they would be swarming again as numerous as ever. Not the slightest noise accompanied this display.

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CARRYING CA

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(3) "Ball Lightning Seen during a Thunderstorm on July 11th, 1874," by Dr. J. W. Tripe, F.R.Met.Soc. During this thunderstorm the author saw a ball of fire of a pale yellow colour rise from behind some houses, at first slowly, apparently about as fast as a cricket ball thrown into the air, then rapidly increasing its rate of motion until it reached an elevation of about 30°, when it started off so rapidly as to form a continuous line of light, proceeding first east then west, rising all the time. After describing several zigzags it disappeared in a large black cloud to the west, from which flashes of lightning had come. In about three minutes another ball ascended, and in about five minutes afterwards a third, both behaving as the first and disappearing in the same cloud.

(4) "Appearance of Air Bubbles at Kemenham, Berkshire, January, 1871," by Rev. A. Bonney. Between 11 and 12 a.m. a group of air-bubbles of the shape and apparent size of the coloured india-rubber balls that are carried about the streets were seen to rise from the centre of a level space of snow within view of the house. The bubbles rose to a considerable height, and then began to move up and down within a limited area, and at equal distances from each other, some ascending, others descending. These lasted about two minutes, at the end of which they were borne away by a current of air towards the east and disappeared. Another group rose from the same spot, to the same height with precisely the same movements, and disappeared in the same direction after the same manner.

Mr. H. C. Russell, F.R.S., of Sydney, described a fall of red rain which occurred in New South Wales, and exhibited under the microscope specimens of the deposit collected in the rain-gauges.

SCIENTIFIC NEWS.

THE preparations for the meeting of the British Association in Manchester are progressing satisfactorily, and a guarantee fund of upwards of £10,000 has been raised to cover the local expenses. The reception-room will be in the newly-built Natural History Museum, Owens College, and the rooms for the sections in the College or its vicinity. It is expected that a large number of foreign men of science will attend the meeting.

The Government Astronomer at Madras, Mr. Pogson, has published a first volume of results of meridian observations of fixed stars made during the first three years (1862—64) of his superintendence of the observatory. They were made with the transit circle by Troughton and Simms, the aperture of which is 5¼in. and focal length about 50in. The volume is to be followed shortly by others containing lunar and planetary observations.

Dr. Thome, of Cordoba, has published in the *Astronomical Journal* some particulars of the great southern comet which he discovered on Jan. 18. The comet seems to have been all tail, the head being without nucleus or condensation; the tail, however, presented a remarkably beautiful sight, being over 40° long, shining with a soft light against the dark sky.

In the same journal Prof. Asaph Hall publishes the result of a new determination of the parallax of Aldebaran, deduced from observations made with the Washington refractor of 26in. aperture from October, 1886, to March, 1887. The places of the star were compared with those of the 11th mag. companion, and the result, 0·102″, with probable error ·0296, appears entitled to considerable confidence, as the observations were all made near the meridian, and the conditions generally were as good as are likely to occur.

According to the twenty-first report of the Board of Visitors of the Melbourne Observatory, the great telescope has been devoted almost exclusively to observations of the southern nebulæ, the only exceptions being in the case of remarkable comets. The meridian work was done with the new transit circle.

The Council of the London Mathematical Society have awarded the second De Morgan Medal to Prof. Sylvester, F.R.S., for his numerous and brilliant contributions to pure mathematics. The presentation of the medal will take place at the annual meeting in November next.

The prize of £1,000 offered by the Grocers' Company has been renewed, as the problem has not been solved by any of the candidates. The question put was:—"To discover a method by which the vaccine contagium may be cultivated apart from the animal body, in some medium or media not otherwise zymotic—the method to be such that the contagium may by means of it be multiplied to an indefinite extent in successive generations, and that the product after any number of such generations shall (so far as can within the time be tested) prove itself of identical potency with standard vaccine lymph." The prize is open to universal competition, British and foreign. Competitors for the prize must submit their respective treatises on or before the 31st of December, 1890, and the award will be made as soon afterwards as the circumstances of the competition shall permit, not later than the Month of May, 1891. In relation to the discovery prize, as in relation to other parts of the company's scheme in aid of sanitary science, the Court acts with the advice of scientific assessors. All communications on the subject are to be addressed to the Clerk of the Grocers' Company, Grocers' Hall, London, E.C.

The proposal to establish a marine biological laboratory at Grimsby under the auspices of the National Fish Culture Association, has produced a letter from Prof. Ray Lankester, the hon. sec. of the Marine Biological Association of the United Kingdom, in which he deprecates the seeming rivalry which will be thus established if the proposal is carried out. The Marine Biological Association has a building fund of £12,000 and an income of £1,000 a year. Its affairs have so far been conducted without payment to any of its officers, who have given time and work freely to its objects. The great laboratory at Plymouth, a locality selected on the best scientific advice, will be completed this summer, at a cost of £9,000. It will be provided with every appliance for the thorough and scientific study of marine food-fishes and for experiments on such questions as the artificial culture of these fishes. It is the opinion of those who have directed the policy of the Association that no results of value in regard to fish questions can be obtained either hurriedly, or by the use of inadequate appliances, or by ill-considered experiments and unskilled observation. It is in order to protect the public against the quackery and interested pretensions which have led to fruitless legislation and to the waste of vast sums of money, literally thrown into the sea by private speculators, that many men of science and politicians, such as the members of the late Trawling Commission, joined the Marine Biological Association and contributed to its funds. Local bodies would, he thinks, act wisely if they asked for the counsel and assistance of the Marine Biological Association before they erected laboratories which may prove to be worthless, and they would certainly avoid the appearance of conflicting with an association which has been established for the benefit of the whole nation.

M. Pasteur has addressed a letter to the Imperial and Royal Society of Vienna, in which he refers to the strictures of Dr. von Frisch on his method of treating rabies or hydrophobia. M. Pasteur points out that the experiments performed by Dr. von Frisch, the results of which were unfavourable to his method, were made chiefly upon rabbits. He discusses their value, and concludes that "these facts not only ruin the experiments in question, but shake all confidence in the whole work of Dr. von Frisch." At the last meeting of the Vienna Society, reported in the *Semaine Médicale*, Dr. von Frisch went over the same ground as in his previous communication. He maintained that M. Pasteur's reply was not a refutation of his objections, and said that he was confident that the future would decide in his favour. M. Ullmann, on the other hand, submitted three provisional conclusions to the Society, which were as follows: 1. Animals do not become rabid by inoculation with the preventive virus. 2. Some animals can be made refractory to rabies by the preventive inoculation. 3. The statistics of the preventive inoculations made (by M. Ullmann) in man appear favourable to Pasteur's method.

Mr. W. H. Preece calls attention to the fact that incandescent lamps sometimes explode

when the [illegible]
and he [illegible]
Campinas. [illegible]
was nearly [illegible]
connected [illegible]
face and [illegible]
Preece [illegible]
in the gas [illegible]
formation [illegible]
the remainder [illegible]
He asks [illegible]
explanation.

The results of [illegible]
brakes on the [illegible]
Railroad [illegible]
World the [illegible]
electricity [illegible]
future. Our [illegible]
proved that [illegible]
accomplished [illegible]
the rapidity [illegible]
to a standstill [illegible]
The manner [illegible]
generated and [illegible]
it seems, [illegible]
We may, of [illegible]
but batteries [illegible]
trials. In [illegible]
closed circuit [illegible]
former case. [illegible]
work during [illegible]
on the other [illegible]
shared in by the [illegible]
indication of [illegible]
the apparatus.

With [illegible]
is said to be [illegible]
Sheffield, it was [illegible]
the refuse heaps [illegible]
A. H. Allen, [illegible]
exploded the idea [illegible]
lead in the [illegible]
has the property [illegible]
through the [illegible]
allowed to stand [illegible]

At a recent [illegible]
Prof. Perry [illegible]
why a strip of [illegible]
tudinal axis at a [illegible]
tends to untwist [illegible]
formula to calculate [illegible]
gested that the [illegible]
way of putting [illegible]
and that it is [illegible]
of strings or wires [illegible]
out of rectilinear [illegible]

Deaths in railway [illegible]
rare; but an instance [illegible]
Carnforth line, [illegible]
dead in his box. [illegible]
"on." Telephone [illegible]
signal-boxes may [illegible]
but railway [illegible]
arrangement to [illegible]
as well as the [illegible]
is not wise to leave [illegible]
one man, who may [illegible]
with a fatal disease.

The City Commis [illegible]
to advise the [illegible]
for cattle, on the [illegible]
glanders. If that [illegible]
it is time that [illegible]
to check it; but [illegible]
fountain might be [illegible]
constant supply of [illegible]
always fresh.

The Council of [illegible]
determined to offer [illegible]
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work, £25, £15, [illegible]
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applied to the deco [illegible]
objects, £25, £15, [illegible]
on wood, copper, [illegible]
furniture and in [illegible]
£10; 7, hand- [illegible]
£10; 8, repoussé [illegible]
metal, £25, £15, [illegible]
must be sent in [illegible]
cember 3 next, and [illegible]
Particulars can be [illegible]
of the Society of [illegible]
W.C.

Find Greenwich sidereal time by adding or subtracting the longitude W. or E. in time, to or from given L.S.T.

Find the Greenwich mean time at last sidereal noon (transit of 1st point of Aries, *N.A.* page III. each month).

Add the mean time equivalent of Greenwich sidereal time.

The sum is the Greenwich mean time.

TO FIND G.M.T. CORRESPONDING TO L.S.T.

.... 188

h. m. s.

Given L.S.T. = Longitude =

Long. =

G.S.T. =

h. m. s.

G.M.T. at preceding transit of First Point of Aries (*N.A.* p. III. each month). =

Mean time equivalents (*N.A.* pp. 480—1).
- Hours in G.S.T. =
- Minutes in do. =
- Seconds in do. =
- Decimals of seconds in do. =

G.M.T. required =

III.—To find local sidereal time from the given local mean time and longitude.

L.S.T. required = G.S.T. at last G.M. noon + S.T. equivalent of G.M.T. (which = L.M.T. + long. W.) — long. W.

Find the Greenwich mean time by adding or subtracting the longitude W. or E. in time.

Proceed as in Problem 1.

IV.—To determine the error of Greenwich Mean Time clock.

Observe the times by Greenwich Mean Time clock and Local Sidereal Time clock, T and T_1 when the beats coincide.

[FORM TIME 3.]

True G.M.T. corresponding to T_1 = G.M.T. at preceding Sidereal Noon + M.T. equivalent of G.S.T. (T_2) = T_1 corrected for error of S. clock + long. W. in time.

The difference between this result and T. is the error in question.

Proceed as in Problem 2, having first corrected the Local Sidereal Time for clock error, and then subtract T.

TO DETERMINE ERROR OF GREENWICH MEAN TIME CLOCK.

(To find G.M.T. from L.S.T. and Longitude).

.... 188

Longitude =

h. m. s.

G.M.T. clock when beats coincide (T) =

L.S.T. " " " (T_1) =

Error of L.S.T. clock =

True L.S.T. =

Longitude =

Greenwich Sidereal Time (T_2) =

Mean time of preceding transit of First Point of Aries (*N.A.* p. III. each month.) =

Mean time equivalents of (*N.A.* pp. 480—1)
- Hours in T_2 =
- Minutes in T_2 =
- Seconds in T_2 =
- Decimals of seconds in T_2 =

Mean Greenwich Time =

Subtract T. =

Error of Mean Clock =

V.—To determine error of Greenwich mean time clock from local mean time dial on sidereal time clock.

Observe the times T T_1 by the G.M.T. clock and the L.M.T. clock when the beats coincide.

[FORM TIME 4.]

True G.M.T. corresponding to T_1 = L.M.T. + mean time equivalent of error of sidereal clock + long. W. in time.

The difference between this result and T is the error in question.

Find the mean time equivalent of the clock error [*N.A.* pp. 480-1], and apply it to the local mean time.

Add the longitude W., or subtract if E. in time, giving true Greenwich time.

Subtract the time by Greenwich mean time clock (T.)

Remainder is the error.

TO DETERMINE ERROR OF G.M.T. CLOCK FROM L.M.T. DIAL ON SIDEREAL CLOCK.

.... 188

Longitude =

h. m. s.

G.M.T. clock when beats coincide (T) =

h. m. s.

L.M.T. clock when beats coincide (T_1) =

s.

Error of sidereal clock (E) =

Mean time equivalent of E =

Longitude =

True G.M.T =

Subtract T =

Error of G.M.T. clock =

Sm.

(*To be continued.*)

DECIMAL COINAGE.

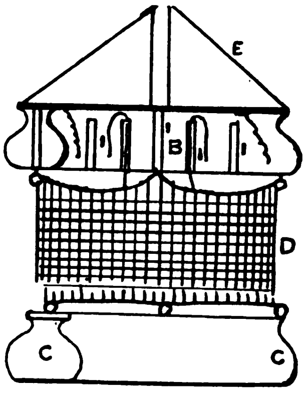
[27476.]—IT is to be hoped we shall, for once, not be treated like cattle in this matter—getting a foreign currency forced upon us without being asked if we will have it or not. Government should issue papers with the two questions thereon to be answered. The postmen would leave one paper at each house, and the papers, when answered, being posted by the householders, would be collected by the postmasters, pros and cons. counted, and the figures telegraphed to headquarters, where the sense of the nation on the subject would be apparent. The nation as a body is quite fit to decide this question, I think. **Silke.**

ATTEMPERATOR, AQUEOUS DISTRIBUTOR, OR REFRIGERATOR.

[27477.]—IF any of the above names do not fit, I would thank some of "ours" for one more fitting. To explain matters I am afraid I shall be taking up too much space; if so, the Editor must curtail. In September, 1884, in getting out the plant for the installation for the electric lighting of Victoria Station, I met with an accident which has told rather severely on me—had a fall from a platform, backwards, and in falling the bottom of my spine came in contact with the corner of a lathe bed, which very nearly knocked the life out of me, that I scarcely knew whether I was on foot or horseback. You may guess that it left my nervous system rather shaky. I tried to pull through; but, to mend matters, I was most cruelly submitted to a fumigation of salammoniac, chloride of zinc, and Baker's fluid, for no earthly purpose but for annoyance, my accident having made me irritable. The effect of that upon my head, nostrils and throat, and my system was something terrible. At last I was obliged to cry a go, and go to seek some medical advice. My first medical man would take my statement into consideration, and treat me; but the last laughed at me, and called me everything but a sensible man. After being drugged with strychnine, phosphorus, and iron, the which put me in such torment that no pain can describe, for twelve months, I came to the conclusion if peg out I must, I would die a natural death, so would take nothing more in the shape of drugs. Thanks to a Doctor Allinson, I am improving, but very slowly, and what I am fighting for now is a little peace or ease if I am to live the allotted time of man. I am just completing the last of my three score. I have bathed and steamed to no purpose. It is thus with me, and for this last three years, and cannot get rid of it: frosty dry air to breathe, it is like breathing scalding steam, the while it seems as if I had two hot wires probing up into my head, making my eye balls ache and burn, and very near blind me, and nose and eyes run of water as if I had a very bad attack of influenza. The present hot and dry weather, as well as the hot dry air of a room, distresses me very much to breathe. My nostrils seem burnt up, and when moving my nostril it seems to split somewhere inside, and a tear of blood, watery, or scalding clear water follows. At times I get a gush of several drops of clear water which sting me like the most powerful ammonia, which bring on such a violent attempt to sneeze, that it seems to fairly buckle my poor ribs over one another, and does not end in a sneeze. I am afraid that some of these days I shall meet with a serious rupture or burst a blood-vessel, and so wipe me out—and with the present state of my nerves it distresses me so that I scarcely know where to put my head or what to do with myself. I have come to town, and find that the dry London atmosphere and dusty roads are worse than the country. I have hit upon a plan which affords me great relief, and, of course, must come to the old shop for assistance—a trifle, that if I can get it anywhere, I think I can here. And, another thing: I have an idea that my scheme will be useful, and mine will not be the only one made by many hundred. I find by saturating an old jute bag I have, and hanging up in the open doorway, I lower the temperature considerably, and afford great relief. But there are great disadvantages: gravity and capillary attraction take the water out on to the floor or into a bath so rapidly, and leave scarcely anything for evaporation, and wants renewing every ten minutes or quarter of an hour. Now, I want to know whether there are any of "ours" that can tell me where I can get a coarse jute or hemp canvas tanned the same as that used for leggings, bags, and slippers, only I want it stout, open (about ¼in.) mesh, and about 16 or 18in. wide, made something after the style of jack-towelling. The following is a sketch of the idea, and I would like someone's opinion of it, and these sultry days, if once tried, I think would be adopted by more than myself. There are some things connected with my poor carcase that I cannot understand, and what bothers me is, I can walk 20 miles far better than I can either sit to write 20 minutes or stand still, so if there is nothing else in "old Jack," there is still some go, and all else is a question of time, so I must grin and bear it, though to suffer what I have done this last three years has many a time made me offer up a prayer for my release.

Jack of All Trades.

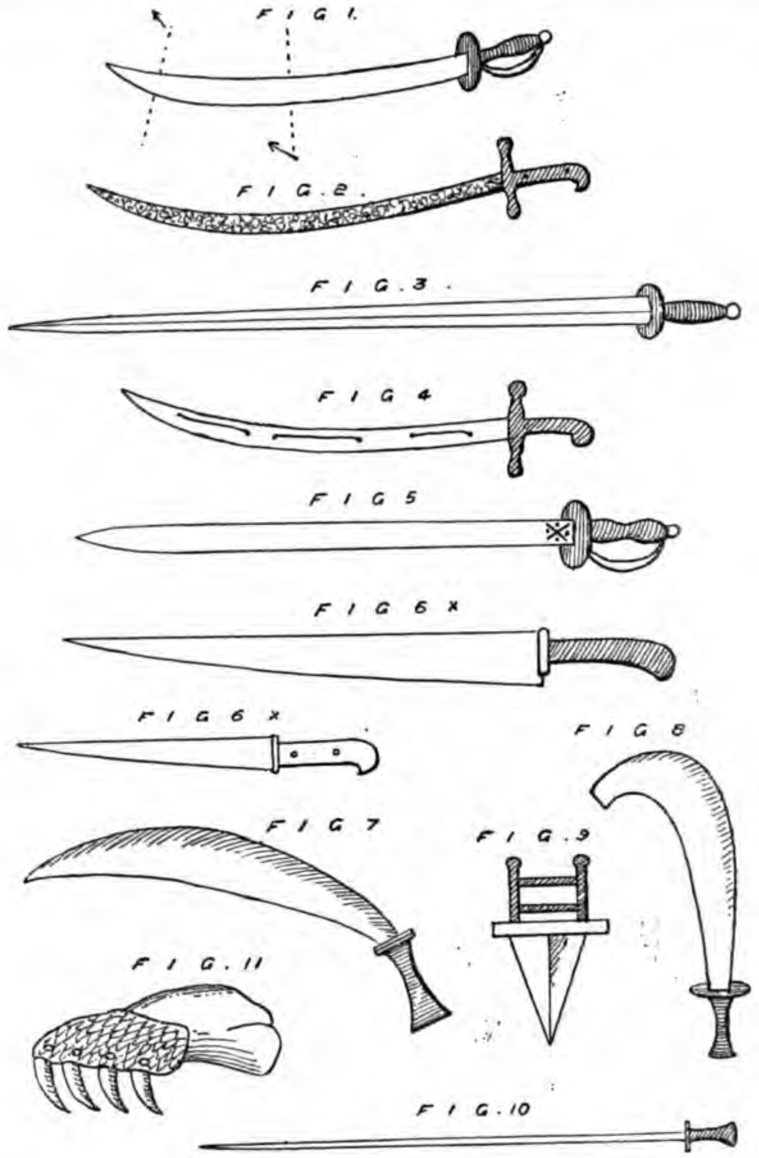
Sky Parlour, London, E., June 15.



Explanation of Sketch.—A is a receptacle made of zinc to hold water; B, a tubular way for the sling; I, I, I, I, tubes to hold lamp cotton siphons, passing through the bottom and looped into the meshes of canvas D; C, another receptacle at bottom made of zinc for a catch-all, if needed, but I think the feed will be so slow that it will not be needed; the bulb of vessels about 3in., and 18in. long. Not patented.

EASTERN SWORDS AND DAGGERS.

[27478.]—THE high-class damascened and exquisitely-tempered blades, the curved scimetars of extra hard steel, and the keen weapons of highly-finished durability, came to India with those mighty conquerors of the East, the Mohammedans, whose descendants under the victorious and peace-promoting British rule can no longer follow the craft, disarming being the prevailing *régime*. The comparatively few sword blades of sterling quality nowadays are only to be found in the palaces of loyal princes, most of them heirlooms in their armouries. Before the great Mutiny, every native, even menial servants, carried a sword; the peasant at his plough wore the weapon of defence; so did the homeless wanderer in search of employ, and the black soldier on short leave. It was a national appendage, due to the unsettled state of popular feelings and lawless inclinations. The excited Moslem printed and shouted the great text of the False Prophet, "The sword is the key of heaven and hell"; while the quiet Hindoo frequented midnight meetings, and brought his *tegher*, or village sabre, to a razor edge. The quiet dweller in England will scarcely believe the prodigies performed in sword-cutting by these coarse, ill-looking bits of curved metal, costing frequently no more than 1s. 6d. to 2s.! The Englishman can excel in everything if he chooses to master the object. Not less than half a dozen, perhaps even a dozen, have attained such swordsmanship with the Oriental weapon as to be acknowledged champions, the title of "Master of the Sword" (Sahib Tulwar) being bestowed on them by universal consent. I had shot numerous wild beasts, when I was told by an expert that my hunting education was very deficient, as I could not handle a scimetar to stop my game. I was told to exercise continually on a pillar of soft clay, and thus acquire the drawing out at the proper part of the blade; then on a pillar loosely stuffed with cotton; then on a newly-killed wild cat or jackal, kneaded previous to the practice by the feet of a heavy man till the carcase became a loose, soft mass; then on a great pond carp, a fish clad with heavy, horny scales, like elastic mail—considered an A1 feat to test man and sword. My first trial at this experiment resulted in a triple fracture of the good blade, [illegible]



flying in the air, uncut, only dislodged; then the artistic *tour de force* at paper cones placed on a table, and muslin thrown up to a height—all manner of strange and difficult tasks, which, being only ornamental, I eventually forsook for the useful and more easy decapitation of fierce quadrupeds, beginning with a wounded wild hog of full growth, and on essaying the sloping stroke behind the ear, sweeping off the head nearly, that important part dropping between the fore-feet. Not long before I had seen a bold young Ghoorka princeling dismount from his elephant, leave it standing to await his return, and follow on foot alone an immense boar he had wounded with his rifle. On nearing the powerful brute, it champed its foamy tusks to charge. He drew his *kookree* (or Nepaulese sword), and as it sprang at him, the blade was buried across piggy's back, all but severing him in two parts! Perhaps the readers of "E. M." will not credit my statement of village peasants with sword and shield attacking and slashing a full-grown tiger, when one of these powerful animals has strayed from the forest into their fields. Yet I have often known such encounters—a man or two always killed and several wounded, the tiger's skin spoiled, too, by the long, deep cuts of their teghars. I saw a champion swordsman, a native soldier, who went into the rose-bushes alone with no other weapon—shield on shoulder. His cuts were masterly; but the bold man was soon struck down and severely mauled. A crowd came to the rescue and shot the beast; the hero slowly recovered. "The Manly Weapon" is its designation. In their party fights each side would swear that no other deadly arm should be used. I accidentally witnessed one of these combats. Swordsmen, shield on arm, in twos and threes came running to the scene of quarrel—a cow's trespass. It was an exciting event. Clansmen were continually arriving, and every man selected his foe. There was grand sword-play. The head, legs, and arms seemed to me the chief points of attack. Being a British subject, passing through an independent State, I was obliged to gallop off as fast as my horse could go at the commencement of this battle. At the same time and place near my camp two brothers fought a duel about land; one was killed, the other well slashed. In two or three days I passed by a battle royal; the King of Oudh's troops were besieging some refractory landowners, who refused to pay their rents. Heavy cannon were booming around and musketry cracking; the village swordsmen and feudal retainers, under cover of night, made many a daring sally, and left the print of their teghars on Moslem limbs. I saw blood-stained bodies on rude cots being carried away to their homes. The unequal struggle had already lasted three days. That tough and stubborn peasantry could boast that in long years they had never once been defeated—no, not even by regular troops! Among some military trophies, I once saw a very rude, rusty teghar—*locally worth a shilling*—which had cleanly decapitated a raw recruit, severing coat, collar, brass buckle, and caste necklet of hard enamel beads. The nimble village rebel had sprung on the Sepoy from a bush while trimming his flint-lock after a miss-fire. This and all the low-priced teghars and tulwars are of very soft metal, capable of being bent and straightened across the blade, while the arch, or cutting portion, with razor edge, offers immense resistance in the hands of an expert, who, behind his shield, can watch and measure his opportunity; only the straight thrust of British bayonets or Dragoon blades can reach him. The metal and finish of cutting arms improve when we enter North India. Hard steel of fine temper and high workmanship used to be common until two Sikh wars and the great Mutiny abolished the demand for such deadly wares. The skilful Mohammedan craftsman had to emigrate for a livelihood, or too often dwindled into a blacksmith of harmless occupation. I remember in the good old times of the East India Company itinerant sword pedlars, Persians and Afghans, of great stature and big turbans. "Do you want any swords?" "Yes—but where are they?" "Here," and the vendor's hands were lifted to his head-cloth, where they groped awhile; out sprang three or four shining steel snakes, elastic blades, unhandled *à la mode*, £20 to £50 each in value, sometimes more. Then the dealer put them through various severe tests to satisfy his customer, packing them away again in their hiding place, should there be no sale, and going on his road. But there were many shapes and sizes and sorts of scimetars of great price, harder and less flexible, both plain and damascened. The black steel of Khorasan, very rare in the market, reputed to cut off the neck of an anvil—an Eastern anvil, of course. The Persian and Central Asian specimens, elegantly watered in circular veins, some so light that a girl could use them, others so heavy that height and length of arm, with breadth of chest, were needful gifts of nature to utilise them—men like "Rob Roy," or "Mahmoud of Ghuzni," whose hands hung below their knees. The latter notable carried an awful steel mace in preference to a sword, and smashed idols and idolaters with his own arms on all occasions! There are certain trade marks and superstitious symbols on special blades which the Asiatic of those days feared to counterfeit. The ponderous curved sabre called the *Hosainee*, with very peculiar deep channels, like hieroglyphics, from hilt to point, found in the clenched hand of its slain owner after a great battle; the "Goojeratee" blade from the Deccan, stamped with signs and straight grooves, of hard steel, elastic as whalebone, the trusty companion of outlaws and brigands, and handed down from generation to generation of warriors—often the last dying relic of the Sepoy mutineer. Terrible two-handed swords, double-edged, heavy, and many feet long, requiring the limbs of a Hercules to wield them—such a human hero as the big Sikh Champion, who defied a crowd of bayonet thrusts in a small room heaped with his dead comrades, killing and wounding with his whirling blade every man of the 10th Regiment who advanced, till one of them, with more of caution than chivalry, transfixed the Champion by throwing his heavy musket and bayonet like a javelin. There are one-handed swords, too, of lighter construction, with hand and arm guard attached; whirling the blade swiftly with the right hand, the left one carries a dagger or pistol as an auxiliary arm. There are thin, springy, long daggers for assassins, called *kungas*, easily concealed in the long, loose vestments of Orientals; the still more treacherous and secret *kuttar*, or Afghan dagger, with which Dost Mahomed as a boy paved the road to his throne. There is the abominable and ferocious tiger's paw, consisting of hooked dagger blades set in a heavy mailed gauntlet (said to have been sometimes poisoned). This cunningly-contrived instrument has also figured in Indian history. There is the death-dealing knife of the Khyber Pass, too well remembered in the destruction of a British army forty odd years ago. These are worn and carried of every size and weight, some as large and heavy as a sword, with which the owner can cut a sheep in two parts for a feast, or expertly amputate the thigh of a charging horseman—he only fears the Lancer. The very peculiar national weapon of the Ghoorkas is something between a sword and a knife, made in two shapes. These brave little mountaineers can fell a tree or their enemy equally well. In war the Ghoorka soldier is very prone, after the discharge of his rifle, to shift the firearm into his left hand, carrying it as a guard to his body while he rushes a-muck into the thick of the fight, spreading death and disorder with the fearful steel. He has never been vanquished except by starvation or overpowering numbers, and prefers death in war to capture. The metal and temper of these Nepaulese weapons is first class, the steel being worked entirely by charcoal. I have seen them made. As I have stated above, the sword is the religious emblem of Mohammedanism. The higher classes of that fierce creed never objected to eat with Christians in public after a sword was laid across the dinner platform ("*Tugt pash*"), the respective believers taking their places on either side of the dividing symbol. Everything except the flesh of swine was in the bill of fare, after being killed according to prescribed rule—*i.e.*, cutting the throat while repeating the creed of true Moslems. The hands of Orientals are remarkably small in proportion to their bodies. We English are obliged to dismount their hilts and handles and replace them by larger sizes. I became the owner of the fine *Hosainee* blade I have described, and though not big-handed, was compelled to order a new fitting, as the weapon was destined to be my faithful hunting ally. In all my long residence in the East I never could obtain any manufacturers' secrets from the followers of Mohammed; they are all jealous, cautious, and reserved in these matters towards Christians and Pagans alike; the artistic manipulation of steel remains locked in their breasts.

Fig. 1. *Teghar*, or "village sabre" (also called *Tulwar*); dotted lines show the portion of the blade used in making the "drawing cut" at an angle of 45 to 50°. Fig. 2. Oriental scimetar, only used by horsemen, the "long curve" enabling the warrior to reach a foe afoot or mounted. Fig. 3. Double-handed sword, with double edge, so as to cut backward and forward when the bearer is

surrounded. Fig. 4. Hossainee sabre (my hunting sword); weight, 7 or 8lb. Fig. 5. The rare Goojeratee blade, single-edged, and for cutting only. Fig. 6. Afghan knife, made in every size, to 10 or 12lb. weight; very thick blade. Figs. 7-8. Forms of Ghoorka *Kookree*. Fig. 9. *Kuttar*, Afghan dagger. Fig. 10. *Kungar*, or *Grooptee* of India. Fig. 11. Tiger's Paw, curved razor-edged blades, four or more in number, mounted in brass sockets on brass-mailed leather gauntlet.

All scabbards are of soft wood and leather, to preserve edge of blades. **Eos.**

THE SANITARY INFLUENCES OF TREES.

[27479.]—A few years ago, a dispute was carried on rather hotly amongst some Continental medical men as to the sanitary influences of trees, and although common sense suggests that at least they cannot do much harm, while they give a pleasant appearance to streets, there is, it seems, much to be said against planting trees in spots not adapted to them, or where they are in the way, in more senses than one. Thus, I find it stated that both the atmosphere and the soil are cooled and moistened by the presence of trees. This results from the drawing up of the water from the subsoil and from the exclusion of the sun's rays. Besides this, a considerable portion of the rainfall collects on the leaves and branches. M. Fantiat has shown "that the leafage of leaf-bearing trees intercepts one-third, and that of pine trees one-half of the rainfall, which is afterwards returned to the atmosphere by evaporation. On the other hand, these same leaves and branches restrain the evaporation of the water which reaches the ground. This evaporation is nearly four times less under a mass of foliage in a forest, and 2½ times under a mass of pines, than in the open." Then we have stagnation of air from that interruption of wind currents caused by the foliage. It is, therefore, not without reason that the sanitarian studies the trees of the yard or lawn in their bearing upon individual health. Persons of susceptible lungs or having any tendency to rheumatism need to be carefully guarded against such influences. Where the foliage is dense about houses, or where the limbs overshadow the piazzas or roof, they become the storage places for damp, unwholesome air. The falling leaves gathering from year to year give a corresponding dampness to the soil, while at time of foliage the sunshine is measurably excluded. It is pretty evident that mankind was not intended to be reared in the woods. The influence of trees in causing malaria, or in so intercepting it as to have it tarry among them, has long been known. "A dry garden on gravel, of three acres in extent, in Surrey, surrounded by trees, is generally three or six degrees colder than the open common beyond the trees; and a large pond in a pine wood twenty miles from London afforded skating for ninety consecutive days in the Winter of 1885-6, while during the greater part of the time the lakes in the London parks were free from ice."

We know with what interest the lover of trees watches the growth of those planted by his own hand, and how many are apt to be scattered about the new home mansion. As years go on, and their growth and foliage increase, the owner is loth to remove them or severely to shorten their branches. If so, there is great danger that the dry soil and once comfortable home will come to be the dampest and least desirable spot in the neighbourhood. A recent careful writer has given the following sensible direction as to tree planting, as it bears upon the conditions of health:—"A tree should not stand so near a house that if it were to fall it would fall upon the house; or, in other words, the trunk should be as far from the house as the height of the tree. Belts of trees may be planted on the north and east aspects of houses, but on the east side the trees should not be so near nor so high as to keep the morning sun from the bedroom windows in the shorter days of the year. On the south and west aspects of houses, isolated trees only should be permitted, so that there may be free access of the sunshine and of the west winds to the house and grounds. High walls and palings on these aspects are also objectionable, and should be replaced by fences, or, better still, by open palings, especially if the houses are occupied during the fall of the leaf and in the winter. Trees for planting should be chosen in the following order:—Conifers, birch, acacia, beech, oak, elm, lime, and poplar. For our American homes we must add the maple, the ash, and the tulip tree, or American poplar, although the dense foliage of the maple is sometimes objectionable. Pine trees collect the greatest amount of rainfall, and permit the freest evaporation from the ground, while their branchless stems offer the least degree of resistance to the lateral circulation of the air. Acacias, oaks, and birches are late to burst into leaf, and therefore allow the ground to be warmed by the sun's rays in the early spring. The elm, lime, and chestnut are the least desirable kind of trees to *plant near houses*. They come into leaf early and cast their leaves early, so that they exclude the spring sun and do not afford much shade in the hot autumn months when it is often required. Trees are of value in indicating choice of residence. Rich foliage, ferns, and mosses tell of dampness and alluvial deposits. Flowers and fruiting trees point to a dry and sunny site. Children will be healthiest where most flowers grow, and old people will live longest where our common fruits ripen best. **R. G. P.**

DAMMAR.

[27480.]—This is a very useful resin, exuding from one of the most valuable timber trees of virgin forests in India (*Thorea robusta*, or Sâlwood), occasionally met with in England; when melted in linseed oil by slow heat is employed for caulking the thousands of boats on the great rivers. It is usually of mixed quality, and full of bark, grit and dirt. The pale kind is a nice varnish for lithographic drawings, &c., 2 parts in 2½ parts of oil of turpentine. This resin is only partially soluble in alcohol. Dammar promises well as an ingredient in waterproof cements. I found that its brittle quality was overcome by incorporation with linseed oil and other additions. I employed it as a waterprof glue on English woodwork, disjointed by heat and damp, for mending canoes, stopping leaky gutters, &c. Dirt cheap in its native country. **Eos.**

NOISES IN THE EAR.

[27481.]—I have read and heard much of this troublesome complaint, and can speak *in propriâ personâ* of its obstinate character. I have always considered that *Tinnitus aurium* frequently has its origin in malarious fevers. A friend of mine who served in China, and got a dangerous attack of marsh fever there, was plagued for five years after his return by these humming sounds. I, after several and equally dangerous jungle fevers in India, was some time after the last of them, worried for ten or fifteen years off and on by the same strange *tintinnabulum*, varying in time and character. Tinkling, whistling, whizzing, chirping, ringing, &c.; in fact, the whirring squeak of the larger *Grylli*, or the humming chorus of the lesser, may well be alluded to by "R. W." as similitudes. The "singing of a kettle," too, may be recorded in the milder phases of this attendant demon.

I was twice threatened with total deafness in the affected ear: once in passing near Zanzibar, when the land wind was blowing strong from shore; on the second occasion, when violent west winds were coming off bogs and marshy fields in an English county. On the first occasion I recovered when we reached the warm open sea; on the second occasion I heard no sounds for twelve months on that side of the head; not even the loud tick of a fine old watch pressed on the lobe of that ear was audible. I treated myself perseveringly for the above period, and have long ago been free from the slightest deafness. I always found *tinnitus* suppressed by 5 grains sulph. quinine (temporarily). A long sea voyage always removed it; whenever I landed it reappeared, and I have suffered in Europe as much as in Asia or Africa. An outdoor life in pure mountain air has proved my best remedy, and I now seldom hear the enemy. **Eos.**

TO MEASURE MAGNIFYING POWER OF MICROSCOPE OBJECTIVES.

[27482.]—I am desirous of making an accurate table of the magnifying powers of my micro. lenses from 2in. up to $\frac{1}{20}$in. with the various eyepieces from 1 to 6, and shall be much obliged for the information which will enable me to do it. The textbooks are not sufficiently explicit, and are, in fact, in some instances, confusing and contradictory. I may go further, and say that I have applied for aid to some friends who are old microscopists, and, in one instance, to a maker, without anything like a satisfactory response, and I have come to the conclusion that the whole process is involved in obscurity and uncertainty to a degree that I should not have thought possible had I not set myself the task and then looked about for assistance, which I thought it was only "to ask to have." I have presumed upon your space, somewhat, in thus introducing my inquiry, from a hope that some of the many experts in microscopy who from time to time kindly assist those of us who ask for it, may have their attention drawn to the query, and give us simple and definite instructions accompanied with the "reason why." My object is to ascertain, absolutely, when I have an object on the stage how many diameters the image I am viewing is amplified with the particular o.g. and ocular then in use, and with the draw-tube in any chosen position, and perhaps if I may encroach still a little by pointing out some of the conflicting directions from various sources, it may facilitate the answers. By one "authority" I am told to measure from the stage to the eye-lens of ocular; by another from the front lens of the objective to the eye-lens; by a third from the last-named point to the diaphragm of eyepiece, and by another from the "stop" of the objective to various parts of the ocular. As a quarter-turn of the adjustment collar of a high power, after the object is focussed, materially affects the dimensions of the resultant image, it appears to me that the necessary and desired measurement must be an operation of considerably greater delicacy than is implied in any of the methods here quoted. My present table of measurements, which, of course, is only approximate, but which, I apprehend, is as nearly correct as those of the majority of amateurs, is simply a record of the magnifications by the various combinations of objectives and oculars with the microscope placed horizontally and the image projected on to, and copied by means of, Beale's camera, the drawing paper placed 10in. below the centre of the eye-lens of ocular. I know that "10in." is the agreed distance for (average) distinct vision, and that this arrangement permits something like a comparison between the objectives by various makers, but that only roughly and with no pretension to the exactness which is the quality I am seeking preparatory to constructing the desired table. If some practical microscopist will kindly furnish the information I am asking for, my impression is that many besides myself will value it. Briefly, the question is *from* what point *to* what point is to be measured along the tube to enable the operator to project on to drawing paper an image which shall be *absolutely identical* in size to that seen in the field of the instrument? The necessary instructions along with the *rationale* thereof will be a boon, I am confident, to many in addition to

Exeter. **F. R. Brokenshire.**

ON THE RELATION BETWEEN THE AMOUNT OF WIRE ON AN ARMATURE AND ITS VOLTAGE—TO G. T. PARDOE AND OTHERS.

[27483.]—As several correspondents seem to be interested in this subject, I have thrown my replies into the form of a letter instead of attempting to answer each correspondent separately.

There is no doubt whatever that in a fairly-constructed machine, be it Siemens H, Gramme, Pacinotti, or Mather-Platt form, one volt can easily be obtained from one yard of wire. This is my own personal experience, even with very small machines. The smallest dynamos I make stand 4½in. high, have a solid Siemens H armature 1½in. in length, and this, when wound with 15 yards of No. 24 wire, gives an E.M.F. of 16 volts.

To our valued correspondent, Dr. Gerard Smith, I supplied, a short time ago, a small dynamo standing 6in. by 4in. by 3in., with laminated H armature 3½in. in length, 1¾in. diameter. This was wound with 15 yards No. 18 wire, and lighted easily a 20c.p. lamp of 30 volts. Tested with the voltmeter it gave 25 volts at a speed of 3,000 per minute. Dr. Gerard Smith was so delighted with its efficiency that he wrote me "It is the best £2 10s. I have ever laid out."

But I would not have my querists depend upon my statements only as testimony to the possibility of obtaining at least 1 volt per yard of wire. In Silvanus Thompson's "Dynamo-Electric Machinery," at page 510, in the appendix, will be found the description of three dynamos—one by Kapp, a second by Paterson and Cooper, and a third by Mather and Hopkinson—in all three of which the voltage is close upon 1 volt per yard. As this may be of interest to many, I reproduce the dimensions, &c., textually:—

Kapp's Dynamo (4½ units, arc lighting).—Revs., 1,150 per minute; volts at terminals, 300; ampères, 15. Armature: Diameter, 8·5in.; length, 11·5in.; winding, 36 sections each of 16 turns of 0·057 gauge; total length, 1,245ft., or about 4ft. per volt.

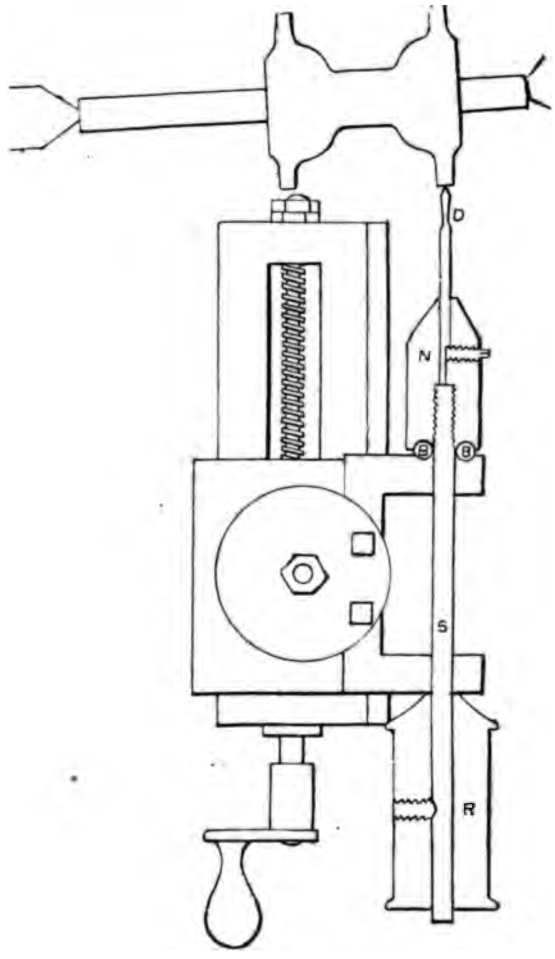
Phœnix Dynamo (Paterson and Cooper, 65 unit).—Revs, 800 per minute; volts at terminals, 105; ampères, 620. Armature: Weight of iron in core, 530lb.; weight of copper in coil, 175lb.; length of coil, 240ft.; volts per yard of copper, 1·31.

Manchester Dynamo (Mather and Hopkinson, 24 unit).—Revs., 1,050 per minute; volts, 110·5; ampères, 220. Armature: Diameter of core, 12in.; length do., 12in.; winding, 120 turns of 0·203 gauge wire; volts per yard of copper wire, 1.

Passing from these "classical" dynamos to those made by "our" correspondents, there is the small 30-lighter described by W. H. Eaves, which gives 50 volts for 12lb. of No. 12 wire = 36 yards, or 1·4 volt per yard nearly. But this record is "knocked into a cocked hat" by that of the Forbes dynamo, which for 18in. of conductor gave 5·8 volts! **S. Bottone.**

DRILLING BICYCLE HUBS—LECLANCHE BATTERIES.

[27484.]—Having seen questions from time to time in your paper as to the best way of drilling a bicycle hub truly, I beg to send you sketch of a small apparatus I constructed, which answers the purpose admirably. I daresay it is not wholly



but those amateurs who wish to build their machines may find it very useful.

e spindle S should be ⅜ steel, and run in lel bearings, exactly level with the lathe es. On it is screwed the brass or gunmetal piece N which holds the drill, and has a 'e turned at the back to receive the steel B which take the pressure; R is a boxwood for driving by a bow. The apparatus is shown in the top slide of rest. If well made, and bicycle hubs turned correctly, it will not be sary to centre punch holes, and anyone who ot a division plate can set out the spokes truly enough with compasses.

iave seen somewhat conflicting statements in 'E. M." as regards charging Leclanché bat- s. Some correspondents tell us to use a saturated ion of sal-ammoniac, others say a half- ated solution is best because it is less liable eep, and does not so readily deposit crystals e zinc, whilst "E.M.F." is just as high. It be useful to state what, perhaps, few of our eur electricians know—viz., that a saturated ion (of NH_4Cl) conducts about twice as well half-saturated solution, and therefore the nal res. is much smaller with the former. . In case the above leads any of my readers it the conductivities of solution sal-ammoniac arious strengths for themselves, I would on them that in passing current through a g solution, chloride of nitrogen, the most nt explosive known, is apt to form on the ate.) I always use a weak solution for electric as small internal resistance is no object, but ghting with the 6-block form a saturated solu- is best.

isworth. **C. Provis.**

OLD VOIGTLANDER LENSES.

'485.]—MAY I appeal through the medium our extensively circulated journal for a little mation respecting the old form of lens manu- red by Voigtländer, and known as the ortho- ic?—for I cannot find the publisher of any on lenses except the little brochure of Dall- r, and cannot obtain any catalogue of Voigt- r giving any detailed description of the graphic lens, although I have written to that who courteously stated they only now sup- the euryscope, and Messrs. Marion, the pre- agents; Mr. Thomas, of Pall Mall; and ner firm of opticians in Bond-street, formerly gents of this German manufacture, were un- in reply to my verbal inquiries, to assist me. valued correspondents—Mr. Bottone, or the ibutor at Plymouth who sometimes aids the troubled photographer—may, perhaps, very kindly give me an answer if I briefly describe the instrument: It is a Voigtländer of 2in. aperture portrait combination, and covers a cabinet size; but the focus is somewhat short. There are two flanges, and to one of them, the portrait lens, i.e., the front lens, fits, and should cover a plate 10in. by 8in.; but if used as a single lens, open, the definition is so indistinct as to be useless; upon this fits a cap having a very small aperture, but when attached the lens is so darkened that very little can be seen on the screen, and the image is but a very, very trifle sharper; into the same flange fits a back combination, having a set of stops between three lenses, the same front lens of the portrait combination fitting in front, whereby, it is said, a plate, 15in. by 12in., can be covered; but with this combination I cannot get clearness of definition, and just now the weather is so suitable for work. I am in a terrible fix, possibly for want of better information as to the adjustment of the various parts, and shall highly esteem any particular instruction your readers can give.

As I hold it a duty to supply any information I can, on the principle that by showing a light to my neighbour mine will not burn less brightly, let me mention that any brother photographer desiring a reliable sodio-potash developer will find an excellent formulæ on page 145 of the *British Journal Photographic Almanac and Photographers' Daily Companion* of current year. May be some fellow reader can give his experience of the Beach developer on page 83 of the same book. I have tried it, and others known to me, but without success, as density was not obtainable to the extent demanded, although the plates answered admirably with an ordinary alkaline developer. This, however, may arise from some little misconception in mixing the solutions, and an interchange of ideas of the photo. readers of the MECHANIC hereon may not be without profit. **Abaete.**

NIBLETT'S SCREW GEAR.

[27486.]—I AM sorry "O. J. L." writes sadly. We owe him much, not only for other things, but also for this, one of the most original devices brought before us these many months. My letters were combined into one, and so did not show the pressure under which they were written; nevertheless, with the exception of a thoughtless sentence that reflected perhaps on the cloth, I do not think he should be annoyed;—for that I am sorry, however.

Many of us at first thought only of the common swash-plate moved very slowly and *used only during a small portion of the turn.* This seemed no great gain, and was at once stated to be wrong in principle. Niblett apparently had, however, tried it, and found the error, and by opening the curve to correct it stumbled on the curve pointed out as a "spiral" by "J. L.'s" mathematical friend. That there was such a curve Mr. Pocklington proceeded to show.

All were delighted, and proceeded to laud the device as perfect in both theory and practice, and though some expressed doubts, the error was stated as, at any rate, certainly small. It seemed to me desirable to point out that such was right as far as he went, and further that the nature of error should be clearly shown and its probable amount. Hence, though I cannot call myself a mathematician any more than "J. L.," I made a shot at it, with the result I should like to see confirmed or disproved.

With the curve and condititions I assumed the error would be hardly appreciable in 1in. of Whitworth inch thread; in an inch of $\frac{1}{16}$ pitch only about ·001in.; of 32 to the inch, ·00025 approximately. If, as is probable, the curve be adjusted for some intermediate pitch, the error for coarser pitches would be much reduced. I should, however, prefer a second special spiral for these if greater accuracy were required.

It is curious that on the above suppositions the error does not grow continually, even if more than ⅜in. of thread be cut. I am as charmed with the invention as "J. L." It is just one of those cases where theory fears to try seeing an error, but not realising its insignificance, whereas the practical man tries and succeeds. The old story over again of friction on the rails.

Mr. Pocklington asks if the theoretical error could not be removed—*cui bono?* But, as one should always aim at perfection, I may say, I doubt it; but have not time now to work at it. "Virginian," in Vol. IX., or thereabouts, did suggest a swash-plate, with a tracer point to touch it at various distances from its centre, the swash-plate to turn, say, 10 times slower than mandrel to give 10 threads of guidance, and shaped like a single turn of a screw of pitch varying from nothing at centre to, say, 1in. at circumference. His difficulty was to shape the plate, and get the slow motion. This theoretically perfect device, was therefore, practically unmanageable. If Mr. Pocklington be interested, however, in the matter, he will find much about it in Vols. VIII., IX., and X. of the ENGLISH MECHANIC

"J. L." has not given dimensions of plate. The larger within reason, the more manageable the quick pitches. As I said before, I should not adjust the curve to an intermediate pitch; but keep the lowest pitch practically (mathematically) correct, and keep the error of quick pitches in bounds either by enlarging the disc or a second ring. I object to the wedge action in extreme inclination, however, in any case, and perhaps it would be simpler to alter the rates to 12 to 1.

Bow.

THE CUSHMAN CENTRE PUNCH.

[27487.]—THIS is certainly a very old tool. I find a description of a bell-centre punch with diagram (minus the "milling") in a very excellent little work of its day, entitled *The Penny Mechanic and Chemist* (Aug. 27, 1842). It is there stated that it is identical with that used by Sir Isambard Brunel for centring the "iron pins" in the manufacture of ship's blocks by his famous block machinery at Portsmouth Dockyard.

It may, perhaps, be hardly worth mentioning, but I may state that I constructed a "bell-centre punch" from the above diagram at least twenty-three years ago, and used it in my business for many years.

The practice of appropriating an old device, and introducing it as a new invention, is of itself a very old device indeed, and it must always prove a source of great satisfaction and comfort to its introducers to know that the genuine meanness of the transaction is so perfect as to leave, like the above little tool, so small an opening for any improvement or reinvention.

Joseph Leaney.

LATHE MATTERS.

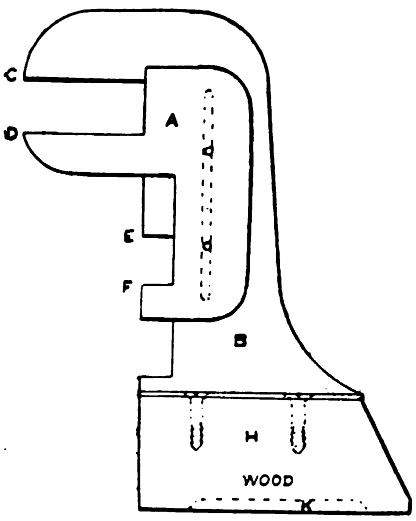
[27488.]—LET me endorse "O. J. L.'s" letter published May 20th, headed "The Lathe at Saltaire," in which he expresses the wish that someone would prepare for "Ours" a description of the Saltaire lathe, which, he says, is the most complete tool ever made. If such a description would be appreciated by the author of "The Lathe and its Uses," living, as he does, within easy distance of Charing Cross and Wardour-street, how much more important and acceptable would it be to the large body of your subscribers who cannot have access to London tool shops. Is it too much to expect?

Touching the standard mandrel, which is again under discussion, I hope that the question of thread-rate will soon be settled. I want to have a first-class lathe-head made by some English manufacturer, and, if a standard mandrel is adopted, would use it. If no conclusion is reached, I will use the Edmunds cylinder base and broad flange, against which no good argument has ever been made, and which constitute the real merit of the mandrel. If I am compelled to decide for myself, I shall use a V-thread, truncated, and 8 pitch, on a nose 1⅛in. in diameter.

I see that, in Dr. Edmunds's mandrel, as recently published, he leaves no room, and makes no provision for, segment apparatus for tangent wheel. Does he intend putting them on the tail of the mandrel to the left? The division plate would, I presume, be bored in the large gear wheels.

Boston, Mass., June 7. **P. S. Macgowan.**

[27489.]—The following is a suggestion for a gauge to test the height of the tool point as compared with the centres of the lathe. This form of gauge shows at a glance how much packing up the tool requires, and at the same time forms a caliper by which the packing slips themselves may be accurately and conveniently measured as to thickness before placing them under the tool. The instrument is shown in the accompanying sketch.



H is a base of boxwood about 2in. square, and is conveniently made out of a piece of wood such as used by the wood-engravers. It has a recess K to lessen the liability to its being set on grit or shavings. The upright part B is a piece of thin German silver or brass cut in the form shown, and having an overhanging beak C, which is exactly at the level of the lathe centres when the gauge is placed on the flat part of the slide-rest just below and in front of the tool. A sliding piece A embraces B, and is secured by rivets passing through the slit, as shown, and in using the gauge the line D is slid down until it just coincides with the point of the tool, when the latter is simply laid in place without any packing up. It is clear, then, that the space C D represents the thickness of packing the tool requires, and on taking the gauge in the hand (it is very light) a kind of caliper is at once supplied for measuring the packing slips required. The notch at E F, which of course opens and closes at the same time, serves for adjusting a drill or tool when it is more convenient to measure by placing the gauge on the face of the upper slide. The beak C is made long to suit inclined and overhanging positions of the tool point.

Richard Inwards.

LATHE MATTERS—PROPELLING STEAMSHIPS.

[27490.]—I am rather of "F. A. M.'s" and "Loxley's" opinion as to the friction of Waltz's balancing arrangement. At first I thought of lining the hoop of the eccentric with balls; but I don't know if that would be much better. My last idea was to go to Berlin and inquire further into the matter. I cannot make out what "Loxley" requires.

The reason why steamships cannot be propelled at 50 miles an hour is because the water offers too much resistance to the present form of hull. To obtain great speed the weight-carrying capabilities must be sacrificed. The idea of propulsion by paddles or ducks' feet is absurd. The power of the engines *might* be expended in the simplest possible action; but certainly not economically, and the speed would not be 50 miles an hour. A 2,000 ton steamer could no more be stopped immediately with paddles than it can now with the screw, and they would very likely be bent or torn off in the attempt. If the paddles projected from the sides they would be constantly being damaged in dock; while if on the bottom they would all be torn off by touching a sandbank. The idea is hardly a new one, and will not be a more successful competitor against the screw than the fin, hydraulic, and many other systems.

A. F. Shakespear.

Lüttichaustrasse, 14, Dresden, June 19.

PROPELLING STEAMSHIPS.

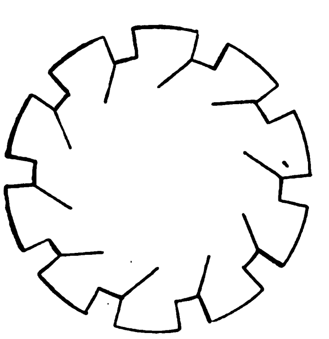
[27491.]—"The screw is an abominably inefficient and clumsy contrivance." Is this not rather extravagant, Mr. Torrop? Is a less clumsy mechanical contrivance possible? Is there a more efficient one in existence? Can any duck paddle at the rate of 50 to 100 miles an hour? With a little more speed than this a vessel would, I suppose, rise bodily out of the water and skim along like the blade of a scull in the feather-stroke, doing away with water friction. I don't think we have quite come to that yet, Mr. Torrop. I have often wondered what would be the effect of a locomotive on the banks of a canal dragging a barge at, say, 80 miles an hour. Would the water friction eventually diminish?—not taking into consideration the fact of the engine being higher than the barge; but simply considering the inertia of the water and the incline of the boat's sides as tending to force the boat out of the water at a high speed. A real example of this is met with in the shape of "ducks and drakes." I have lately invented a new form of propeller giving the full stroke of a paddle, and that at complete immersion; but I am still doubtful as to its being more effective than the screw. If further trials on a calm day are satisfactory, I will, with the Editor's permission, send sketches. Meanwhile, by all means let us hear and see more of the *under-water* paddles that propel faster than the screw. **Silke.**

[27492.]—T. J. Torrop (27433) appears to hold erroneous opinions upon the above subject. I maintain that the quickest speed cannot reasonably be looked for by any method which not only involves the ceasing of the propelling action for a time, but also the forcing back for the next stroke of the blade or paddle, even under the most advantageous conditions possible. I am not aware that any bird exhibits a remarkable speed in paddling along. Whereas, theoretically, the screw is one of the most efficient means we have for applying force to anything, and as applied to a vessel once started, it does not cease "pushing" at any time until it be stopped. It does not work in its own backwash unless there be too many blades, and it "must" be just as effective when reversed, save that it would then throw its backwash upon the ship and thus retard her. The reason why vessels are not likely to travel at even 50 miles per hour is because water is so much denser than air that the friction increases enormously with the speed. The problem awaiting suitable solving is, How to retain the screw as the best method of propulsion possible, but to do away with the objectionable length of shafting necessary to the present arrangement.

A., Liverpool.

CORRECTION—CUTTER.

[27493.]—In letter, No. 27386, the sketches were



not reproduced full size, the length of spindle being 105mm., diameter of hole 9mm.

The following extract from the *Horological Journal* may not prove uninteresting to readers who have not had an opportunity of examining the machines of the Waltham Watch Co. at the late Inventions Exhibition:—

"For cutting teeth of pinions a very excellent tool is shown. There are three circular cutters following each other; the first merely a saw, the second of an outline to give the required form to the tooth, and the third taking a slight cut to finish. The last two cutters, formed of steel discs, have each ten slits, equidistant about the circumference, to give cutting edges, and from one bottom corner of each slit a saw cut is made, going obliquely towards the centre, as shown in the sketch. The circumference of the disc is then squeezed in till the surfaces where the saw cut started are in contact, and a clearance equal to the width of the saw cut is thus obtained. This is a clever idea, and gives an effective cutter at small cost." **G. W.**

BURMESE LACQUERED WARE.

[27494.]—Possibly a few of the readers of our "E. M." may have seen or possessed one of those pretty and ingenious waterproof boxes light as pasteboard, chiefly of Pegu manufacture. They are sometimes of considerable size, sufficient to contain the wardrobe and personal paraphernalia of a Burman lady. The colouring of these, especially the vermilion and black, is very glossy and smooth as glass. The material consists of bamboo-rind pared very thin, bent round, and fastened with closely-woven straps like a basket. This is overspread with some cement, wood ashes incorporated, and smoothed down; then painted with a coloured varnish, said to be composed of Gurjun oil, shellac, and the sap or fluid oil of *Holigarna longifolia* (known as the "black lacquer varnish tree"). The boxes, when painted, are placed in subterranean rooms and dried very slowly, but no European knows the exact preparations or processes. Shields of buffalo and rhinoceros hide are finally coated with the lustrous black varnish of *Holigarna*, it is said, being waterproof and preservative, besides ornamental. **Eos.**

SOME EXPRESS RUNS.—VII.

[27495.]—One will not often make a better run than the following:—No. 1739 and 5½ coaches—

M. CH.		H. M. S.	Speed.	Remarks.
	Nottingham	3 17 16	—	due ...3.17
2 66	Edwalton	3 22 27	—	
10 68	Broughton	3 31 41	52·1	
29 76	Oakham...........	3 51 37	57·5	
33 43	Manton	3 54 53	65·8	
38 59	Harringworth ...	3 59 18	70·6	
51 54	Kettering	4 14 6	52·7	due ...4.17

Out of regard for your space I will only quote a section—St. Alban's to Bedford—of a very fine run I made in March with the 3 p.m. We had been delayed by signals shortly after Kentish Town, and from passing St. Alban's to passing (at the usual reduced speed) Bedford, the times were as below:—

M. CH.		H. M. S.	Speed.
19 69	St. Alban's	3 34 21	—
24	Post	3 39 6	52·6
35	"	3 50 8	60·0
36	"	3 51 2	66·6
41	"	3 55 12	72·0
42	"	3 56 4	69·23
44	"	3 57 46	70·59
47	"	4 0 16	72·0
48	"	4 1 7	70·59
49	"	4 2 1	66·6
49 65	Bedford......................	4 2 57	—

Luton was passed at 3h. 45m. 20s., and Kettering was reached a few seconds after 4.29. The load was 5½ coaches. **Kappa.**

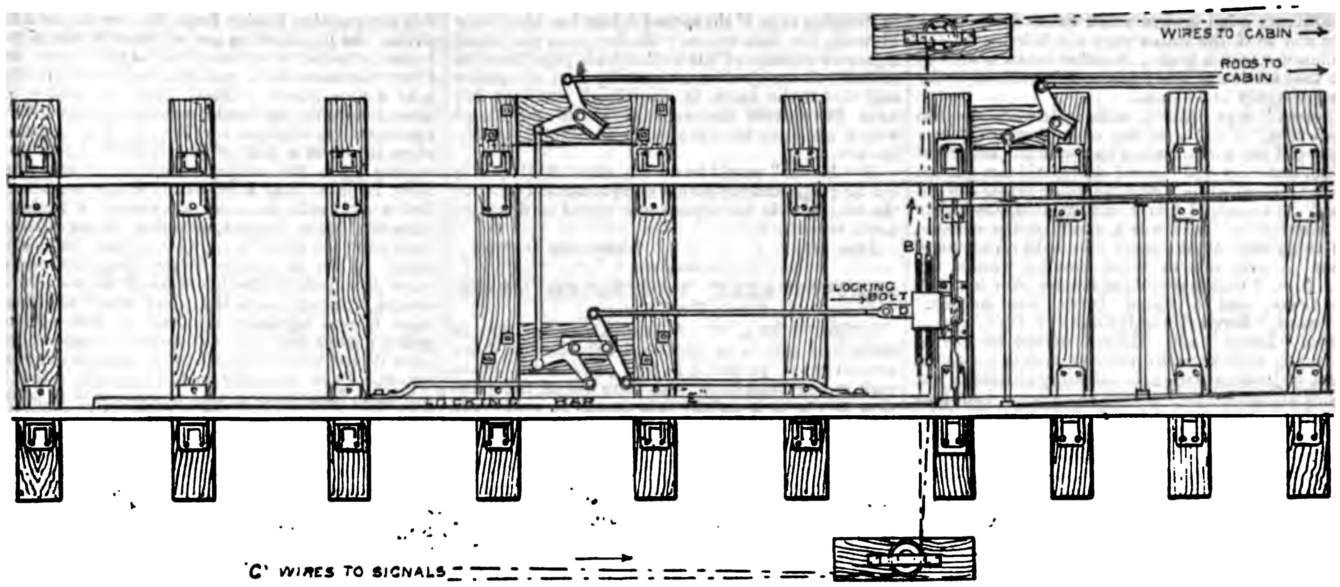
LOOSE JOINTS ON RAILWAYS.

[27496.]—In reply to Mr. Hy. Lanchester (27420, page 347) and his question as to why the jolting of a train over uneven ways cannot be remedied, I may say that there is a great lack of energy displayed on this point by most railway men; that it should, in these times, have found a more definite solution than it hitherto has; there is also, I think, in railway companies too great a tendency to abstain from a little expenditure in order to secure level travelling, as, with the exception of the Great Western Railway, and perhaps one other, the point has had no really practical, energetical consideration by engineers. The remedy certainly lies in that the two top edges of the metals in the joints shall be perfectly level and close; the longitudinal sleeper question is better than the cross on this point. Now, why cannot a steel sleeper, as used on bridges, be placed under the joint only, thus giving a partial improvement on the suspension joint, combined with the strength and facility of the cross sleeper? **P. W. Harvey.**

RAILWAY SIGNALS—FACING-POINT LOCK.

[27497.]—I trust the annexed diagram of the Kirby point lock will furnish the details for which your correspondent, "Signalman," asks (p. 333, 62557.)

The invention consists of a new description of facing-point-lock plunger, A, which at once detects and makes known to the signalman any defect



which may exist in, or breakage of, the rods of his locking apparatus.

The locking slides B of the facing points are attached to and form part of the wires C, running from the signal-box to the signals; it, therefore, follows that unless the points be placed in the proper position the signals cannot be lowered.

It is important to notice that the locking-bolt D receives its motion from the locking-bar E, therefore, if the bar should, in consequence of a broken rod or the failure of a joint, not move as required, the locking-bolt prevents the signals from being lowered for any direction except the one for which the points are actually placed and locked. I may mention that the Kirby lock formed one of the inventions inspected at the offices of Messrs. Saxby and Farmer last week by the Executive Committee of the Amalgamated Society of Railway Servants, and was very highly approved on account of its efficiency and safety.

Clement E. Stretton,
Consulting Engineer Amalgamated
Society of Railway Servants.
40, Saxe Coburg-street, Leicester, 11th June.

THE HARRINGAY PARK ACCIDENT.

[27498.]—IF the matter to which the above heading refers was not of public interest—that is, to all railway travellers—I might be contented to leave it with the letter of "Loco." (p. 369) as a fitting finale; but he unfortunately has put a new face on the matter, and implies that the driver of the erring locomotive wilfully ran past the signals. Mr. Stretton, on p. 321, says the driver mistook the question, "Are you right, driver?" of the signalman, for "Right away, driver," and then proceeded to accomplish the feat of running two miles on the wrong road and dashing into a train proceeding in its proper direction. I have asked whether something could not be done to prevent such a blunder in future, and your courteous correspondent, "Loco.," replies that I "seem to want a kind of self-acting railway, made so that a driver cannot run past signals." He then, pertinently enough, says that if a driver will not obey signals, he should be "protected against himself by taking him off his engine." Just so; but then the question naturally follows, Are the public to wait to be smashed up before the companies find it necessary to "protect" a driver by taking him off his engine? Mr. Stretton says that according to the report the driver in question is a "steady man," the only entry against him being that he had previously done something similar to what he did at Junction-road. I do not think I have ever read anything more illogical than the remarks of "Loco." (p. 369). It seems that instead of adopting means to prevent a driver making a mistake, or to correct him when he has made one, we are to wait until he makes a smash, and then remove him from his engine, because a "man who won't obey signals is not fit to be a driver." The profundity of that remark is too amusing, especially when "Loco." goes on to tell us in a rather comical way that "Mr. Stretton, all railway men, and the Amalgamated Society, will all agree with me." The juxtaposition is ludicrous, and I should think Mr. Stretton, who seems to have declined to tackle this question, must say "Save me from my friends." As this driver, according to "Loco.," wilfully continued on the wrong road for two miles, and wilfully pitched into an inoffensive train, it would be interesting to know how the company stands with those injured in the accident. This latest "incredible accident" has been treated in an extraordinary way in your columns. I have ventured to make a suggestion how such disasters might be prevented—which is doubtless very impertinent on my part; but I have also asked others—those, for instance, who debate so much about runs, and brakes, and dimensions—to suggest some means of protecting drivers against "mistakes" of the kind, and I thought, as we heard so much about "mere mistakes" that probably someone might have a remedy. The sentence, "it looks well on paper, but it will not do," reminds me of what was said when the block system of working was proposed. That "would not do," according to "all railway men"; but somehow it does. Surely somebody, besides "Loco.," can offer suggestions—though I fail to find any in the remarkable epistle on p. 369. **Nun. Dor.**

CONTINUOUS BRAKES.

[27499.]—IN reading over the correspondence in your issue of the 17th inst., I see Mr. Gobert (27449) states that I had no foundation for asserting that less air was required to apply the vacuum automatic brake than is necessary for the Westinghouse. I can assure him he is quite mistaken. I did not say (as he seems to assert) that less air must flow into the vacuum pipe than out of the pressure. I am quite aware that such is not the case.

Mr. Gobert, in his calculations, showing time of application for Westinghouse, does not even take into account the very air which applies the brake. This most certainly must be taken into consideration—why the air which leaves the train pipe is only a means of opening the triple valves; but these valves must be opened before the brake can begin to apply, and it is not an impossible thing for a valve constructed in such a way that friction is the essence of part of its mechanism, to refuse to act immediately, so that 25lb. may be released before any air enters the cylinder. It will be seen that Mr. Gobert has simply shown the time and air which he considers necessary to fully open the triple valve, and has not touched in the least upon the application.

As to the question of adapting the vacuum brake, so as to work through the medium of triple valves, why this would be going back many years; it has been tried, and the present form has been adopted in preference.

I scarcely understand Mr. Gobert's position on this important question: he seems quite troubled about the use of the vacuum automatic; but I am under the impression that only a few weeks ago he said he had no fault to find with it in its present form.

With regard to the question of working the brake on thirty carriages, undoubtedly this can be done. The Burlington trials did not prove the Westinghouse to be the best for long trains; it was beaten by the Eames vacuum.

"Rover" (27448) and "Engineer" (27450) seem very desirous of having some questions answered. Why, I cannot find that "Loco." has asked any; he certainly did ask for "answers" to a number of assertions, my views on which I think your readers are well aware of.

The tone and style of "Rover's" letter remind me very forcibly of the lawyer without a case, who for want of evidence spends his energy on the abuse of the witnesses of the other side. I feel very sorry indeed for his "benighted mind"; I should have thought he would not find fault with the Midland for not working the Lickey incline with the leak-off brake. I don't think it likely anyone would advise them to do so.

Now as to the question of running two engines with a vacuum train, "Lowmoor Driver" is quite correct in what he says. In the first place, why did the Westinghouse fail under such conditions? Because the releasing of the brake by the engine from which it was not applied, destroyed the pressure in the reservoirs, and the final application, which should have stopped the train, was useless. But the vacuum is quite different; the release of the brake does not destroy the reserve power, which is always at command. So much for "Rover's" "sheerest humbug."

Geo. Kiernan.
166, Duke-street, Brook's Bar, Manchester.
June 18.

[27500.]—THERE was "a method," Mr. Gobert, in my roundabout way of coming to the question I asked in "Ours" of 3rd June, which question, I must say, you have answered manfully. You say, however, that the stuffing boxes of the automatic vacuum brake "are a continual source of leakages and increased friction." This is not the fact. The packing of the piston rods for the vacuum automatic brake is simply a loose indiarubber ring or washer, which fits to, and falls away from, the rod, according to the action of the atmosphere and the ejector; and there is practically no friction or leakage. These washers give no trouble, and last for years.

I have read Mr. A. Kapteyn's letter. It has nothing to do with the point I raised. The question was, Can the Westinghouse be graduated? and not, Is that brake used on inclines? I say *it is* used on inclines; and I say further that if the companies who do so will stick to it, disaster will follow in due course. On the Rocky Mountains, Paris, Lyons, and other railways they do not mean this to occur, and have, therefore, put on the Westinghouse non-automatic brake for use down inclines.

Mr. Gobert praises the supporters of the automatic vacuum for keeping quiet. I think he should impress upon the supporters of the Westinghouse the necessity of doing likewise, for by "rushing into print" they have given opportunity for some awkward cases to be brought and kept before the public; and my advice to them is, Keep quiet! If anybody should say, "Save me from my friends," it is the Westinghouse Company.

The particulars, Mr. Gobert, of the Leeds collision will be found in Major-General Hutchinson's report dated Sept. 30, 1884, and you will find therein he said the old "leak-off" brake "did good service."

The last paragraph, as to the probable result had the Crook train been fitted with the automatic vacuum, is, I think, sufficiently answered by "Lowmoor Driver" (27402).

I was much amused by the letters of Mr. Stretton, "Rover," and "Loco." last week. Mr. Gobert's letter coming just before theirs is certainly rough for them. He, a practical man with Westinghouse brake, admitting that it cannot be graduated; they more or less gingerly still arguing that it can. The truth of the old saw, "a little knowledge is a dangerous thing," is clearly demonstrated in their case.

Much has been said about the Lickey incline and the Midland brake. The regulation as to working "fast passenger trains" down this incline was, on the face of it, made so as to be on the side of safety, with an exceptional bit of road (2 miles 1-37 and 1-30). The use of the vacuum brake is not prohibited (as a matter of fact, these passenger trains have been worked down the incline with it for years); guards are merely instructed to apply the ordinary hand-brakes when descending, in the same way as if the trains were not fitted with the automatic vacuum brake. No other brake is worked over that section of line; hence the vacuum brake being the only one named.

"Rover" says (27330), with reference to the Crook case, "*I am at a loss to know* why the first driver did not whistle when he found his brake not acting, and why the second driver did not put his brake 'on' when he found the other driver did not do so." The second driver said in evidence before the inspector—"That was a short, sharp whistle, and the driver at the same time held up his hand to me. I took this to mean that he wanted my assistance. I pulled my brake handle over to apply the brake, and I found there was no air." Awkward, "Rover," was it not?

Both "Rover" and "Loco." persist in having the seven objections to vacuum brakes answered. These objections are most certainly childish; but if they are determined to have some more, I suppose they must.

1. As made by the Vacuum Brake Company, their automatic brake *will* remain "on" when the tender is parted from the engine, therefore it fulfils "conditions" of Board of Trade, and does not fail.

2 and 3 may be answered together. The vacuum brake could be made to do this by putting cocks on the main pipe; but the Westinghouse Company knew the danger of them, and substituted automatic valves in the couplings; these, however, were for obvious reasons soon removed, and the dangerous cocks again resorted to. But with cocks, a repetition of the fatal collision at Bow-road, G.E.R., on 3rd Sept., 1881, is possible. A non-fitted engine was working fourteen empty coaches with the air-pressure left in them, and the Westinghouse brake crept "on" without interference from the guards, and stopped the train, and before the brake could be released by hand from each vehicle, a passenger train ran into the empties, and the passenger driver and fireman were killed on the spot, and eleven passengers injured. It may be said, What did the independent store of power do in the North Wootton accident? You had better not ask the question, gentlemen, for I am conversant with the slender evidence in its favour there. I say it is a great pity these two lives were sacrificed.

4. "Piston rods get dirty and stick." Very, very seldom. Triple valves do so continually.

5. "Maintaining vacuum uses a great deal of coal." If so, so does maintaining air-pressure.

6. "Getting brake off is a big job." Getting Westinghouse brake off and getting along with your train, is a much bigger.

7. "Vacuum is longer going 'on' than Westinghouse." This is an error so far as initial retardation. It has been demonstrated by disinterested parties, and not railway officials, and both in running and standing experiments, that speed of application is in favour of a properly designed vacuum brake.

Leeds. **Samuel Davies.**

RAILWAY BRAKES.

[27501.]—I AM quite in accord with the views of "Rover" as to contents and pressures being wide of the mark in this discussion, and Mr. Kiernan's figures are not correct. I will take an ordinary coach. Well, Sir, the space in the Westinghouse pipe and under side of triple-valve is 330in., and 66 cubic inches of air let out puts the brake full on.

Now turn to the vacuum. The brake-pipe and lower side of cylinder contains 3,300 cubic inches, and to put the brake on 2,600 cubic inches of air must enter. How can Mr. Kiernan say that 66 is anything like the "same quantity" as 2,600?

The following from a Melbourne paper shows the value of a good brake:—

"As showing the inestimable value of a quick-acting and powerful continuous brake, an occurrence which took place at Melbourne recently supplies ample proof. A passenger train had started from a station platform without the driver having noticed the signal being at danger, and crossed over the junction ahead, at which point an express train was approaching. The critical state of affairs was just observed in time, and by the application of the Westinghouse brake the express was stopped within *ten feet* of the fouling train, and a dreadful catastrophe was thus averted. In this case the fractional part of a second's delay in the action of the brake would have been fatal."

With regard to the vacuum brake being no use when engine and tender parts, some experiments were last week made on the Lancashire and Yorkshire, and the brake was proved not to act in case of engine and tender parting. **Practical.**

[27502.]—I SHOULD like to inform "Rover" (letter 27448, June 17th) that where two vacuum engines are coupled together, there is no necessity whatever under ordinary circumstances for the *second driver to interfere with the brake. I say again that the first driver experiences no difficulty* in stopping even if the second driver has his ejector blowing, for this reason: the first man can admit a greater volume of air to the train pipe than the second one can eject; consequently I am of opinion still that if the train in the Crook accident had been fitted with the vacuum brake the result would not have been the same as alleged by Mr. Gobert.

If "Rover" would be a little more charitable in his language and pay rather more attention to facts, the tone of this correspondence would no doubt be much improved.

June 18. **Lowmoor Driver.**

ELECTRICALLY PROPELLED TRAM-CARS.

[27503.]—ON p. 332 of MECHANIC for June 10 there is an article on the above subject. In it are several ways mentioned for placing the leads, such as overhead lines, which are out of the question as far as a public conveyance is concerned. With rails as conductors there is some amount of danger. The secondary cell is admitted to be extravagant in power; also the weight of the cells as well as passengers have to be carried from place to place, but may have some questionable advantage at hill-climbing, as giving greater adhesion to the rails.

While reading the article, my thoughts ran back to an operation I saw the other day, and also to a probable solution of the future position of tram-car electric leads. In Edinburgh and suburbs are being laid down cable tram-lines, and in the channel for the cable may be found a means for placing conductors for the conveyance of the electricity required to drive the car motor. The said channel is somewhat bottle-shaped in section, having a slot the whole length of the lines, free for any conductor required, and the leads could be placed on each of the slots, and under the street level, and be perfectly insulated both from earth and from wet; also would be out of danger to the public. **Will.**

A GOOD DAY'S WORK.

[27504.]—THE heaviest day's work of a smith that I have ever seen performed was by a remarkably clever Cornishman, an engine smith.

I got a hurried order to truss a new roof, which, from an error of the architect, had begun to sag. The truss rods required sixty-four 1¾in. hexagon nuts, &c., so I let the job to the smith, and he was determined to show what he could do. The swaging the ends for screwing and the welding on to the rods was all simple enough; but to forge the nuts out of bars was the part in which he took some pride. He cut his lengths, 10in. by 3½in. by 1in., at the shears, and made up his hollow fire overnight; he had a large hearth, a water tuer 1½in. diam., and a powerful fan blast; he employed two hammermen, and began at six in the morning, and at six in the evening he had the 64 nuts done; a sound job, except that one split in the screwing, and for which no one blamed him! He kept at least three pieces in his fire together, got a good mellow heat on the first, prepared the ends for welding, and bent it roughly into shape in the hexagon swage, took a welding heat, swaged again, gave the nut a good sweat, finished the outside, and drifted it for screwing. Of course he regulated matters so that while one nut was being wrought another was heating, and so on. The time actually worked was 10½ hours, or 630 minutes; an hour taken for dinner, and half an hour for breakfast, and I think he gave his men an afternoon ten minutes, so that it was a trifle over nine minutes for the forging of each nut! The job doubled his usual pay, which was given him with much pleasure and some little compliment by his employer.

Rho.

ORIGINAL ELECTRIC EXPERIMENTS: HOW TO MAKE A POWERFUL WIMSHURST MACHINE.

[27505.]—TAKE a pair of, say, 24in. discs, and attach bosses to them as I have before described in these pages, as well as the framework for same. Fix a suitable piece of lining paper to a drawing board, strike a 24in. diameter circle, a 23in. do., also one of 12in., as well as one of 8in. Now divide this into 32 divisions, and this gives 16 sectors and 16 spaces. These sectors are to reach from the 8in. to the 23in. circles, and must have their corners rounded off. It will be found handy to cut out a tin template in order to cut the tinfoil by, with a penknife upon a smooth board. Lay the disc upon toe divided sheet of paper and paste the sectors in their places. Leave them until next day. Next give them a coat of lac varnish upon the same side as the sectors are upon. Next day, in order to save giving repeated coats of the lac varnish, I melt the following ingredients in a small frying-pan over a Bunsen burner:—½lb. black rosin, 2oz. shellac, 2oz. Venice turpentine, and about 1oz. paraffin wax. Have the disc alongside on a bench, laid upon a newspaper. Brush on this composition thickly from the boss to the 12in. circle. As it cannot be got on smooth, take a gas-burner attached to a piece of indiarubber pipe, and direct the flame down upon the stuff so as to bring it to a nice glassy surface. Now we must apply several coats of lac varnish so as to overlap all the exposed edges of the sectors for, say, ¼in., "as these edges throw off a deal of electricity." Put a good coating upon the outside diameter of each disc. Now, in order that it may start in any weather, I find it advisable to make a rubber by taking a piece of cloth or drugget, according to the distance separating the two discs. Cover this with lining paper. Make it a little larger than one sector, paste this upon the inside of one of the discs opposite to a sector; pick the place where the plates come closest together, so that it just touches gently; when dry next day paste a piece of foil upon it, and this will enable it to start at any time almost. It is desirable when using this rubber to rub these faces with a rag moistened with petroleum oil occasionally. To obtain the electricity from the discs, I find that a single fine wire unwound for, say, 1in., of the bass-string of a violin, fastened in a small piece of brass tube by a wooden peg is amply sufficient, and I cannot find, after repeated experiments, that there is any advantage gained by making a fork and taking it simultaneously off both plates. In fact, the best effects are obtainable by substituting for, say, the front neutralising rod, two large jars with wires, as described, and suitable jumping places arranged by means of strips of foil pasted on same; all edges and exposed glass of said jars to be covered with lac thickly. In order to start with this arrangement it is advisable to place a finger upon one of these connections until the electricity comes on. This electricity is of great energy; that is to say, it apparently bores holes in a knuckle if applied to a large-sized conductor in connection with same, and gives very pretty effects with a vacuum tube. The noise of shocks can be nicely got rid of by taking a few inches of glass tube, putting a cork in each end, through which pass a stout brass wire having an eye upon one end to hang upon horizontal arm of jar which carries the fine wire touching sectors, the end inside filed to a blunt point; these can be put to any required jump, and from the bottom hook goes a wire to the outside foil of jar. Note: A curious experiment is to fill a glass tube, as aforesaid, with petroleum oil, cork tightly, and in a turn or two there will be sufficient gas produced to blow out one of the corks with a violent explosion.

June 17. **A., Liverpool.**

ATMOSPHERIC ELECTRICITY.

[27506.]—SINCE the Meteorological Society have been recently drawing attention to the slight extent of our knowledge of atmospheric electricity, and have suggested its further study through the medium of instantaneous photography, the following note may be worth insertion.

While passing up the Channel between Deal to the East Geodwin Lighthouse (lat. 1° 26′ E., long. 51° 10′ to 16′ N.) on Monday evening, May 30th, we observed flashes of lightning close to the horizon in a N.E. by E. direction at irregular intervals of about 2½ minutes.

The first flashes were forked; but the sixth flash was an extremely brilliant one, radiating in all directions from a point on the horizon. An instant after we observed at an altitude of 30°, and to the east of this point by some 25°, a brilliant globe of a yellowish white colour, and of about the apparent size of the moon. The edge appeared regular and fairly well-defined, except at a small point diametrically opposite to the centre of luminosity of the flash, at which part it was interrupted, for there was here an obscure patch covering about a sixth of the whole area, and projecting inwards nearly to the centre. The globe disappeared almost immediately, and no motion was observed. Time, 9h. 16m. G.M.T.

Some eight minutes elapsed before another discharge occurred, and, with the exception of three other radiating flashes, in connection with which, however, no luminous globe was observed, later ones were mainly of ordinary sheet lightning.

The weather was fine, after a close day, the sea fairly calm, and only a slight breeze on. No thunder was *heard*, but previous experience proves that the low rumbling noise of a distant storm is not noticed at sea on account of the noise of the waves.

This observation appears to give some confirmation to the theory first put forward by Snow Harris that "Globe lightning is due to a glow discharge from certain points of an electrically excited atmosphere," for we may regard the centre of luminosity and the obscure portion of the globe as being the two oppositely electrified poles, but too far apart to allow a spark to pass; the radiating flash from earth being a brush discharge, while the globe itself might represent a glow discharge from the atmospheric pole.

Wm. Buchanan.
Wm. Scudamore.

Normal School of Science, S.W., June 17.

HOW TO ADJUST A TELESCOPE EQUATORIALLY BY DAYLIGHT.

[27507.]—ERRATA in last number (June 17): page 372, 1st column, 7th line from top, for "Declination is then horizontal," read "Declination axis is then horizontal." And again, in the 12th line, for a full stop after "central," and a capital W in "when," the sentence should have, after "central," no stop at all, and a comma after "O." It would then read: "The bubble stands central when the Dec. Vernier reads O," **Al Fard.**

KEYLESS WATCHES.

[27508.]—AS I originated the correspondence on the above subject in the ENGLISH MECHANIC, would you allow me space in order to make the subject more clear?

All the letters (Nos. 27409, 27437, 27438, 27439) published agree with me; but their writers do not see where the real fault is; others do not know the remedy.

My aim is to put the question before the public in such a way that the public can judge for itself. I do not expect that watchmakers will introduce any improvement unless compelled by the demand of the public.

My letter, published in your paper 3rd June, explains the matter; but I would add to that, and ask watchmakers and watchwearers the question, What is your object in having a bow to your keyless watch? It certainly does not facilitate winding the watch—no one can say or think it does; on the contrary, it hinders the winding. Mr. Rawlins writes that he can turn down the bow—quite right, but the bow would still be in the way; and why put the bow there at all if only for the sake of being turned down, as it is not wanted in the least for the watch?

The only object anyone can have in putting bows to watches is to secure the watch to the chain; but the bow in a keyless watch does not secure the watch to the chain at all. It is a make-believe, something like the soft bayonets—when put to the test found useless.

Mr. J. H. Wells writes in your paper of the 10th inst., after he had lost his gold keyless watch: "I did not know before how insecure my watch was." He also writes: "I shall take good care when I have a watch again to get one without a bow."

Mr. Rawlins writes, June 17th: "I have often had the bow of my watch detached, and on account of this I doubt whether I would now purchase a keyless watch."

"D. G." writes: "It would certainly seem that the bows of ordinary keyless watches are not to be trusted."

"D. G." is wrong in supposing that the arrangement mentioned in my letter of the 3rd inst. cannot be applied to an existing watch; on the contrary, it can be applied to any watch, old or new, at a small cost, by any watchmaker who knows his business.

I am willing to give all the information to any one who might desire it.

Another side of the question is of some importance also. In a good gold watch, the bow and extra large pendant weighs about 3dwt., that is, in an 18-carat case, worth 9s., and if we put only 1s. for workmanship, that makes the watch cost 10s. more to get a piece of work which everybody must admit is bad.

Having glanced at it from a commercial point of view, I will only mention that there are made something like two million watches in the world per annum. Supposing we save only 1s. on each watch by doing away with the useless bow, the economy would come to something handsome, not to mention that it would be a check to pick-pocketing. **Christian Lange.**

28, Great Portland-street, W.

ARACHIS HYPOGÆA.

[27509.]—I TRUST "Eos" (to whom we are all much indebted for the interesting information he is giving us on Indian matters) will not think me hypercritical if I point out that the arachis is not known (in Europe, at least) as the pistachio nut; but as the earth nut, monkey nut, pinder nut, or Pindar. The pistachio is an expensive luxury, even in Italy, where the arachis is a common object of cultivation. **S. Bottone.**

GURJUN BALSAM.

[27510.]—THIS is known to Europeans in India as "wood oil," or "Gurjun oil." It is sold in all native cities at a retail price of 1s. to 1s. 6d. per quart bottle. Its uses are many and valuable in the arts, and it ranks medicinally as equal to Copaiba in the local hospitals. As a solvent of rubber, lac, copal, nearly all the gums and resins—even solid gluten—its rapidly drying qualities recommend it highly. For the same reason house and carriage-painters employ it alone, or mixed with raw linseed oil. A favourite formula for a waterproof, *shiny varnish in the Madras district* is the solution of shellac in this oil; another of dammar resin in the same for ships and boats, being a preservative from ravages of the all-devouring white ant. This balsam is collected in the virgin forests of Burmah, Assam, and contiguous tracts by cutting a deep notch in the immense trunk of a *Dipterocarpus*, a fire being kept up against the wound till it is charred; then the liquid begins to run into a rude trough leading into a receptacle made to catch the supply. Forty gallons may be collected in a season if the wound be cleaned and freshly charred, and fires lit anew. I have never met with this oil in Europe; probably its great utility has not been made known, though Rangoon has been a British port for over 30 years. However, East India brokers may be able to explain this fact. **Eos.**

WORKSHOP SCRAPS.—BLACK VARNISH FOR IRON.

[27511.]—A FRIEND of mine in India, whose two-horse carriage had become very shabby in that destructive climate, wished to have the vehicle painted and varnished in as brief a time as possible without any dislocation of the wood and iron. This was easy enough as regards the first material. Not so the last, for corrosion and red rust defied the adhesion of the usual black paints and varnishes, unless the metal parts were removed and chemically cleaned. In this dilemma, he asked my opinion, which I gave in the form of a black japan, with which I had recently experimented. Pure asphalte is dissolved in Gurjun balsam to the consistence of treacle; then strained through horse-hair cloth, lampblack being added to give the proper jet tint, the iron being previously cleaned from grease and darkened over fire, is painted with this while the metal is warm. The varnish dries rapidly in the sunshine, when another, or even a third, coat may be added. We found this application very neat and effective after all the metal work had been scraped and scrubbed with dry sand. **Eos.**

INDIAN TINWORK.

[27512.]—THE cleanest joints I have ever seen were made by workmen who use the fragrant resin known as East Indian olibanum, being a sticky substance. The operator merely dips a pointed stick in the same and draws it along the seam. I always preferred it to the British powdered rosin, which falls about and is wasted. **Eos.**

THEORY OF MACHINES.

[27513.]—REFERRING to Mr. Stansfield's letter (27456, p. 370) and my diagram, Fig. 49, p. 334,—in the latter it should have been explained that to vary the speed g should have two rims, one to gear with e and the other with c, that gearing with e being the smaller, and the face of c broad enough to extend over both wheels, as one of course must lie behind the other. **Francis Campin.**

METALLIC CEMENT FOR STONE.

[27514.]—THE process given on p. 377 is unnecessarily complicated, and is inferior to the original form in hardness and strength. The proper way to make this cement is to use common coarse oxide of zinc, the coarser and denser the better. Exposure to air damages its properties as a cement, owing to its absorption of carbonic acid, which is driven out when the liquid is added, causing sponginess. If the oxide is not perfectly fresh, and the work is important, it should be heated to bright redness before using. If flinty hardness is required, such as will turn a steel chisel, the oxide must be dissolved in strong nitric acid until a pasty mass is formed by excess of oxide, and this mixture must be evaporated until nitrous acid fumes are given off. The mass must then be thrown in small quantities into a red-hot crucible to drive the remainder of the acid off, the result being an extremely dense crystalline oxide of zinc, which requires grinding up to powder. This tedious and expensive process is not necessary except for excessively hard cements.

When the cement is required for use, the powder must be mixed quickly, in as small quantities as possible, with a fluid made by dissolving the oxide of zinc in hydrochloric acid until the acid is saturated. The speed of setting depends on the strength of this solution, and if too quick the solution must be diluted with water. This cement is a very basic chloride of zinc, and any foreign matter added either to the oxide or to the solution decreases its strength and power of resistance to weak acids and water, which, when the chemical composition is considered, are most extraordinary. Joints made with it will stand unchanged under water for years, and it is soluble with difficulty in hydrochloric and other acids.

A similar cement, but weaker, can also be made by replacing the zinc oxide with magnesia; but it is of little if any use, owing to its greater cost, and also to its strong expansion after hardening. There are also many little-known cements which can be formed in a similar manner from the sulphate or nitrate of zinc or magnesia, the phosphate of zinc or tin and other similar compounds which have the property of setting hard with an excess of their own bases. The cements formed by some basic phosphates of tin have a curious and beautiful translucence; but, owing to the commercial difficulties in the manufacture, they have not up to the present time been utilised.

Warrington. **Thos. Fletcher.**

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[62355.]—**Phosphorus (U.Q.)**—A large proportion of the phosphorus made in England is prepared from Sombrerite, an impure calcium phosphate found on the Island of Sombrero in the West Indies. It appears that almost the whole of the phosphorus made in the world is manufactured in two works—viz., that of Messrs. Albright and Wilson, at Oldbury, near Birmingham, and that of MM. Cognet et Fils, in Lyons. (Hofmann's report on Vienna Exhibition.)—SM.

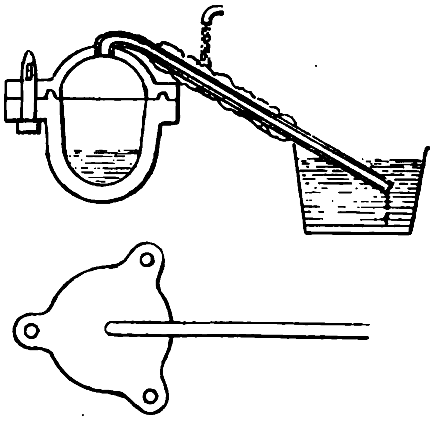
[62365.]—**Mirror Galvanometer.**—My Thompson galvanometer has a three-legged base, with levelling screw in each. The coil is a circular bobbin; but I do not know the gauge of wire. The mirror is slightly concave, and is attached to a vertical strip of aluminium which has below a fan of the same metal, and is suspended by fibre at top. The fibre is attached to a brass rod, which slides vertically in a tube, so that the mirror and attachments can be lowered and be safe for transit. Can I tell you anything more?—SM.

[62385.]—**Drawing.**—Maxton's "Manual of Engineering Drawing," published by Lockwood and Co., is a standard textbook for those who want to enter the drawing office.—E. M.

[62386.]—**Moulder's Mineral Blacking.**—Plumbago, or so-called blacklead, is the mineral blacking used for fine work. Potter's clay is mixed with water, and plumbago added to suit the workman's ideas. Generally speaking, the "blacking" is charcoal dust. If the querist does not know exactly what he wants, I would recommend him to get West's book on "American Foundry Practice," or look up the subject in your back volumes. There has been a good deal about moulding and casting, and no doubt the querist would find exactly the information he requires.—SELIM.

[62389.]—**To Die Makers.**—It is not easy to see exactly what "G. H." expects by way of reply. He can obtain a stamp of the required dimensions from any of the makers of such articles, and can punch as many pieces as he requires out of 26 W.G. sheet steel, as it is only ·018in. thick. That is easily cut through if the sheet is placed on a lead block and the stamp hit with a mallet. Any good steel will do to make the stamp or die.—J. T. R.

[62396.]—**Purification of Mercury.**—In quartz-crushing batteries, when the mercury gets "sluggish" and dirty, sodium is put into it, and it becomes bright and lively, and more able to catch (amalgamate with) the gold. When it needs purifying, it is put into a bell-shaped cast-iron retort, which has a turned joint luted with clay, and drawn together with three cotter-bolts. A wrought-iron pipe is screwed into the cover and bent down into a bucket of cold water, the pipe being kept cool by covering it with cloths on which water trickles.—T. F. S. T.



[62392.]—**Planing Thin Boards.**—To answer this query would be simply to advertise a maker. Any of our makers can supply such a machine as is required by the querist, at all events for facing up the work; but it might be cheaper to do the edges by hand.—R. and M.

[62404.] — **Oxygen Gas Tank.** — Cannot "Amateur" reduce the dimensions himself, or does he want someone to work out the scale drawing and save him the trouble?—J. M.

[62405.] — **Colouring Copper.** — There are some recipes for this in back volumes; but as it is impossible to know which will suit the querist, he may try the following:—Prepare a solution of sulphide of barium about 3 to 6 grains to 1oz. of water, and put the clean copper articles in it for a longer or a shorter period according to the tone desired. It should produce a warm chocolate with metallic lustre. There is also a tedious process of coating the copper with crocus paste, holding over a fire and smoking it; but the querist might try the above first; or, if he prefers a dark colour, let him place the copper medals in a solution of hydrous carbonate of copper in liquid ammonia. Burnish, when colour is obtained.—Nun. Dor.

[62407.]—**Davis' Interlocking for Signal Arms.**—If this device is not patented, no doubt Messrs. Saxby and Farmer have a drawing or sketch; but if it is patented all the querist need do is to consult the specification. I have not time just at present; but if the subject is of sufficient interest to your readers I will look it up and see if I can send a diagram, or at all events a clear description.—Nun. Dor.

[62409.]—**Galvanising.**—The art of galvanising and the methods employed have been frequently described. Does this querist want someone to tell him how to start a business and make a lot of calculations for nothing? See a reply on p. 267, No. 1079. In the simplest process the articles are scoured perfectly clean and dipped in a bath of molten zinc, which is covered with a layer of sal-ammoniac; but I believe it is better to coat them first with a film of tin by dipping into a bath of the muriate. Iron is tinned much in the same way, except that the plates go through a tank of grease before entering the tinning bath. The querist will find all about it if he will only look through back volumes.—Nun. Dor.

[62441.]—**Luminous Paint.**—Thanks to Mr. Hart for his courteous correction. I overlooked the fact that the paint was wanted to shine through glass. What Mr. Hart says on p. 374 is quite correct. I shall hope that the suggestion or the "arrow" contained in the last three lines of my reply on p. 326 will find its mark.—Saml. Ray.

[62500.] — **Lathe Bands.** — Gut bands are wonderfully improved by rubbing in a small quantity of castor oil; no other oil is so beneficial in helping the gut to work. Practical men know how to shorten or lengthen a gut band just a little by twisting or by untwisting it two or three turns. Searing the gut slightly at the end when through the hook or eye puts a head on, which helps it to hold.—Francis Spencer.

[62502.]—**High-Speed Electro-motor.**—You will find a description and three illustrations of Ayrton and Perry's motor, at pp. 432 and 433 of Silvanus Thompson's "Dynamo-Electric Machinery." If you cannot gain access to this work, ask again, and I will reproduce the article *in extenso*.—S. Bottone.

[62523.] — **Harmonium Vibrators.** — Permit me to call the attention of those interested in this question to a reply on p. 503, No. 1063, and also to one on p. 524, No. 1064. I gave the prices of harmonium reeds in the former, such prices having, to my knowledge, existed for 10 years previously; but Mr. Fryer, on p. 374, last week, says that reeds can "now" be purchased for 12s. a set. He was told so some years ago, but simply contradicted those who gave him the information. To answer the query, however, which Mr. Fryer has not done: the vibrators for harmonium reeds can be made out of any good brass by hammering well with a large-pened hammer, or by flattening out pieces of good brass wire and cutting roughly to size. I think it a good plan myself to anneal the brass at least once when making from wire (that is, by making red-hot and allowing to cool); but if the querist is in London or any large town, he will be able to procure suitable rolled brass from which he can cut the majority of the vibrators. In punching the holes for the rivets, see that the burr on underside is carefully filed off.—G. L. B.

[62524.]—**Gas Cooking Range.**—Although the query was not put by me, I am obliged to Mr. Fletcher for his remarks. Does he, however, not think my tiles would be cleaner and better altogether for keeping in heat than any enamel on the plates?—Hendon.

[62538.] — **Re-Brazing Lumps of D.B. Breech-Loaders.**—As no one has replied, I venture to give a reply. I must first say that I have never known a lump to come off. I have been in the gun trade all my life. I spent twelve years in India, and during those years I had the whole of the officers' guns to repair (the officers of my regiment), and many others. But I never knew of a case where the lumps gave way. True, British officers have, as a rule, good guns. "Tukang Besi" must have come across some bad specimens. However, I will give him the best advice first. By all means take the barrels to pieces (as we call it in the trade), that is, hold them over a fire till the soft solder melts. Take off the upper and lower ribs, then put barrels in position and braze, then put on ribs and solder. But wait, those barrels have been in use, they are just bored to size; now the act of brazing may cause them to scale. You may prevent the scaling by filling up the chambers with moist clay. I assume you understand brazing. Take my advice and use silver solder: it does not cost so very much. The weight of a shilling will be enough for your lumps. Do you know how to make silver-solder? If not, I can tell you: Melt 2 parts of silver and 1 of brass. Enough on that subject. Now I come to the practical point. Breech-loaders are many and various. In some patterns the strain on the lump is great, on others the strain is little. Now, where the strain is not much, you might with safety resolder with tin. Go this way about it. Use pure tin (not tinsmith's solder). See that your lumps fit almost perfect, tin the lump, bind the barrels together with stout wire; also tin that part of the barrel on which the lump has to rest, and if there is no great strain, tin solder should hold. But let me here remark the only genuine way of doing the job is to take the barrels to pieces and re-braze. I know it is a trouble; but you must not mind trouble. Then resolder the ribs. But what rubbish of guns where the lumps come off! Any other information I will give you. I can't bear giving too much in the "E. M." I see others can write better than I, and I don't like taking up space. Give your address, and I will give you many hints. I have had experience.—Armourer.

[62545.]—**Moths.**—Will "T. F. S. T." forgive me if I point out that the "silver fish" which is described as the male moth, is not a moth at all, has no relation to moths, but is a totally distinct insect well known to microscopists as a test for low powers, under the name of *Lepisma saccharina*.—S. Bottone.

[62547.]— **Coins of the Present Reign.**—There are two varieties of the sovereign—one with a shield on the reverse, and a later one with a poor reproduction of the old George and Dragon which appeared on the earliest sovereigns issued. Two half-crowns, the later issues being much poorer in relief and general execution than those of the early part of the reign. The querist also appears to have forgotten that there are two varieties of the florin, the first coined (the graceless) smaller than those which followed, having the legend in Roman letters. There are pence, halfpence, and farthings of copper for use in Ireland, with a harp on the reverse; and a bronze as well as a copper coinage for Jersey and Guernsey. There are the penny, halfpenny, and farthing for the Isle of Man, a very beautiful coinage of silver and copper for Canada, and a large series of coins in both metals for India. There is considerable variety to be found among the bronze pennies; I have eight or nine, varying in the breadth of the neck, and in the position of the rose on the bust, as regards the edge of the coin, some only showing a part, others the whole of the flower. The third of a farthing, and probably the half and quarter, have lately been coined in bronze. I find I have forgotten to mention the gold coinage of Australia. It is to be hoped that the Jubilee coinage will be superior to the other coins of this reign, as excepting, perhaps, the florin, they are a very poor lot, going from bad to worse.—W. A. G.

[62549.]—**Electric Kite.**—I beg to supplement "A., Liverpool's" answer to the query by reproducing an account of the fate that befel Prof. Richman, of St. Petersburg, August 6th, 1753. He had constructed an apparatus for drawing electricity from the clouds, and was attending a meeting of the Academy of Sciences when the sound of distant thunder caught his ear. He immediately hastened home, taking with him his engraver, Sokolow, in order that he might delineate the appearances that should present themselves. While intent on examining the electrometer, a large globe of fire flashed from the conducting-rod to the head of Richman, and instantly deprived him of life.—S. Bottone.

[62566.]—**Unamalgamated Zincs for Bunsen Cell.** — If the querist will turn to p. 79, Vol. XXIV. "E. M.," he will find "Sigma's" reply to a similar query. The paragraph with the desired information is to be found on page 199 of Buckmaster's "Experimental Physics," 1869. It is a description of Hearder's nitric acid battery, which is a modification of Callan's cast-iron battery. "In spite of all precautions, it sometimes happens that the amalgamation is destroyed by nitric acid, which gets through the diaphragm. An action of this kind in a single cell frequently throttles, as it were, the whole battery, and reduces its power to a mere trifle. To obviate this difficulty, Mr. Hearder always employs a saturated solution of chloride of ammonium, instead of dilute sulphuric acid, in contact with the zinc, which thus requires no amalgamation, thereby saving much time and avoiding the perplexity occasioned by the amalgamation breaking down." Curiously it is stated in Vol. VII. p. 543, of Orr's "Circle of the Sciences," that in a patent dated 1849, "Charles Thomas claims the use of alkaline salts in solution, which did away with the necessity of amalgamation." And on the following page it states, "In working Callan's battery it is better to excite the zincs with muriate of ammonia." In reference to the above, Mr. Hearder's son gave me a pamphlet published 1865, containing some experiments performed by his father in electric lighting in 1849, and on page 2 he says, "The battery employed for the light on top of the Devonport column consisted of 80 cells of an arrangement of my own, modified from Callan's cast-iron battery, in which saturated solution of muriate of ammonia was used with the zinc, as it supersedes the necessity for amalgamation, which is very apt to break down with nitric acid arrangements." I have given all the information in my power in the hope that some of our electrical readers can really say who first adopted the plan of using unamalgamated zincs—Hearder or Thomas? The querist also stated he found the zincs covered with crystals if left standing. Culley suggests amalgamation as a way out of the difficulty when this occurs with the Leclanché zincs; but I think it is questionable if anything is gained. A very good maker the other day told me he never amalgamated Leclanché zincs, even when in the form of a plate 6in. by 3in.—An A.S.T.E.

[62566.]—**Unamalgamated Zincs for Bunsen Cell.**—If this querist will turn to page 79, Vol. XXIV., English Mechanic, he will find "Sigma's" reply to a somewhat similar query. The quotation he desires is to be found in "Buckmaster's Experimental Physics," published in 1869, page 199, and reads thus:—"In spite of all precautions, it sometimes happens that the amalgamation is destroyed by nitric acid which gets through the diaphragm. An action of this kind in a single cell frequently throttles as it were the whole battery, and reduces its power to a mere trifle. To obviate this difficulty, Mr. Hearder always employs a saturated solution of chloride of ammonia, instead of dilute sulphuric acid in contact with the zinc, which thus requires no amalgamation, thereby saving much time and avoiding the perplexity occasioned by the amalgamation breaking down." The above paragraph is from the description of Hearder's nitric acid battery, which is a modification of Callan's cast-iron battery. Hearder first mentions the use of this battery in a pamphlet published by himself in 1865, giving an account of some electric-lighting experiments made by him from the top of the Devonport column. On page 2 of the pamphlet he says: "The battery employed on this occasion consisted of 80 cells of an arrangement of my own, modified from Callan's cast-iron battery. The cast-iron cell was excited by pouring into it a mixture of nitric and sulphuric acid, and the diaphragm was filled with saturated solution of muriate of ammonia. I adopt this fluid for exciting the zinc, as it supersedes the necessity for amalgamation, which is very apt to break down with nitric acid arrangements." Although Hearder, of Plymouth, was the first to use in a practical way unamalgamated zincs, the inventor seems to have been a Mr. Pearce, for in "Orr's Circle of the Sciences," Vol. VII. p. 543, under the "Practical Chemistry" section, will be found the following:—"In 1849, Charles Thomas Pearce claims the use of alkaline salts in solution, which did away with the necessity of amalgamating the zincs," and on page 544, same work, it says:—"In using Callan's battery it is better to excite the zinc with muriate of ammonia." As to the latter part of this query (relative to the crystallisation on the zincs when using sal-ammonic solution), Culley, in his last edition but one, says that the only reason the zincs are amalgamated in Leclanché's cell is to prevent the crystals adhering; but even this, in the presence of nitric acid, I think would be useless, because amalgamation is no protection against nitric acid (see Sprague's "Electricity," old edition, pages 86 and 88).—An A.S.T.E.

[62573.]—**Force of Outlet Steam.**—I will explain to "T. C., Bristol" the query. Suppose a pipe, area 1 square inch, was discharging steam from boiler at a pressure of 60lb. to square inch, with what force would the steam blow against an object placed 3in. from the end of the outlet pipe? And what is the rule (if there is one) to calculate the pressure at various distances from the outlet and under various pressures in the boiler?—J. N.

[62579.]—**Western Australia.**—The "Penny Western Australian Handbook," to be had at nts' Information Office, 31, Broadway, gives formation asked. Rough and ready are the at are welcomed.—N.

30.]—**Wave Motion.**—Experiments made brothers Weber show, that in a trough eep and filled with water, the waves which eated on the surface extended to the bottom trough. And they noticed it also by small es floating near the bottom moving in their long after the surface had become quiet. nade another remarkable discovery, namely, e waves reached the end of the trough on face before they reached it lower down. I py the average result from their book enlehre," page 139. A wave created on the reached the end of the trough at 1sc. 38tert.; low, 1sc. 24tert.; 2in. below, 1sc. 20tert.; low, 1sc. 12tert. They, however, could not e that the wave travels slower in the deep the surface, and came to the conclusion that ve decreases in breadth towards the bottom. had given the measure of the height and of the wave, we might be able, with the bove, to calculate how deep a wave reaches ards till it comes to a point.—J. H. HT.

34.]—**Tour in Norway.**—Having spent the part of eight summers in Norway, princi or the enjoyment of its grand scenery, and easure an intercourse with the Norwegian try afforded me, I am prepared to offer ..." the following advice regarding a short that country. (1) Purchase at once a guide nd read it up. Murray's is excellent, and ome others) contains a glossary of common and sentences. Learn as many of them as n, because few people you are likely to meet peak English. Of course, this remark does ply to captains of steamboats, waiters at otels, &c. In the country there are, how but few hotels; the roadside "stations" g-houses) serve as inns. "Nielsen's Guide" good. It is translated into English. "Ben Iandbook" (a sort of "Bradshaw") is most if not essential, in posting. All these books d by Stanford, of Charing Cross. (2) Take h money, and change it in Norway at money r's in Bergen or other towns. (3) Don't let ggage weigh more than 50lb.; every pound that is a curse. Stout nailed boots, and a roof are essential. (4) Write to Messrs. T. and Co., shipowners, Hull, for a list of sailings. (5) Exclusive of the voyage to y and back, I think £1 a day will cover all es. Living at a country place (as I have or weeks at a time) costs rarely more than s. a day; but you must consider that you, on t a tour, will be travelling all day, either amer or karjol ("carriole," as the English his national conveyance), and it is this g about that runs away with money. (6) ing generally, and from an artist's point of the best (most gloomily grand) scenery is to nd towards the heads of the *fjords* (Scotch, , particularly the smaller fjords which branch from the main channels, and in the valleys lead down to the fjords—e.g., Gudvangen, e magnificent Geiranger Fjord. The roads h the interior of Norway are comparatively except in a few places. Romsdalen is weird im enough in all conscience, but only towards rth end, where it descends for some twenty h miles to the sea. (7) On landing in Nor buy a steamboat time table (Norges Kom ationer). This gives you the times at which tle steamers on the great fjords call at the s stopping places, and enables you to plan ourneys so as to catch them. When you fail ch a steamer you may still proceed in a row the shores being portioned out into water . (8) The following is not a bad route for a weeks' tour. Hull to Bergen. Bergen viâ vangen to Gudvangen, where you catch a er on the great Sogne Fjord, which will land Vadheim. (Should you find you have suffi time, say two days, before going to Vadheim, t Aardal, and visit the Vettisfos—the finest fall in Norway.) From Vadheim, partly by and partly by water (see Route 17, in Mur Guide), you journey to Hellesylt, and, after the wonderful Geiranger Fjord, proceed by er to Söholt, where you land, or you may ps go on with the steamer to Molde, should ll there. From either Söholt or Molde easy to reach, in a short day, Veblungsnæs. there, drive through Romsdalen en route ristiania, where you embark for England. tour might be slightly shortened by leaving omsdalen and Christiania, and returning from sylt to Faleidet (on the Nordfjord, a steam tation you have already passed), and thence a passing steamer to Bergen. In that case, mbark for England from Bergen. In either however, a couple of days may well be spent e Nordfjord in exploring (from Faleidet) the s Brigsdal and Næsdal. They abound with rs, and, for savage scenery, have few rivals Norway. (9) Two or three general remarks and I will conclude. Owing to the paucity of accommodation (e.g., horses, food, beds, &c.) at the small stations, the fewer your party consists of the better you will get on. The Norwegian peasantry are the finest in any part of Europe. You will find them kind and obliging, as a rule, provided you treat them with proper civility and consideration, and drop all idea of social rank. A very little "Norsk" goes a long way; without any you may, however, now and then find yourself in difficulties. You must never *order* a man to do anything; but ask him to be kind enough to do it, and he usually will try his best to oblige you. All who have lived as much with Norwegians as I have know the truth of this. When you drive, have mercy on the poor pony; in numbers of instances you may be sure the gentle little animal has been working 40 miles a day for several days together. A station-master I knew was once on the point of knocking down an English nobleman for his brutality in striking a horse. If you are in a hurry, let the horse-boy drive; the pony knows his "chirp," and will go twice as well for him as it will for you. Don't hamper yourself with a fishing rod; nearly all the good fishing is tightly preserved. Lastly, take a little powdered camphor with you to sprinkle between the sheets where fleas abound, as at some of the small and poor stations they certainly do. I have found this a fair safeguard against those nocturnal warriors. —J. R. CAMPBELL.

[62587.]—**Equations.**—Number the equations (1), (2), (3), &c. They form one system (not two systems), involving four unknown quantities. Add (1) and (2) together, and subtract their sum from the sum of (3) and (4). The result is—

$$z + \sqrt{z} = 0,$$

which gives us two values for z—viz., $z = 0$ or 1. Put $z = 0$ in (4) and (5), which are now easy equations between x and y. Lastly, substitute for y its value obtained from (4) and (5) in (2), and so determine r. Of course, by making $z = 1$ we obtain another set of values for x, y, and r.—J. R. C., Charing.

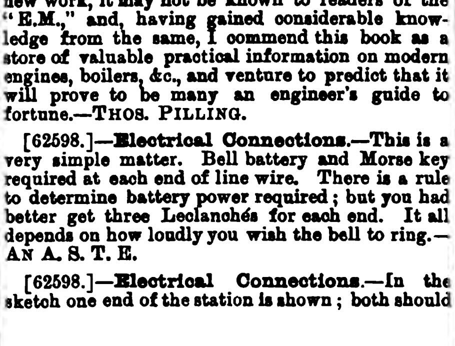
[62588.] — **Wood Pulp.**—Chop the wood up small, say, across the grain, ½in. long. Boil with caustic soda in a revolving boiler, under 150lb. pressure, for six to fifteen hours, according to kind of wood. Mash well, and drain. It may then be mixed with glue, and pressed into moulds. —T. F. S. T.

[62596.] — **80c.p. Dynamo.** — TO S. BOTTONE.—Yes; you would get good results.—S. BOTTONE.

[62597.]— **Turbines.** — Having myself been searching diligently for information on this subject, I am able to say that you will find engravings and rules for turbines in "Hutton's Practical Engineer's Handbook," published by Lockwood and Co., Stationers' Hall-court, London. This being a new work, it may not be known to readers of the "E.M.," and, having gained considerable knowledge from the same, I commend this book as a store of valuable practical information on modern engines, boilers, &c., and venture to predict that it will prove to be many an engineer's guide to fortune.—THOS. PILLING.

[62598.]—**Electrical Connections.**—This is a very simple matter. Bell battery and Morse key required at each end of line wire. There is a rule to determine battery power required; but you had better get three Leclanchés for each end. It all depends on how loudly you wish the bell to ring.—AN A. S. T. E.

[62598.]—**Electrical Connections.**—In the sketch one end of the station is shown; both should be fitted up thus, and the ends of the wires connected at O and P, which are, of course, the 150yds. of line wire. The following applies to both ends: The knob D is pressed in front for ringing, which makes contact with A, and when done, or a signal required, should be allowed to go back on B, where it should always remain, whether in use or not, when the bell C is required to ring from the further end. About four or five cells at each would do if a well-wound bell is used.—W. F. DRAW.



[62599.]—**Leverage.**—The whole arrangement is simply that of a pair of scales with equal arms, but with the disadvantage of the friction of wheels. No mathematics at all required, as you must see that 6lb. cannot raise more (but a trifle less) than 6lb., otherwise we should have perpetual motion—which possibly is what you are aiming at; if so, save your trouble.—T. C., Bristol.

[62599.]—**Leverage.**—You would have less friction certainly by the last arrangement of guides; but you do not seem to grasp that you have simply a weight suspended by a cord passed over a pulley, which weight can be balanced by an equal weight suspended from the other end of cord. In this case the weight = 6lb. There is no leverage about it, and I do not see how you can expect to lift double the descending weight.—ELAG.

[62599.]—**Leverage.**—If I understand Mr. Hillier's idea upon p. 377, he is evidently bent upon evolving a perpetual-motion scheme. He may rest assured that with the arrangement as shown there, it matters not whether the said 4lb. weight were close in to vertical or any given distance from it, that it would merely act as a weight equal to the said 4lb., and would not gain any leverage under such conditions; and it would be as much as he might expect to hoist, say, 2lb. with same. He may also rest assured "that no possible arrangement can be made so that 4lb. falling any given distance could lift 4lb. to an equal elevation."—A., Liverpool.

[62599.]—**Leverage.**—In reply to Mr. J. W. Hillier, I have to say that no variation in the arrangement of the pulleys will affect the hoisting power of the weight. "Leverage" has no effect here except as regards the friction of the pulleys: the farther apart they are the less friction will there be. Under this arrangement, in no case can more than the descending weight be raised, for you cannot get work out of nothing, and you will see that the velocities of the descending and ascending weights are equal, and therefore (ignoring friction for a moment) the forces must be equal; your total weight of 6lb. falling 10ft. will do 60ft.-lb. of work, at the same time the hoisting hook rises 6ft., giving as dead-pull 60ft.-lb. ÷ 10ft. = 6lb. From this the friction must be deducted, as shown in my previous reply to No. 62457; in fine, the whole effect of your bracket and runners is to add to the friction of the movement, and no advantage can be gained; "leverage" can only be exercised about a fixed fulcrum, and then what is gained in force is lost in speed. I say thus much, because I fancy he may have regarded your bracket as a true lever in respect to the weight lifted. If you mentioned the object to be gained, I might definitely explain how best to effect it.—FRANCIS CAMPIN.

[62600.]—**Steam.**—You do not give the piston speed and point of cut-off, and do not say if condensing or non-condensing. But, practically, 25lb. per H.P. per hour would be ample, if condensing. —T. C., Bristol.

[62601.]—**Lancaster Oval-Bore Rifle.**—Not due to bullets being too long; not due to system of boring; as a rule, due to neglect. Look through your barrel from one end to the other; doubtless you will see some dark marks which we in the gun trade call honeycomb, or honeycombed. They are marks left by rust. Very slight they may be, but enough to cause a bullet to strip and leave lead in the barrel. In the first place, get the old lead out by means of a wire brush, which you can get from any gun-maker for about 9d. or 1s.; or you might use an iron rod with an eye in it, and put through the eye a small piece of scratch card. Now, if the cause of your bullets stripping is corrosion on the groove and barrels, proceed as follows, and you get a cure:—Get a rod of iron somewhat smaller than the bore, file one end of it square and somewhat taper; never mind about it being square, any shape will do, but file it below the diameter of the rod. Pinch it in a vice, and with a hammer or chisel knock a few rough points on the edges away from the length of the rod—in short, rough the edges. Now wrap round your rod just where your filing left off, a few turns of cotton, cotton waste, or rag, a bit of string, or anything to make a fit in the barrel; push this through from the breech end till the iron rod is flush with the end of the barrel. Now pour some hot lead down the muzzle of your barrels. The wrapping round your iron will prevent the lead going down the barrels. When the lead cools you will have a perfect impression of the inside of your barrel. You must have the rod of such a length as to extend about 1ft. or 18in. behind the breech—in other words, 18in. longer than the barrel or barrels. Now, before you insert the rod, 'tis as well to tell you you want a handle to the rod at the breech end. Just you make what handle you like; but the best I have found (and I am not an amateur) is a wooden handle so fixed that the rod with its lead at the end will revolve when rifling—that is, have your handle T-shaped, washers, &c. I assume you know something, so no particulars. Now, all this ready, first put a little oil on your lead, put yourself at the breech end (having your barrel tight in some sort of vice) pull the rod up and down the barrel one or two times, then push the lead a little way through the muzzle, put on the lead a small pinch of flour emery, work up and down. You will get a fine polish on the inside, you will remove the corrosion marks. Then take off your rook rifle barrel, and, believe me, you will not again be troubled with leading, as it is called. I have much respect for the correspondents of the "E. M.," many of whom I know have guns—not rooks, perhaps, but double barrels. The process I have given applies to all guns, even to the Armstrong, on which I at present happen to be employed. But a warning to those who might try the plan on their double barrels: most people know that "double barrel guns are held together by the ribs"—ribs top and bottom just with soft solder. Now, anyone owning a double gun trying my advice might find his barrels come away just as the hot lead was poured in. That would be bad. Just take this precaution: wrap a piece of wet stuff round the muzzles for about 4in., you are safe. Last, allow me to say that the process I have attempted to make plain is good for all guns, rifled or plain, and is good. I am aware of the fact that the barrel is made slightly larger; but, as a rule, not detrimental, if not overdone. Any other information given with pleasure.—ARMOURER.

[62605.]—**Force of Blow.**—This can be only stated in foot-pounds, as it depends entirely on the resistance. 70lb. with a velocity of 22ft. per second $= 22^2 \div 64 \times 70 = 529{\cdot}4$ft.-lb. If the resisting body was compressed $\frac{1}{50}$in. in stopping the above, the blow would be $529{\cdot}4 \times 12 \times = 317{,}640$lb.—T. C., Bristol.

[62605.]—**Force of Blow.**—The *force* of a blow (as distinguished from its *energy*) is equal to $\frac{\frac{1}{2}mv^2}{S}$, m being the mass of the body, and its velocity in feet per second, and S the space through which it acts. In your example the body has an energy of $70 \times \frac{1}{2} \times (22)^2$, or 16,940 units. Supposing it to be stopped dead in the space of 1in. ($\frac{1}{12}$ft.), the average force of the blow will be $\frac{16{,}940}{\frac{1}{12}}$, or 203,280 units. The shorter the space in which the motion of the body is arrested, the greater will be the average force of the blow.—REYMOND.

[62605.]—**Force of Blow.**—The energy in a moving body = weight in pounds × (half the square of the velocity in feet per second, divided by 32·2), or the height through which a heavy body would have to fall to attain such velocity; in this case, 70lb. travelling at 15 miles an hour = 22ft. per second.

$$\therefore 70 \times \tfrac{1}{2}\,\frac{22^2}{32{\cdot}2} = 525\text{ft.-lb.} = \text{energy in body.}$$

Then, force of blow = 525, divided by amount of deflection in feet of surface of stationary object. Supposing the surface of stationary object gave to the extent of $\frac{1}{100}$ft. $\therefore$ Force of blow $= 525 \times 100 = 52{,}500$lb.—ELAG.

[62608.]—**Pronunciation of the Irish GH.**—As an Irishman, I would pronounce the first as "Lock Naz," the next as "Donahadee, Drauada."—A., Liverpool.

[62608.]—**Irish GH.**—It is impossible to describe the exact pronunciation of the "gh" by reference to any English word—it is pure Celtic. In the word "Lough-Neagh," the gh in "Lough" is very full, but it is nearly silent in Neagh, which is pronounced more like "Nee-ah"; in the words Drogheda and Donaghadee the "gh" is fully accentuated. The greatest difficulty, however, in pronouncing Irish proper names is that all Irish, even the higher classes, use the Gallic "a," as in "car," and not the Anglican a, as in "fate"; this is the invariable rule, except in the word Nass, which, curiously enough, they pronounce Nace.—ULSTER.

[62608.]—**Pronunciation of the Irish GH.**—The *gh* in the English spelling of Irish names and words usually stands for an original *ch*, the sound of which is precisely the same as that *ch* in Scotch Gaelic, and about the same as that of German *ch*. This guttural, in Irish as in German, is of different strength in connection with different letters; with the broad vowels, *a* and *o*, it is, for obvious reasons, stronger than with the slender vowels, *e* and *i*. Lough Nĕagh, which is properly *Loch n-Echach*, the Lake of Eochaidh (i.e., Eochy), affords an illustration—the first *ch* of *Echach* is nearly lost. Gh in English spelling of Irish names sometimes stands for an original *gh*, which, when fully sounded, is a very soft *g* which has lost its consonantal character, or something like a broad guttural *y*. The sound of the Hebrew and Arabic *letter, 'Ain, is very nearly the same.* In some connections *Irish gh* is like a soft *h* or quiescent.—EIRIONNACH.

[62611.]—**Steam Launch Engines.**—I think the explanation is more likely to be found in the fact that the compression of the steam stops the momentum of the moving parts moving at a very high velocity, and which exerts a great centrifugal strain on the crank-pin, and which, as pointed out by Mr. Rigg some few months since, used up a great part of the power of the engine. This centrifugal action is seldom considered, and he pointed out in several diagrams the loss of power due to it. With a proper amount of cushioning, the compound should be most economical.—T. C., Bristol.

[62612.]—**The Dynamo.**—Since your dynamo is already shunt wound, the introduction of a shunt on the outer circuit simply runs off current to waste. In the dynamo described in my book (which is series wound) the introduction of a shunt when a single lamp is used allows sufficient current to pass round the F.M.'s to magnetise them, which current would not flow round if a single lamp were used. The less resistance placed in the circuit of a shunt-wound dynamo, the lower the actual voltage of the machine; hence, by putting too many lamps *in parallel*, you actually lower the efficiency as you decrease the resistance.—S. BOTTONE.

[62613.]—**Thermopile.**—TO MR. BOTTONE.—As it will take me a longer time to write out a serviceable description of this instrument than I can dispose of before this goes to the post, I propose to spend my "Jubilee Day" in writing out a full account—which will appear as soon as the Editor pleases to insert it—under the heading of "Electrical Instrument-Making for Amateurs."—S. BOTTONE.

[62614.]—**Silver Solder.**—I have with the blowpipe done the following for many years with the best result:—Two parts of silver and one of brass. All, or nearly all, my work has been on light work, such as rings and brooches. I always made my own on a small scale. The way I do is this: I get a piece of charcoal, say, the size of one's fist, but no matter; I dig out a small hole, no particular shape; I cut up my silver and brass very fine; when nearly melted, I throw in a very small piece of borax; let it cool then, hammer out as soon as you find it crack; make red hot again, let cool or dip in water; hammer again till you get it down to about notepaper thickness. Now it is ready for use. To use it, get a piece of slate, any slate; get a piece of lump borax, wet it, grind it on the slate till you get a paste of borax; with the end of a pointed match wet the parts to be joined with the borax paste; apply little bits of the silver solder, previously wetted with the borax paste, to the parts you wish to join. The less solder you use the neater your work. Place your article on a nicely-prepared piece of charcoal. You should now have no difficulty. If you find any difficulty, give your address, and I will write to you more fully.—ARMOURER.

[62618.]—**Dynamics.**—Speed of circumference $= \frac{{\cdot}75 \times 3{\cdot}1416 \times 600}{60} = 23{\cdot}56$ft. per second.

$$\therefore \text{Energy} = 40 \times \tfrac{1}{2}\,\frac{23{\cdot}56^2}{32{\cdot}2} = 344\text{ft.-lb.} = {\cdot}01\text{H.P.}$$

(See answer to query 62605).—ELAG.

[62618.]—**Dynamics.**—The power stored up in a flywheel 9in. diameter × 40lb. weight × 600 revolutions per minute is as follows:—Speed of wheel $= 600 \div 60 \times \frac{3}{4} \times 3{\cdot}1416 =$ say, $23\frac{1}{2}$ft. per second, and to attain this speed a body would have to fall $23\frac{1}{2}^2 \div 64 =$ about 8·6ft., so whole power is $8{\cdot}6 \times 40 = 344$ ft-lb., which, if you use up in half a minute, is equivalent to $\frac{1}{5}$ horse-power, or $\frac{1}{10}$ horse is used up in one minute.—T. C., Bristol.

[62620.]—**Keybeds.**—If you have a large number to do in wheels, a slotting machine is what you want. Get a tool-maker's catalogue for illustration. If you have a lathe, you could fix a tool in slide-rest, and wheel on face-plate, and slot them by means of the rack worked by hand.—T. C., Bristol.

[62626.]—**Water Gauge Glasses.**—It would be difficult to imagine a quicker process than nicking with a file and snapping. I was told by a man who had many to do that he preferred a worn round file.—HENDON.

[62627.]—**Faulty Gas-Burner.**—I would suggest that either the service-pipe communicating with your part of the premises is smaller than necessary, or there is some choking of the diameter by means, say, of a tap or taps, which has the effect of reducing the pressure, so that opening any door and shutting same will make the gas jump in your room. This may be caused by the door of any other room in the building if their gas be lit at the same time.—A., Liverpool.

[62635.]—**Winchester Repeater.**—One of these weapons, 450 bore 1876 model, served me a nasty trick about a year ago. The base of the cartridge split at the rim, and the escaping gas blew the right-hand lock-plate clean off. If it had been the left side I should probably have lost an eye instead of merely having my hand scorched. On examining the rifle I found that from use the toggle joint which keeps up the breech plug had become loose, so that there was a space of about the 32nd of an inch between the cartridge base and face of the plug when the lever was home. The Winchester models of 1873 and 1876 are certainly not suited for heavy charges; but the company have brought out a new pattern—the 1886 model—which is much superior in strength, the breech plug being locked in place by a vertical bolt.—TUKANG BESI.

[62635.]—**Winchester Repeating Rifle.**—In the Winchester rifle the breech bolt has at its rear a mass of metal which supports, at either side, the front end of one of two side links, which form a knuckle joint. The rear ends of the other links bear against the rear of the receiver, giving the necessary support for the bolt in firing. The outer ends of the links are pivoted to the bolt and receiver; *but the construction is such that no strain comes on the pivots.* A groove on the inside of each rear link receives the end of a strong pin on the breech bolt lever. Motion of the lever consequently produces a corresponding motion of the links, and through them of the bolt. If the pin on the breech bolt lever or any of the pivots were damaged sufficiently to prevent the weapons working (which is very unlikely to happen, as their only office is to open and close the breech action), it could not be fired, and so no danger would be incurred. Any less damage to the pin would not be dangerous, as when the links are in position the force of the explosion is received by the rear of the receiver, the strength of which latter part, or of the mass of metal at the rear of the breech bolt, would appear to be the only limit to the powder charge, so far as regards the breech mechanism.—W. A. DRYWOOD.

Mushrooms: Their Nutritive Value.—The Vienna school has been investigating this subject, and has arrived at conclusions of importance for all countries where, like Austria, the edible fungi are a common food. The traditional view has been that mushrooms are equal in nutritive value to butcher's meat, and physiologists, like Lorinser, in his work on "The More Important Fungi" (Vienna, 1883), have urged, in the interests of the poor, the more frequent use of an aliment so easily procurable and so sustaining. Dr. Stromer, of Vienna, has, however, after repeated and carefully checked investigations, reached the following results:—1. The fresh mushroom differs widely from the dry mushroom, the former containing 90 per cent. of water and only from 2 to 3 per cent. of albumen, while the latter contains 23 per cent. of albumen. Moreover, the different parts of the mushrooms contain more or less albumen, the "hat," for instance, having twice as much as the stem. 2. The fresh mushroom contains ·52 per cent. of carbon hydrates, while the dry contains 24·5 per cent. of them. Experiments conducted on Stutzer's method give the following results as to the digestibility of mushrooms:—Out of 4·7 per cent. albumen in the *boletus edulis* there was digested 79 per cent., of 5·6 per cent. albumen contained in the "hat" there was digested 80 per cent., while of 2·7 per cent. albumen contained in the stem there was digested 75 per cent. Compared with other aliments this means difficult digestion. Black Vienna bread contains 1·2 per cent. albumen, and of this, in the same time, 86 per cent. was digested; bean-meal contains 3·6 per cent. albumen, and of this, also in the same time, 94 per cent. was digested; pease-meal with 3·9 per cent. albumen yielded 95·6 per cent. to digestion, raw ham 98 per cent., and grated butcher's meat as much as 99·25 per cent. Results, the same to a fraction, were reached by Saltel, of Amsterdam, and Mörner, of Upsal. Dr. Stromer concludes: 1. Mushrooms possess small nutritive value, their heavy charge of water reducing to very little their quantity of nutrient substances, and, above all, the albumen, which is difficult of digestion. 2. Dry mushrooms are not much better, because they absorb a great deal of water in cooking. 3. Mushrooms approximate in nutritive value to vegetables, particularly to cabbage, and, being cheap and easily procurable, deserve *pro tanto* the attention of the poor.—*The Lancet.*

What is a Sleeper?—The following from a contemporary may help some who are interesting themselves about terms and definitions. A railway sleeper is not often defined at length:—"A sleeper is one who sleeps. A sleeper is that in which the sleeper sleeps. A sleeper is that on which the sleeper which carries the sleeper while he sleeps runs. Therefore, while the sleeper sleeps in the sleeper the sleeper carries the sleeper over the sleeper under the sleeper until the sleeper which carries the sleeper jumps off the sleeper and wakes the sleeper in the sleeper by striking the sleeper under the sleeper, and there is no longer [illegible] sleeping in the sleeper on the sleeper

ANSWERED QUERIES.

umbers and titles of queries which remain unan- 'or five weeks are inserted in this list, and if still red are repeated four weeks afterwards. We trust ers will look over the list, and send what information for the benefit of their fellow contributors.

our last, "Sm." has replied to 62355.

Sprague's Universal Galvanometer, p. 160.
To "Fiddler," 161.

Eight-Wheel Rolling Stock, p. 256.
Medical Battery for Neuralgia, 256.
Deliquescency, 256.
Speeds for Crank Shaft, 257.

QUERIES.

]—**Faulty Watch.**—I have a Geneva which casionally. The action is very feeble. There is able play or shake between the barrel and centre which I feel ,certain to be the cause. Will any indly inform me how to correct this?—F. W.

.]—**Compound Steam-Engine.**—Will "T.C. Mr Gobert, or "Elag' answer the following ques- lating to a compound engine (horizontal)? rs working side by side, cranks set at right angles, wheel between them. Cylinders 29in. and 45in. 5ft. stroke, 50revs. per min., Corliss valves. iver between cylinders. Initial pressure in h.p. = 70lb. absolute, cut off at 3-10th of the stroke. e equal 3in. of the stroke in both cylinders. any expansions will be in h.p. cylinder; what ninal pressure be; what will average pressure at will back pressure be in h.p. cylinder with in l.p. at half-stroke? Supposing back pressure lb. absolute, at what point of stroke must exhaust compress steam up to 54lb. absolute? How many ons will there be in both cylinders; what will ressure be in l.p. cylinder; what will terminal age pressures be? Supposing back pressure to be re vacuum line, at what point of stroke must ex- lose to compress up to 10lb.? At what point open the exhaust? If the answers with formulæ res are given in full and as clearly as possible, a mber of "ours" will receive some benefit.— TOWN.

.]—**Boring Holes in Gas Tubing.**—I ne hundreds of small holes (less than 1-16 diam.) in iron gas tubing. Will any reader kindly ow to make and temper the drills for this? Some- can get a drill to bore as many as 80 holes, and at nes break several in one hole.—J. C. S., BELFAST

.]—**Celeste Action.**—Will Mr. Davies be good to describe how to put a celeste action to a cottage ith sketch of same? Also where I can obtain the ighted blocks for attaching to the stickers that he some time ago?—T. S.

.]—**Legal.**—A mortgagor becomes bankrupt, s £850 on mortgage, which appears to mortgagee an property is worth at present time, and proves state for £150, which is allowed and a first and final l declared. If at any time the mortgagee should to meet with a purchaser, will he have to account itate (which is closed), for anything in excess of nal mortgage with £5 per cent. added, or is the vested absolutely in him—the mortgagee— m whom he would be able to get his title ble him to give a good title to others. is case a somewhat similiar thing occurs, only we ed the property was of the value which the mort- presented, and on being applied to by the official d in the bankruptcy as to what we would do, we to give £1 and take the property. He, however, ok any notice of this, but closed the bankruptcy ared final dividend. I should be glad to know w we should proceed in this case also.—NEMO.

.]—**Concert Flute.**—Will some of our readers ell me the best way to make the above? I want the best wood to get, the size of hole through he distance and sizes of holes for notes, and the outh hole?—TURNER.

.]—**Electro-Motor.** — Would Mr. Bottone inform me what size and quantity of wire I ut on a motor of the following dimensions?— agnet vertical, somewhat similar to the Kapp ; the section of cores oval, ⅞in. at middle and ne ends, 2⅞ high by 3½in. wide, pole pieces ⅜ thick wide., the base plate forming the yoke, both of e of cast iron. The armature is built up of sheet s 3in. diam. with six projecting arms which are to up with the wire, and will form six sections. I o work with 100 volts, and two or three ampères. ase say what power I may expect from it?—NIL ANDUM.

]—**Slide Valve.**—To "T.C., BRISTOL."—I am for your reply, re Governors, for my horizontal 3in. bore, 5in. stroke, 225 revolutions. Will you say what part of stroke steam should be cut ide valve, that I may get the most power out of I think she wastes a lot of steam now.—W. J. J

.]—**Yacht's Launch.**—To "T. C., BRISTOL." e a yacht's gig 21ft. long, 4ft. 10in. beam, 2ft. deep. Will you please say what size I should want to drive her about eight er hour, and what size vertical boiler with bes for same? I have a three-bladed screw pro- in. diam., 2ft. 6in. pitch. Would this be large and also, what speed should it run? She is not a vy boat, and is a good shape for speed. How are ellers fitted to boats to lift out of the water in over ropes, &c.? I saw one on a yacht's launch r day, but could not examine it.—W. J. J.

.]—**Filter for Steam-Engine.**—I have a water of which I use for steam-engine. A great he water I get is from the sides of roads, which, of ometimes is thick, therefore I wish to filter all I use, say about 80 gallons per hour. Would someone kindly inform me how I can do this? What I do, I want it for a permanency.—G. S.

[62646.]—**Photographic Chemistry.**—How can I test water for traces of hyposulphite of soda? My well is close to the sewer, through which the washings from gallery, &c., run, and, I fear, has become contaminated, as prints washed in the water don't tone properly, and water never becomes milky when washing prints before toning. Nor does it show any signs of milkiness when I add HCl thereto. Could any chemical or photographic reader enlighten me?—HYPO.

[62647.]—**Bees or What?**—Last year a friend of mine was annoyed by the havoc which a colony of bees (?) made with his lawn, on which they settled in considerable numbers, and in which they made small holes or burrows, the earth of which formed a little heap at the mouth of each. The appearance of the grass for some square yards was completely spoilt, and it was apparently impossible to drive the insects away. The same annoyance having begun again this year, I should be much obliged if any of your correspondents could inform me whether anything can be done to abate it (short of separately killing each individual insect)? The creatures are very like hive bees, but rather smaller and lighter in colour. I have not heard of any person being stung by them. A dead one which I examined appeared to have a sting, however. Nothing in the way of honey has been found in such holes as have been examined. Are the insects really bees?—R. N.

[62648.]—**Brewing Scotch Ale.** — Will any of "ours" kindly inform me how to brew the above? What quantity of ground malt, hops, and the quantity of water, and temperature for first and second mashes, for a total quantity of 36gals. when finished;—in fact, what to do to brew a good ale? We have had two brews, or rather attempts, the product being a pale, muddy, bitter, sour fluid containing 6·2 per cent. of proof spirit, though they say they put more than the usual quantity of malt in it. It seems to me there is a large amount of acetic acid in it, which is a proof of our being wrong either in cooling before fermentation, or in the working.—BONNY.

[62649.]—**House Duty.**—If I take a house that has been empty some time, can the tax-collector make me pay any house duty that may be owing? If I take it of an outgoing tenant, of whom I may know nothing, can he make me pay—not arrears, for they don't as a rule allow "arrears"—but the proportion of the duty that should have been paid by the outgoing tenant? The simple question, I suppose, is this: Can the Queen's tax-collector insist on an occupier paying any duty that may be due on a given house?—TRYFORITE.

[62650.] — **Primula Culture.** — Can any of your readers give any information as to the culture of primulas from seeds? I want to bloom some in the spring?—PRIMROSE.

[62651.]—**Rhododendron.**—Can anyone tell me how to force these into bloom? I have a bushy plant which this year carried two good blooms, and is now standing outside in full sunshine. It wants shifting into a larger pot; but if I do that now, will it not encourage leaf growth? What treatment would be best to induce it to form flower buds?—HORTUS.

[62652.]—**Anti-ferment.**—Which is the best to prevent fermentation—boracic acid, borax, or salicylic acid, or salicylate of soda? Proportions per gallon will oblige. —QUERIST.

[62653.]—**Kidney Disease.** — Some years since a friend of mine was affected with a pain above the eyes, and not being able to find a cure, he was advised to quit drinking coffee, and in a short time the pain left. A year or so after he commenced to use coffee again, and the pain came back as before, but ceased when he abandoned his coffee a second time. He now drinks tea, but is afflicted with kidney disease. Does tea-drinking produce kidney disease in some persons?—W. M. B.

[62654.]—**Launch.**—Will some brother-reader help me over the following? I am about to build a steam launch, 30ft. on keel, and want to know what would be a good sharp and comfortable beam and depth with a good free board. I have a 5in. bore, 6in. stroke engine, which I want to put in, and would like to know what size propeller I should want to gain a good speed from same.—R. BENNETT.

[62655.] — **Preventing the Coagulation of Albumen.**—I desire to find a simple and harmless chemical or other substance which will prevent the coagulation of albumen on the application of heat. If any of our readers will kindly inform me, I shall esteem it a great favour.—ZETETIC.

[62656.]—**Photography.**—Having a Lancaster—a ½ Instanto., I have had a difficulty in getting good negatives from Mayfield's extra-rapid plates, and their single fluid developer. I find the negatives come out so weak after long time developing. I thought it might be that the developer requires reducing, as I do not think the shutter closes too quickly, as the arm with rubber ring is quite down. I have by me a list by Chapman, for weak and dense negatives. In the first place, he recommends a small quantity of mercury perchloride in water, then liquid ammonia (·880) in water. After having these ready he says, immerse the negative in the first solution, then wash it in clean water, and then immerse it in the ammonia solution. Of course this is for weak ones, and for dense a solution of perchloride of iron, potassium bromide, and water. I shall be glad to know if this is a good prescription for all makes of plates, such as Lancaster's, Edwards', England's, Fry's, and Gray's. Mr. Chapman calls his "Gelatine plates." I presume all are gelatine—are they not? Is there any difference between instantaneous and extra rapid, or is one as quick as the other? Is ferrous oxalate developer far superior to pyrogallic acid developer? I have been recommended to use alum and citric acid for clearing plates if foggy. Is this a good article? I presume I am right to use any of the developers for above-mentioned dry plate makers? A few hints to above will oblige me and many of our readers.—CHIPS.

[62657.]—**Coil Reel.**—Will "R.E., Belfast" give me dimensions of his coil reel to take the quantity of wire he recommended to "Ignoramus," April 22 (61498)? Is it necessary to tip the end of adjusting screw of contact breaker with platinum? If so, please state how it is done and oblige—ELECTRICAL STUDENT.

[62658.]—**Kiln.**—I should be glad of any information as to the most economical and effective manner of forming a drying kiln floor similar to a malt kiln. It will be placed on first-floor level, over boilers on ground floor, and must be carried on irom girders resting on the walls. I am acquainted with Herrman's patent floor, but this is too expensive. Perforated cast iron plates have also been considered; but if possible we want something cheaper.—MALT.

[62659.]—**Malleable Casting.**—Would some of your readers be good enough to inform me, through the medium of your instructive journal, of the process of malleable casting? What kind of metal is used if melted in small quantities in a crucible or large quantities in a cupola? How is the casting annealed and material used for same? What quantity of such to each casting, the time taken to anneal, and temperature?—DUBLIN.

[62660.]—**Water Engine.** — I should be greatly obliged to any of "ours" who would answer the following. Wishing to drive a 6ft. lathe, a grindstone, a drilling machine, and a circular saw (one at a time), and not being able to use gas or fire of any sort, I should like to know how to make the above. A drawing would greatly help.—G. H. R.

[62661.]—**Tin Alloy—Melting Gold.**—I have tried both compounds, melting in a stove and by gas, as suggested by "C.S." several times over, and the result is no better than what was produced before, namely an unmalleable lump of gold, that cracks if rolled or hammered. Will be thankful to anyone who will put me right, so that I may it get into a workable condition.—J. E.

[62662.]—**Pitch Polisher.**—In hardening the pitch with rosin the pitch boiled. How am I to get rid of the bubbles? The pitch seems difficult to melt without boiling. How should it be liquefied so as to avoid the bubbles? —TRIA.

[62663.]—**Clack Box.**—To "T. C."—Will you kindly explain the action of the clack? How is it that it is lifted up, seeing that there is the same pressure at the bottom surface as there is at the top? Why will not the the water enter the boiler as soon as the steam is turned on and why is it impossible to get the injector on when the water in the tank or tender is hot?—E. A. CLARK.

[62664.]—**Volcanic Repeating Arms, 1858.**—Can any reader give any information as to the above? They had a breech action identical with the Winchester, with the exception of the firing pin, which is the part I wish described. What cartridges did they carry? Were they the original of the Winchester?—W. A. DRYWOOD.

[62665.]—**The Shutt Railway, 1829.**—At South Kensington Museum there is an old engine named "Agenoria," built 1829 for the Shutt Railway. Where is the line; to whom does it belong, and who built the engine? —LOCO.

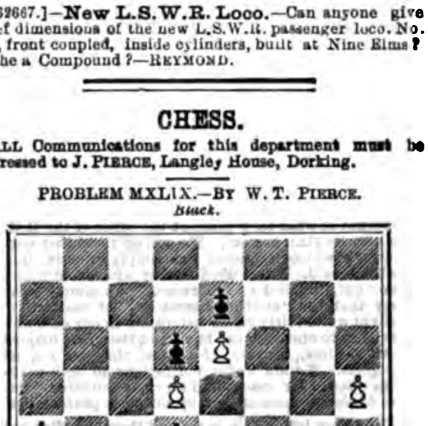
[62666.]—**Engine for L and S.W.**—Wanted details or diagram of the engine for the L. and S.W.Ry., now in the Newcastle Exhibition.—LOCO.

[62667.]—**New L.S.W.R. Loco.**—Can anyone give chief dimensions of the new L.S.W.R. passenger loco. No. 527, front coupled, inside cylinders, built at Nine Elms? Is she a Compound?—REYMOND.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXLIX.—BY W. T. PIERCE.



White to play and mate in four moves.

SOLUTION TO 1,047.

White.	*Black.*
1. K-Q 6.	1. K-K 6.
2. R-Q 4.	2. K takes R.
3. Q mates.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,047 by H. Hosey-Davis, A. Bolus A. E. Mackett, I. Brown, Black Pawn (very difficult). Mr. C. Planck has pointed out the resemblance between this problem and one of Mr. Healey's, published about 20 years ago, and re-published in "English Chess Problems," No. 115. Another with exactly similar play appeared in "La Stratégie." about six months ago, by E. Pradignat. It appears to be one of many corresponding cases of undesigned coincidence. No. 1,047 was forwarded by our contributor "A Beginner." He has explained to us that he did not send it as an original problem. He did not know who was the author.

CORRECT solutions to 1,046 by J. J. Spence (an error in

1. P-K 7 variation). Hensing, I. Brown, G. A. A. Walker (in 1. P-K 7 you have omitted to state which Kt moves to K 4), A. Bolus.

S. J. KING.—If Black on his second move play K-Kt 6, white cannot mate.

A. BOLUS.—We appear to have two three-movers of yours in hand. One $\frac{\text{W K}}{\text{Q R 6}}$, $\frac{\text{B K}}{\text{K-Q 5}}$ has no mate if 1. B-Kt 8. Have you managed to put this right? The other $\frac{\text{W K}}{\text{K B 7}}$ $\frac{\text{B K}}{\text{K 5}}$ shall be inserted as soon as possible.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, June 22, and unacknowledged elsewhere :—

KING, MENDHAM, AND CO.—G. B. Hallowes.—Electra.—Silke.—A Fellow of the Royal Astronomical Society.—P. F. Otto.—Goolwa.—Malta.—Sm.—Tukang Besi.—Anxious.—Xerxes.—R. O'H.—Bach.—H. D. R.—Arthur Mee.—Enquirer.—G T. Pardoe.—Puzzled.—Gorgon.—E. Gobert.—Engineman.

THE R.M.S. AND "A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY."

WE have read with a good deal of pain a paragraph in the last number of the *Journal* of the R.M.S. referring to one of our own most valued correspondents. We only care to say here that, as far as we can estimate them, the tastes and talents of our own contributor and the Editor of the *Journal* of the R.M.S. are so similar and their unselfish love of science for its own sake alike so admirable, that they ought naturally to be the best of friends. First of all, we think "A Fellow of the Royal Astronomical Society" was justified in commenting on the delay in publication to which he referred. Next we admit it would have been better, as a Fellow of the Royal Microscopical Society, had he sought the information direct. Thirdly, we doubt the good taste of fastening the contributions of our correspondent on a gentleman by name, in the lack of any evidence that he ever wrote them; and, lastly, we entirely disbelieve that his account of what took place at the office of the R.M.S. is otherwise than correct. We will only add that our own remark which is quoted was simply intended to mean what it said. We rebuked nobody, and we administered no "cut," unkind or otherwise. We simply meant to say that the "endless discussion" of matters which might quite fairly claim attention in our columns was neither to our taste nor to that of the great majority of our readers, because, of course, they are not microscopists. We are under obligations to both parties to this quarrel for many kind services rendered. Cannot we discharge them in part by acting as peacemaker?

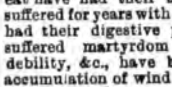
H. H. (Your letter is a sample of those we often receive asking for information which has actually been given in our pages a few weeks previously. You will find instructions for erecting a sundial in No. 1150, p. 133, and further information in the back volumes. A similar query was inserted last week.)—T. WRIGHT. (Try one of Boyle's chimney-caps.)—F. K. (Why not write and ask the firm, or consult a handbook of the art? We do not pretend to understand your first question, and as to the second, the solution used for developing can have nothing to do with the camera and lens.)—R. B. (We do not know, nor does anybody else. The object of vulcanising it to the metal is to fix it as permanently as possible; but you want to "remove and replace it occasionally.")—A. K. T. (Have not many recent numbers contained exactly the information you require? The last question cannot be answered, as it is a matter of pure experiment with the different lamps.)—QUERIST. (For carbon printing see indices, or one of the handbooks now published.)—P. L. J. (It is to a certain extent a so-called "gift," because some can naturally take it up; but much may be done with practice. Procure a little book by F. Hardy, published by Warne and Co., or look through your back volumes.)—DISTILL. (We do not understand such a question—water readily absorbs ammonia, more at low temperatures than at high. The plant necessary will depend on the source from which the ammonia is to be obtained; but it is principally made from the sulphate or chloride, the former being the crude gas-liquor. It is rather a peculiar query to come from a "manufacturing chemist.")—S. H. (The price of silver varies; but during last year the average was about 3s. 7d. an ounce. The price of gold is a standard, and always remains the same. Its Mint value, pure, is £4 5s. per ounce; British standard (22 carats) £3 17s. 11d. per ounce. We cannot tell you where to sell; but if you have only a small quantity, probably some photographer would purchase; but if you have much, better take it to dealers in precious metals.)—A CONSTANT READER. (You can use asbestos, felt, sawdust, charcoal dust—almost anything, in fact. It is placed wherever there is any possibility of loss of heat by radiation.)—AMATEUR. (Kindly look over recent back numbers and the indices of the last six volumes, say. You will find the information you require given many times.)—NEMO. (The "Rocket" is at South Kensington Museum. That was not the original locomotive, but the winner of the prize at Liverpool.)—E. MUMBY. (We do not know; but there are several works on the subject published by Griffin and Co., Exeter-street, Strand, and you could, no doubt, see most of those already issued at the Patent Office Library, Southampton-buildings, Chancery-lane.)—W. (A single lens is not suited for such work. 2. It is a natural product of petroleum, and cannot be made except from the crude oil—consequently, only with economy at the site of the wells.)—T. A.—There is no such institution that we know of.)—W. B. (Lancaster and Son, Colmore-row, Birmingham. You cannot do better with any other maker.)

A New Washable Truss.—An Important Invention.—Harness Xylonite Truss is the most perfect appliance ever invented. It gives complete comfort and support without irritation. It has a beautifully smooth, flesh-coloured surface, and is guaranteed to last a lifetime.—Address: MEDICAL BATTERY COMPANY (Limited), 52 OXFORD STREET, LONDON, W.

A CONTEMPORARY says that a number of experiments made recently by practical machinists give the following figures as the proper speeds at which machine tools should work: Parallel shearing machines and punching machines should work at a speed of $\frac{7}{16}$in. per second; turning malleable cast iron, $\frac{5}{16}$in.; screwing machines and screw taps, $1\frac{1}{5}$in.; lathes for turning various steel articles, 2in.; for turning cast-iron articles, $3\frac{1}{5}$in.; for wrought-iron articles, $4\frac{1}{5}$in.; for turning articles of bronze, 6in. Lathes for turning wood can run at the rate of 10in. per second, with a cutter 14in., and a circular saw may run about $31\frac{1}{5}$in. per second.

BRAZIL has 5,597 miles of railroad. The Argentine Republic has 3,994 miles, of which nearly half is controlled by the State and the Province of Buenos Ayres, the rest being owned by private companies. Bolivia has 23 miles of railroad; Chili, 1,377. Of the Chilian railways the State controls rather more than one-third. The railways of the United States of Colombia are 140 miles in length, and are controlled by private companies. Paraguay has 45 miles of railroad, and Peru 1,560, Uruguay 270, and Venezuela 372 miles.

WORTH £100 GRATIS.



GIVEN GRATIS TO ALL.—I wish to inform all suffering people on the face of this earth, that I, Gould, E. B. P., of Bradford, have for some time past and am now giving the Hop prescription for Bitters to all applicants who send a stamp for postage. Anyone in possession of this valuable prescription can for 8½d. make a bottle of this world-renowned medicine the size of the one usually sold at 2s. 9d.; and for 1s. 5d. can make the 4s. 6d. size. It may be interesting to learn that with this prescription all kinds of hopeless cases have been treated with success when all other remedies had absolutely failed. People who have been partly paralysed have been relieved or cured with this prescription, others have had their reason restored, others their sight; people who could not sleep have had their sleep restored, others who could not eat have had their appetite restored; people who had suffered for years with indigestion and its consequences have had their digestive powers restored; people who have suffered martyrdom with a disordered liver, nervous debility, &c., have been cured; people subject to an accumulation of wind and water have found it disappear under its influence. A gentleman at Lincoln subject to fits fortnightly has not had a fit from the first moment he began taking it. People troubled for years with constipation have had their bowels become regular under its influence. It is a choice, rare, remarkable remedy. The prescription is simple, it is cheap, it is good. Those who haven't sent for it should. It will be found safe, sure, and reliable in almost all ailments incident to the human frame. It is a tonic, alterative, and an aperient combined of marvellous curative properties. These important facts may seem incredible; but it has done far more than is here claimed for it, proof of which is sent with each Prescription. Thousands are blessing the day the Hop Compound for Bitters fell across their path, and it is given absolutely free of charge to all applicants, rich or poor, who send a stamp for the postage of the same. A mode of self-treatment at home has been a long-felt want by all well-regulated minds, and will be found exceedingly advantageous to sensible persons who desire to know what they are swallowing. How many of the suffering poor there are on the face of this earth struggling hard to buy medicines, with the hope of being restored to a sound state of health, and whose eyes have been opened to bitter disappointment. They have tried one remedy, then another, none do them any good; and why? because the principal ingredient of many of those patent medicines may be termed the NEWSPAPER ADVERTISING (?).— Address Mr. Gould, E.B.P., 21, Clough Street, Birch Lane, Bradford, Yorks. **When writing name this paper.**

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JULY 1, 1887.

MODERN COMPOUND ENGINES.

THE extraordinary revolution which has taken place of late years in the views of marine engineers and owners of trading steamers must have astonished those advocates of the single engine who not so many years ago contended that no advantage could be gained by compounding. Our own columns contain one or two lengthy discussions on the subject, carried on in some cases by men who had been familiar with the subject for years, and were professionally engaged in indicating engines. After a time the simple assertion that compounding could not be an advantage was modified, in the face of the telling fact that shipowners were ordering compounds because they found a difference in the coal bills, and then it was pointed out that the economy, which could no longer be disputed, was due to the use of higher steam pressures. To a certain extent that statement was undoubtedly true, but as the compounding of the engines enabled the higher pressures to be employed, the advocates of compounding rightly claimed the full credit for their system. Since then the system has developed in a remarkable manner in connection with marine navigation, and possibly five out of six of the large trading steamers now building will have triple-expansion, some of them quadruple-expansion, engines. Even those vessels which are supplied only with what is known as "auxiliary" steam-power are being fitted with the modern engines, and there is scarcely a sea-going vessel of any considerable dimensions, exclusive of the navy, which is not fitted with compound engines. The reason is easily found, for, apart from the economy obtained by the lessened consumption of coal per horse-power or per mile, there is the saving in cargo space, or, in the case of vessels going long voyages, the ability to take sufficient coal for both trips, and thus avoid the necessity of purchasing expensive fuel abroad. With the introduction of the triple-expansion or triple-compound type of engine steam pressures have risen rapidly; and it is only fair to the old engineers to mention that the improvements which have been made in the production of mild steel plates have rendered possible, or at all events safe, the construction of boilers capable of carrying the high pressures now in vogue—viz., 140lb. to 160lb. and more. We owe the introduction of the three-cylinder compound, or triple-expansion, engine to Mr. A. C. Kirk, of the firm of R. Napier and Sons, and it will probably surprise many who know what has been done lately to learn that so long ago as 1874 he first introduced the system, mainly because he had to use steam at 150lb. pressure in the s.s. *Propontis*. The example was followed to a small extent, but did not receive much attention until the *Aberdeen* showed what could be done by triple-expansion engines on a long voyage like that to Australia, and her sister vessel, the *Australasian*, ran for 40 days without the engines being stopped once, while the coal bill came out as only 1·6lb. per indicated horse-power. That the example of the *Propontis* was not followed with more alacrity is easily accounted for, because shipowners are as a rule conservative, and at the time mild steel plates had not been introduced, and with the thickest iron plates that could be manipulated into a boiler a higher pressure than 80lb. could not be allowed by the Board of Trade or Lloyd's. In the course of a few years, however, several vessels were fitted with triple-expansion engines, and in one special case two sister vessels exactly alike, and engaged in the same trade, were pitted against each other, one having an ordinary compound engine, the other a triple expansion, but both calculated to average about the same indicated horse-power. The vessel fitted with the triple-compound engine showed a saving of more than 19 per cent. in her coal bill, with an average of more than 6 per cent. extra in speed, and since those facts became known the modern steam-engines have been the fashion for all cargo boats. A simple but important point of detail was soon discovered in the fact that there was also a smaller consumption of cylinder oil, the saving of which is a mere trifle, but the effect of which on the boilers can be readily understood by marine engineers. When pressures of 150lb. and upwards are used it is very necessary to have the boiler plates as free from scale as possible—with only that amount of "egg-shell" scale which rather protects than injures. Mineral oil is, as a rule, employed for lubricating the cylinders, and that or its refuse passes through the condensers into the boiler, where, unless great care is taken, it leaves a residue, which is said to be the best non-conductor of heat known to marine engineers; and, consequently, if allowed to accumulate, the plates over the furnaces become red hot and collapse. It is, therefore, important to be able to work with as little oil as possible; and the fact that furnace crowns do collapse must not be attributed to the use of high-pressure steam merely, but to want of care in connection with the boiler and the use of lubricants. This liability to over-heating, however, is not specially connected with triple-expansion engines, but is found as frequently in connection with engines of the ordinary compound type: it is purely a question of boiler care, and has no reference to the design of the engines, except in the manner pointed out above—that the smaller the quantity of oil required by the cylinders, &c., the less liability there is to an undue deposit of the black non-conducting scale. We have thus far endeavoured to show that triple-expansion engines are economical, and it is certain that they are being introduced very largely, especially for what are known as cargo steamers; but it is rather singular that the Atlantic steamers are not fitted with the modern devices, but are almost without exception fitted with engines of three types—the ordinary compound, with intermediate receiver and cranks at right angles; the tandem engine, with four or six cylinders; and the three-cylinder engine, with cranks at equal angles round the shaft, but with the high-pressure delivering into two low-pressure cylinders. The last-named is the type of engine fitted in the more famous vessels; but the tandem style is found in the White Star liners, some of which, built about thirteen years ago, have ever since accomplished their voyages on an average coal consumption of less than 2lb. per indicated horse-power. These vessels have not the power, nor do they run at the high speeds, of the more recently-built Atlantic liners, which burn very little less coal per indicated horse-power than vessels built twenty years ago, in spite of the increase of boiler pressure from 40lb. to 110lb., and the much higher piston speeds now employed. Thus, Mr. Jennings Campbell, in a paper read before the Liverpool Engineering Society, says it seems that the increase of pressure and piston speed has been used solely to augment the power given out in proportion to the size of the low-pressure cylinders, not to allow of a greater expansion of the steam and a consequent increase of economy. If a triple-expansion engine can be kept continuously at work for forty days on a consumption of 1·6lb. of coal per indicated horse-power, there certainly should be some explanation why the new Atlantic liners burn from 2lb. to 2¼lb., especially as their engines are nearly always running at full power. In Mr. Campbell's opinion, one cause of the large consumption of fuel by these steamers is the smallness of the engines in proportion to the power developed, in consequence of which the steam is not expanded far enough to produce a very economical result. He shows that the fast Atlantic steamers have smaller cylinders in proportion to their power than the average cargo boat, even allowing for higher piston speed and pressure—that instead of having low-pressure cylinders of 105in., they should have cylinders of about 129in. diameter, the great difference of which is seen when we compare the respective areas—7,873 to 8,514. Another cause of large fuel consumption—common to most compound marine engines—is the drop of pressure between the different stages of expansion; but this loss cannot be easily avoided, and Mr. Campbell admits that he does not wish to overrate it, but he is strongly in favour of reducing the "drop" as much as possible without upsetting the working pressures in other respects. After referring to some typical diagrams and the advantage of combined diagrams, in a manner which will interest professional engineers, Mr. Campbell proceeded to describe a type of engine which he would recommend for the single-screw vessels of the Atlantic mail service, and we are not surprised that he boldly takes up the quadruple-expansion type having six cylinders driving three cranks, and with steam at a pressure of from 180 to 200lb. He suggests three cylinders of 42in. diameter, placed preferably below three of 100in. diameter, with a stroke of 5ft.—that position being preferred because both pistons can then be got out independently of each other. The course of the steam is as follows: It is first admitted to one of the small cylinders for about six-tenths of the stroke, and then passes to the two other small cylinders; from those it is delivered into the large cylinder in the middle, and passes thence to the two other large cylinders, thus giving a quadruple expansion. The advantages claimed for this arrangement are that with a large total range of expansion the cylinder ratio at each stage is small, thereby enabling the "drop" of pressure between the stages to be reduced to a minimum without an inconveniently early cut-off in any of the cylinders, while an equal distribution of power is obtained on the three cranks. The cut-off in the first cylinder being moderately late allows of considerable variation of power by cutting-off earlier. The expansion in the first cylinder being small, and the ratio between that and the other small cylinders being also small, the initial condensation can be reduced, as the difference in temperature will be small. The multiplication of cylinders will add to the first cost of the engine; but as there are only two sizes of cylinder, the engine ought to be a tolerably cheap one to make, and as the large cylinder pistons and covers are deeply coned, the small cylinders are placed partly within them, and the whole machine is made as compact as possible. It may be urged that these arguments could be used in favour of a sextuple-expansion engine, and we may probably find someone not only suggesting such an arrangement, but actually constructing it; for it must be remembered that in the case of a marine engine the first cost is not so much a consideration as the saving of coals, which means not only less fuel to carry, and less expenditure, but smaller boilers for a given indicated horse-power. In the case of stationary engines these considerations do not apply, while for locomotives they are out of the question. As far as regards the latter, the reciprocating motion is a mechanical defect, and a rotary engine—if an economical device of the kind could be constructed—would be the most theoretically perfect device; but it is useless to hope for that. Nevertheless, compounding has been introduced for locomotives with a fair amount of success, and it may be that we shall yet see it become the ruling practice, although in the case of a steam-engine which has to propel its own weight as part of its work it would seem to be altogether incongruous, besides complicating a machine which has already an enormous number of parts, each requiring careful thought from the designer. Although the principle of compounding steam-engines is about as old as the century, it has always met with much opposition in certain quarters, and twenty years ago those who argued against the utility of the simple compound would have ridiculed the modern triple-expansion and, we must now add, quadruple-expansion engines. It would be unwise to say that at last we have reached the final stage in the development of the steam-engine.

REVIEWS.

Life of Charles Darwin. By G. T. BETTANY. London : Walter Scott.

DARWIN has been dead now more than five years, and though his views are no longer treated with scorn, the man himself and what he did are little known to the great majority of his countrymen. The old accusations still cling, and in circles which doubtless consider themselves amongst the elect Darwin is regarded as a man who ventured on forbidden ground, and because he endeavoured to unravel Nature's secrets, and told plainly what Nature taught him, he is still regarded by many as an atheist, and in their view nothing can be worse than that. The world is apt to form harsh judgments, and it was certainly very harsh when society gave its first verdict about Darwin. Happily, he lived to see the change, and, by those who are capable of forming a correct opinion, the true value of his life's work is now fully recognised. Mr. Bettany has done well ; he has written a readable life of the great naturalist, and contrived to put it in such a form that, once commenced, it is read to the end. The Darwins were a Lincolnshire family—a county which has also the honour of producing a poet who has been called atheist or pantheist too ; but Charles Robert Darwin was born at The Mount, Shrewsbury, on Feb. 12, 1809, the second son of Dr. Robert Darwin and his wife Susannah Wedgwood, eldest daughter of the great potter. Early in life Charles Darwin entered Shrewsbury Grammar School, under Samuel Butler, afterwards Bishop of Lichfield, and subsequently proceeded to Edinburgh University with the idea of devoting himself, as his father and grandfather had done, to a medical career. The youth, who showed no inclination for the usual sports of the school, amused himself whilst at the University by making frequent excursions on the shores of the Firth of Forth in search of objects of natural history, and so long ago as March 27, 1827, he made a "communication" to the Plinian Society of Edinburgh on the ova, or, rather, larvæ, of the Flustra, or sea-mat, and shortly afterwards announced some original discoveries. The study of medicine being distasteful to the young naturalist, he was entered at Christ's, Cambridge, in 1828, with the idea of becoming a clergyman of the Church of England ; but there he made the intimate acquaintance of Prof. Henslow, who recommended him to the post of naturalist on the *Beagle*. The memorable voyage of that little barque (242 tons) is a bright chapter in the history of scientific research, and undoubtedly had much to do with the future course of Darwin's studies. These we cannot attempt to follow here ; suffice it to say that all the more important points in the career of the great naturalist are brought forward in Mr. Bettany's work. What was the secret of Darwin's success? The question is answered by the one word *"observation." He was* always observing, and possessed the ability to understand what he saw. "If ever a man was fitted by worldly position to undertake unbiased and long-continued investigations, Charles Darwin was such a man," says Mr. Bettany, and that explains Darwin's whole career. He sought the truth for its own sake, and was indifferent to the gibes and sneers of the thoughtless. If a statement was not true, no one was more ready to admit it than Charles Darwin ; but in argument he was like an iceberg, slowly but gradually crushing all before it and sweeping over the mangled remains. His facts were drawn from nature, and, marshalled by a master hand, at last compelled conviction even in those who, from choice, would have preferred the explosion of what is known as Darwinism. Reviled, scorned, almost anathematised, he lived to win respect, if not reverence, from his fellows, and was buried in Westminster Abbey, not far from a man equally distinguished—Sir Isaac Newton. As Mr. Bettany says, he was "a marvellously patient and successful revolutioniser of thought ; a noble and beloved man"—a man of whom all England may well be proud. Darwin's life is given as neatly as it can be in a small compass (170 pages) by Mr. Bettany, and Mr. Anderson, of the British Museum, supplies a valuable bibliography, so that we can recommend those who want to know what Darwin did, and what works were written about his theories, to procure this small and unpretending volume.

Labour, Leisure, and Luxury. By ALEX. WYLIE, of Glasgow. London : Longmans.

IT appears that this work was written originally for the benefit of the working classes, and the preface to this, the "popular edition," commences with the assertion that "the teaching of the most erroneous and subversive doctrines regarding property has been increasing and bearing fruit to an alarming extent." Be that as it may, Mr. Wylie's thoughtful little book can be read with advantage by everyone, workers especially, for he strikes the right keynote at once when he says that whatever aid may be derived from legislative enactment or outside philanthropic effort, the improvement of the condition of the working classes rests principally with themselves. On some points the more shrewd amongst the working classes will probably agree with Mr. Wylie in a manner he little expected, for when it is recognised that "the British workman does not pay one farthing of imperial taxes except on his luxuries," he will probably want to know why he should pay so much as he does on them. Mr. Wylie is a large employer of labour ; but he looks upon his employés as something better than mere "hewers of wood and drawers of waters." He recognises the circumstances which have made it necessary for them to hew wood and draw water ; but he also sees that they are human beings, and he desires to make their yoke as light and easy as possible. There is much sound common sense in his lectures, and the little book in which he has printed them may be commended to thoughful working men as full of good advice.

A B C Five-Figure Logarithms. By C. J. WOODWARD, B.Sc. London : Simpkin, Marshall, and Co.

WE commend this little book to all who have not progressed so far in their study of arithmetic as to master the "mysteries" of logarithms, for Mr. Woodward has made the subject as clear as possible, and has wisely confined his tables to five figures. As he says, logarithms should contain only as many figures as will give a result within the limits of allowable error, and they should be so arranged that a log. corresponding to a given number, or a number corresponding to a given log., may be found quickly and with the least expenditure of mental effort. A five-figure mantissa (that is, the decimal part) can be written down with certainty at sight ; but seven figures require two references. The tables have been prepared with special reference to the work of physicists and chemists, and for them the errors of experiment exceed any error likely to be introduced by the use of only five-figure logarithms. Apart from that, however, Mr. Woodward has made the subject so clear that many who have never attempted to understand logarithms will thank him for his little book.

The Geology of England and Wales. By HORACE B. WOODWARD, F.G.S. London: George Philip and Son.

ALTHOUGH this is called a second edition, it is practically a new work, for such large additions have been made to our knowledge of English and Welsh geology, that the first edition, published more than ten years ago, stood in much need of revision, as may be judged from the fact that something like 200 pages have been added. The work is more of a book of reference than a treatise on geology ; but, as its title implies, it is a descriptive account of the geology of England and Wales, especially useful to students, engineers, and others who may be interested in the practical applications of the science. Thus it contains an account of the lithological characters, principal fossils, and economic products of the stratified rocks, with notes on their formation, and references to the chief localities where they may be studied. Mr. Woodward has received friendly co-operation from many of those most competent to help, and the numerous notes appended to the text will give the student the references he requires for further information, while a well-executed coloured map renders the work complete as a geological text-book of this country.

We have also received *The Storage of Electrical Energy*, by GASTON PLANTÉ, translated by PAUL BEDFORD ELWELL (London : Whittaker and Co.), which contains the substance of the many papers written by Planté on the accumulation and transformation of the energy of the voltaic battery, and which is of so much importance that we must deal with it at greater length on a future occasion. —— *Historic Towns, Oxford*, by C. W. BOASE (London : Longmans), is an addition to the series of volumes edited by Dr. Freeman and the Rev. W. Hunt, and a very notable addition, too, for Oxford, like Cambridge, is to many Englishmen an historic town *par excellence*. Mr. Boase has done his work well, and has traced the history of the old city with a loving hand.——*Manchester*, by GEORGE SAINTSBURY (London : Longmans), should also have formed one of the series of "Historic Towns ;" but some differences of opinion arose between the author and one of the editors, and it has been published separately. As the author says, Manchester occupies a unique position, contrasting, as it does, with the great modern towns which have little or no history, and with the historic towns which have little modern importance. He has endeavoured, therefore, to indicate the connection of Manchester with the general history of the kingdom without neglecting local foundations and incidents, and has produced a work which will be welcomed by many who are interested in the rise and progress of our great cities.——*On the Drainage of Lands, Towns, and Buildings*, by G. D. DEMPSEY, C.E., revised, with large additions, by D. KINNEAR CLARK, M.Inst.C.E. (London : Crosby Lockwood and Co.), is a technical manual on drainage and sewerage, and is practically a new work. It contains, amongst other matters, an account of the great scheme of Metropolitan Main Drainage —that is, of the London sewers, with a map— and of some other notable achievements in such work, together with the excellent treatise on drainage generally written by the

Mr. Dempsey.——*A Rudimentary Treatise Land and Engineering Surveying*, by T. ER, C.E. (London: Crosby Lockwood Co.), is the fourteenth edition, revised corrected by J. R. YOUNG, of a text- : which is well-known to students practical workers with the staff and dolite. —— *The Practical Engineer's dbook*, by WALTER S. HUTTON (London: by Lockwood and Co.), is designed companion volume to the author's useful orks' Manager's Handbook." It comes a treatise on modern engines and ers, and a large collection of rules and tical data—is, in fact, full of useful information, and should be found on the office f side by side with the work above mened. —— *Electro-Deposition*, by ALEXER WATT (London: Crosby Lockwood Co.), is the second edition of a practical tise which is regarded as a standard text- : by all who are interested in the study ne electrolysis of the metals—a branch of which is now attracting increased atten- ——*Pneumatics*, by CHARLES TOMLIN- F.R.S., F.C.S. (London: Crosby Lock- d and Co.), is the fourth edition, enlarged, well-known manual for the use of be- ers.——*A Pocket Glossary of Technical ns*, by JOHN JAMES FLETCHER (London: by Lockwood and Co.), is a useful little tcoat pocket book giving the principal nical terms in English-French and French- lish, with tables that will often be found ly for reference.——*A Guide to the ice of Photo-Micrography*, by EDWARD OUSFIELD, L.R.C.P.Lond. (London: W. t), is a useful little manual, containing tical directions which will enable the teur to achieve success in photo-micro- hic work. Dr. Bousfield is a practical oscopist and photographer, and recom- ds nothing that he has not tried and d successful in his own work.——*The ographic Teacher*, by ISAAC PITMAN ndon: I. Pitman and Sons), is the bilee" edition of this well known and ly used guide to shorthand.

e have also to acknowledge the receipt *Metal-Plate Work*, by C. T. MILLIS, ist.M.E. (London: E. and F. N. Spon), of the "Finsbury Technical Manuals"; *ctical Directions for Winding Magnets for amos*, by CARL HERING (London: E. and . Spon); *Levelling*, by THOMAS HOLLO- (E. and F. N. Spon); *Lessons in entary Practical Physics*, by BALFOUR WART and W. HALDANE GEE, "Elec- ty and Magnetism" (London: Macmillan Co.); and *Elementary Microscopical Tech- ıy*, by FRANK L. JAMES, M.D. (St. Louis, ouri).

ASTRONOMICAL NOTES FOR JULY, 1887.

The Sun.

Souths.	At Greenwich Mean Noon.		
	Right Ascension.	Declination North.	Sidereal Time.
m. s.	h. m. s.	° ′ ″	h. m. s.
3 30·45 P.M.	6 40 24	23 7 37	6 36 53·45
4 24·60 „	7 1 1	22 42 39	6 56 36·23
5 10·04 „	7 21 29	22 7 50	7 16 19·02
5 44·93 „	7 41 47	21 23 31	7 36 1·80
6 7·48 „	8 1 52	20 30 5	7 55 44·58
6 15·90 „	8 21 43	19 28 4	8 15 27·36
6 9·07 „	8 41 19	18 17 59	8 35 10·14

e method of finding the Sidereal Time at l Mean Noon at any other station is ibed on p. 382 of Vol. XLIV.

e indications of solar disturbance which eared two or three months ago continue ine spots occasionally appear.

9 a.m. on July 2nd the Sun is in Apogee—that is to say, the earth is in that part of her orbit in which she is at the greatest distance from him. Adopting the solar parallax of 8·848″, an interval of 93,941,978 miles separates us at that instant from the mighty centre of our system.

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
1	η Libræ	6	9 23 p.m.	Dark	14	19	10 4 p.m.	Bright	309	320
6	π Capricorni	5	†9 3 „	N.	184	149				
6	B.A.C. 7053	5½	9 49 „	Bright	68	37	10 53 „	Dark	303	280
6	ο Capricorni	5½	9 49 „	Bright	69	38	10 54 „	Dark	303	280
8	42 Aquarii	6	12 48 „	Bright	65	43	1 45 a.m.	Dark	334	320
17	85 Tauri	6	‡1 5 a.m.	Bright	64	30	1 45 „	Dark	323	286
17	Aldebaran	1	3 16 „	Bright	179	139	3 33 „	Dark	212	172
18	115 Tauri	6	‡1 50 „	Bright	107	73	2 40 „	Dark	274	237
25	B.A.C. 4277	6	8 20 p.m.	Dark	0	34	8 45 „	Bright	315	350
31	21 Sagittarii	5	12 23 „	Dark	75	99	1 29 „	Bright	291	323

† A near approach. ‡ Before moonrise. A description of the construction and use of the above table, illustrated by a diagram, will be found on p. 383 of Vol. XLIV.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	II	Ec R	10	5	29 P.M.	10	III	Oc R	9	29	p.m.	23	*I*	*Tr E*	8	49	p.m.
3	*III*	*Ec D*	8	40	56 „	14	I	Tr I	10	12	„	23	*I*	*Sh E*	10	4	„
3	III	Ec R	10	18	54 „	14	*I*	*Sh I*	11	28	„	24	II	Sh I	9	43	„
6	I	Oc D	11	0	„	15	II	Oc D	10	11	„	24	II	Tr E	9	44	„
7	*I*	*Tr I*	8	18	„	15	*I*	*Ec R*	10	48	39 „	28	*III*	*Sh I*	10	23	„
7	I	Sh I	9	33	„	17	II	Sh E	9	42	„	30	*I*	*Tr I*	8	32	„
7	I	Tr E	10	31	„	17	*III*	*Oc D*	11	11	„	30	*I*	*Sh I*	9	47	„
7	*I*	*Sh E*	11	45	„	21	*III*	*Sh E*	8	15	„	31	I	Ec R	9	6	43 „
8	*I*	*Ec R*	8	53	59 „	22	I	Oc D	9	17	„	31	*II*	*Tr I*	9	43	„

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

Up to the 21st twilight persists from sunset to sunrise in every part of Great Britain.

The Moon

Is Full at 8h. 34·2m. a.m. on the 5th, and enters her Last Quarter at 6h. 57·1m. in the morning on the 13th. She will be New on the 20th at 8h. 50m. p.m., and enter her First Quarter at 2h. 30·3m. on the afternoon of the 27th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	10·0	8 58·4 p.m.
6	15·0	*12 37·7 „
11	20·0	4 33·7 a.m.
16	25·0	8 10·9 „
21	0·6	0 40·8 p.m.
26	5·6	5 10·5 „
31	10·6	9 36·0 „

* After midnight on the 5th.

The Moon is in conjunction with Mars at 5h. a.m. on the 19th; with Saturn at 7h. p.m. on the 20th; with Mercury at 5h. p.m. on the 21st; with Venus at 4h. a.m. on the 24th; and, lastly, with Jupiter at 1h. a.m. on the 27th.

Mercury

Is an Evening Star, in the sense of Southing after noon, up to the 28th, after which he becomes a Morning Star, as at 5h. a.m. on the 29th he is in Inferior Conjunction with the Sun. He attains his greatest elongation east of the Sun (25° 51′) at 10 a.m. on the 1st, and for the first week or ten days in July is very fairly placed for the observer. He may at this time be caught with the naked eye after sunset over the W.N.W. part of the horizon. His angular diameter increases from 8″ on the 1st to 11·4″ at the time he is in Inferior Conjunction, diminishing quite imperceptibly again to 10·9″ by the 31st.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	8 30·3	19 2·1	1 53·1 p.m.
6	8 45·5	17 0·0	1 48·6 „
11	8 53·9	15 13·1	1 37·3 „
16	8 54·7	13 55·6	1 18·4 „
21	8 47·9	13 20·8	0 52·0 „
26	8 35·3	13 36·0	0 19·8 „
31	8 21·0	14 35·1	11 45·9 a.m.

This curiously-curved path lies wholly in that uninteresting constellation Cancer, and in a very barren part of it to boot.

Venus

Is an Evening Star throughout the entire month, attaining her greatest elongation East of the Sun (45° 32′) at 8 p.m. on the 13th. She is a very brilliant and conspicuous object after dusk over the W. by N. part of the horizon, and her crescent now presents a most interesting spectacle in the telescope. Her angular diameter increases from 20·8″ on July 1st to 29·8″ by the last day of the month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	9 49·0	14 42·9	3 11·6 p.m.
6	10 8·1	12 39·4	3 11·0 „
11	10 26·3	10 31·1	3 9·5 „
16	10 43·5	8 19·6	3 7·0 „
21	10 59·7	6 6·5	3 3·5 „
26	11 14·8	3 53·5	2 58·9 „
31	11 28·7	1 42·4	2 53·0 „

A study of the above ephemeris will show that the path of Venus during July begins at a point where she forms a rudely equilateral triangle with α and η Leonis, and thence extends practically right across the whole constellation of Leo. She will be about 1° North of Regulus on the 4th, and 30′ N. of ρ Leonis on the 11th; she will be 1° 50′ S. of χ Leonis on the 21st, and less than 30′ S. of τ Leonis on the 28th.

Mars

Remains invisible.

Jupiter

Is still an Evening Star, but is in quadrature with the Sun at 3 a.m. on the 20th. His South Declination is increasing. He Souths in bright sunlight, and, in fact, he is daily getting into a more unfavourable position for the observer. To be seen at all he must be looked at the moment the light wanes enough for him to become visible. He sets after midnight at the very beginning of July, but before 10h. 30m. towards the end of it. His angular equatorial diameter decreases from 37·5″ on July 1st to 33·5″ by the 31st. After this month we shall discontinue our ephemeris of him until next year.

Day of Month.	Right Ascension.		Declination South.		Souths.	
	h.	m.	°	′	h.	m.
1	13	38·6	8	54·7	7	0·6 p.m.
6	13	39·2	8	59·5	6	41·5 „
11	13	40·0	9	5·8	6	22·7 „
16	13	41·2	9	13·6	6	4·1 „
21	13	42·5	9	22·8	5	45·8 „
26	13	44·1	9	33·3	5	27·8 „
31	13	46·0	9	45·1	5	10·0 „

The path indicated above is described somewhat to the East, and *just* to the North, of Spica Virginis.

Saturn

Comes into conjunction with the Sun at 4h. a.m. on the 19th, and is, of course, now invisible; as, for the purpose of the ordinary observer, are both Uranus and Neptune too.

Shooting Stars

May be watched for with the greatest chance of success on the nights between the 17th and 20th inclusive, and again from the 25th to the 30th.

Greenwich Mean Time of Southing of Seven of the Principal Fixed Stars on the Night of July 1st, 1887.

Star.	Souths. h.	m.	s.
β^1 Scorpii	9	20	28·68 p.m.
Antares...	9	44	1·77 „
α^1 Herculis	10	30	54·62 „
α Ophiuchi	10	51	2·98 „
γ Draconis	11	15	17·04 „
Vega	11	54	18·30 „
ζ Aquilæ	12	21	19·87 „

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above List on any other night in July, as also that of determining the Local instant of its Transit at any other Station, will be found on p. 384 of Vol. XLIV.

EXPERIMENTS WITH SAFETY-LAMPS.

THE competition between the new electric safety-lamps and the old gauze-protected oil-flames is not unlikely to result in the production of a real safety-lamp—that is one that can be trusted to burn in the foulest atmosphere of the most fiery workings of a coal-mine under all possible conditions. A series of experiments with the well-known forms of safety-lamp were made recently at the Neepsend Gasworks, Sheffield, in the presence of a number of inspectors and managers, and lately several of the portable electric safety-lamps have been subjected to actual trial in the mine. The renewal of Mr. Lever's offer of £500 for the best real safety-lamp has had something to do in stimulating practical men to make further efforts; but there is also a great desire to do what can be done to prevent those fearful disasters which occasionally horrify the newspaper reader, and bring grief and misery to the relatives of the victims. Amongst practical men the opinion has been gaining ground latterly that the real safety-lamp will be found in some electrical arrangement, and for that reason we recently illustrated (p. 286) the electric safety-lamp patented by Mr. Miles Settle, as a typical example of several devices which are now available. At first sight it may appear complicated, but that will be no drawback if it is found successful in practice; the greatest obstacle to its introduction will, we are afraid, be the expense, and in that connection it seems useless to hope for any great reduction either in first cost or in cost of working. Prof. Silvanus P. Thompson has recently drawn attention to the subject, and expressed the opinion that the only really satisfactory guarantee against colliery explosions is the use of the electric safety-lamp. He points out that it is now three years ago since the adjudicators of the Ellis Lever prize were reluctantly compelled to declare that no lamp submitted to them fulfilled the conditions laid down by the Miners' Union; but during that time several electric safety-lamps have been designed and brought to a certain degree of perfection; consequently, he asks whether it would not be advisable to appoint a Royal Commission to make a special inquiry into electric safety-lamps? We do not think much good would be done by a Royal Commission unless their recommendations were enforced by legislation: it would be better to leave the Miners' Union to report on the matter after experimenting with the lamps in actual work. At a recent meeting of the Manchester Geological Society the portable mining lamp manufactured by the Edison-Swan Company, which has been tried with satisfaction in the Atherton Collieries was exhibited by Mr. Burrows, the hon. sec. The lamp consists of a small strong wooden case, suspended by a strap which contains an accumulator and an incandescent lamp combined, the whole weighing about 7lb.; the cell is said to be capable of maintaining a light of 2½c.p. for about fourteen or fifteen hours. The lamp is arranged in front of the accumulator with a concave enamelled reflector behind it, and a thick plate of glass in front to protect it. The whole apparatus is kept within a sufficiently small compass, about 7in. by 5in. by about 4in. Mr. Burrows stated that the lamp gave a better light than four Marsaut lamps, and he did not find the weight any inconvenience, as the electric lamp could be carried in any position as found convenient. Mr. J. R. Williamson (representing the Edison Company), in reply to questions, said the cost of working the lamps would be very little, as the dynamo for charging the accumulators could be driven by the colliery fan engines, and the lamps charged in the night time ready for use the next day; he did not think, however, that the lamps could be produced under 40s. each. With regard to the filaments in the lamps, they were liable to be shattered by a heavy blow on the lamp; but provision had been made to prevent the possibility of this as far as possible. The filaments were reckoned to last 500 hours before they required renewal, which was half the time allowed for lamps in ordinary use; but they had taken into consideration the rough wear and constant use in a colliery. During the discussion which followed, the general opinion was that the cost of the lamp would be a serious drawback to its general adoption throughout a colliery; but it was suggested that stations might be fitted up with them in various parts of a colliery, where they would be available in the case of an accident which had put out the men's ordinary safety-lamps, whilst for exploration purposes after an explosion they would be very valuable. The object of an electric safety-lamp, however, is to get rid of the risk which is believed to attend the use of the ordinary forms of so-called safety-lamps, which are safe enough in normal conditions, but which are not proof against conditions that sometimes arise in fiery workings. Many contend that the Morgan lamp is perfectly safe, and in a lecture delivered the other day in the Durham College of Science, Mr. W. Mawer stated that the Professor of Mining at the Yorkshire College had thoroughly tested the lamp, and declared that it could not be exploded under any conditions which had ever been known to occur in the mines of Great Britain. Mr. M[illegible] Com[illegible] series of experiments, had condemned certain lamps, including the Davy and the Clanny, and it had been to many people a matter of surprise that the new Mines Regulation Bill did not propose to prohibit the use of those lamps. The Royal Commission condemned those lamps, yet they remained in common use in many pits. Many believed that if these lamps were placed in bonnets they became safe lamps; but he proceeded to dispel that idea by causing explosions with the bonneted Clanny, the Davy, and the Gray lamps respectively, in an instant; while the Marsaut and other lamps would yield in less than a dozen seconds. The same test, when applied to the Morgan lamp, gave no such unsatisfactory result. Yet the Morgan was an ordinary gauze lamp, with nothing about it of an unusual character, except that while being an eminently practical lamp it could not, under any natural conditions, cause an explosion. The experiments made at the Neepsend Gasworks, however, are, we think, more trustworthy than any yet made, and we therefore describe the arrangements and the results, as given by the *Sheffield Independent*, with the intimation that Prof. Lupton, of the Yorkshire College, carefully examined the testing apparatus and the anemometers used to measure the velocity of the air-current. The testing apparatus is built of strong boards, 21ft. long and 12in. high by 5in. wide inside. The air is blown into one end of this tube by means of a fan, under pressure of 11½in. of water gauge. Its entry is regulated by a flap valve, the axis of which is furnished with a pointer indicating the number of degrees the valve is open. The gas is delivered from an annular nozzle surrounding the air-pipe under a pressure of 6in. The air and the gas pass along the tube to the opposite end, where the lamp under test is placed. The sides of the tube are furnished with strong plate-glass windows so that the lamp under test can be seen from the outside. The top of the tube is furnished with a number of iron skeleton doors, which hold strong paper panels in position when clamped down. When a lamp explodes the gas, these papers are blown out, and the apparatus is not injured. In the tests the lamp was placed in the box in front of the glass pane, the lid clamped down, and the air turned on. As soon as the proper pressure, as shown by water gauge, was obtained, everyone cleared away from the platform and the gas was turned on. The flame of the lamp generally elongated and disappeared into the upper part of the lamp. There was a suspense, during which 10 seconds seems a long time, and—bang! Out rushed fire through the bursted papers. Some lamps did not fire under this test, and were allowed to remain in the box a considerable time. The following notes were taken by Mr. Campbell, the manager of the gas-works, jointly with Mr. Laverick, a mining engineer:—

Unbonneted Lamps.—Meuseler: instantly, water gauge, 1·4in.

Royal Commission Lamps.—Gray's: would not burn in wind. Marsaut: 11sec., water gauge, 2·2in.; fired the gas. Evan Thomas: 2min., water gauge, 2·3in.; gas burning inside, glass cracked, very hot when taken out, did not fire.

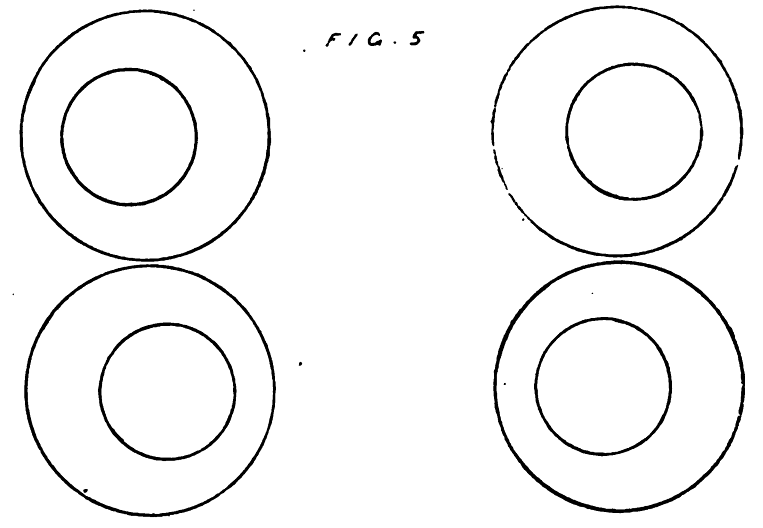
Bonneted Meuselers.—(*a*) From Barnsley: would not burn in wind. (*b*) From Thorncliffe, Protector: 11sec., water gauge, 2·6in.; fired gas. (*c*) "Swaithe Meuseler": 5½sec., water gauge, 2·9in.; fired gas. (*d*) Barrow Hematite: 7sec., water gauge, 2·7in.; fired gas. (*e*) Merceier's: 11sec., water gauge, 2·4in.; fired gas. (*f*) Davis's Ashworth: 2sec., water gauge, 2·4in.; fired gas. (*g*) Davis's: 7sec., water gauge, 2·4in.; fired gas. (*h*) Aldwarke; 3min. 10sec., water gauge, 2·3in.; did not, gas burning feebly.

Other Lamps.—Clifford's: water gauge, 2·4in.; all out instantly. Bonnetted Clanny: 3½sec., water gauge, 2·4in.; fired gas. Wm. Morgan's: 1min. 7sec., water gauge, 2·6in.; fired gas. Richard Purdie's Victoria, No. 1: would not burn in wind. Richard Purdy's Victoria, No. 2: 2min., water gauge, 2·6in.: no explosion, glass cracked, gas burning inside. Richard Purdy's Victoria, No. 3, 25½sec., water gauge, 2·6in.; fired gas. Jack: 12sec., water gauge, 2·9in.; exploded. Clifford's: 1min., water gauge, 2·9in.; all out instantly. Foster and Caldewell: 11sec., water gauge, 1·7in.; exploded. W. Sandbrook: 3min., water gauge, 2·2in.; all out by fusing plug. Hardy's: 3sec., water gauge, 2in.; fired. Donald's, from Eckington Colleries: 11sec., water gauge, 2in.; fired. Protector lamp, with corrugated bonnet, 3sec., water gauge, 2in.; fired. Whittaker and Holland: 2min., water [illegible], 2·2in.; all out by fusing lead. M'K[illegible]; [illegible] lamp, 2min., water gauge, 2·2in.; [illegible] burning inside, glass cracked. Marsaut: 17sec., water gauge, 2·4in.; fired. Hardy: No. 2, 11sec., water gauge, 2·6.; fired.

A POWERFUL GALVANIC BATTERY.

AMONGST the many claimants for improvements in galvanic batteries we note that Mr. Alfred Dun and Herr F. Hasslacher, of Frankfort on the Main, have patented a combination for which they claim the high E.M.F. of 2·5 volts per cell, while in consequence of the small resistance of the exciting and depolarising liquids employed, the strength of current is very considerable. Moreover, notwithstanding its considerable power, the element is so constant in its action that it may be used with great advantage for electric lighting, or for driving motors. The new element consists of a carbon negative electrode having as depolarising liquid nitro-hydrochloric acid (aqua regia) either alone or mixed with ferric chloride. As positive electrode in the other cell zinc is employed, or any other metal soluble in soda lye, or, at any rate, on closing the circuit, and as exciting liquid soda lye of greater or less concentration is used. The chemical action of the element is as follows:—The zinc is oxidised by the oxygen evolved, and the oxide formed is dissolved by the soda lye, while the hydrogen is at once taken up by the aqua-regia, forming hydrochloric acid with its chlorine. In the gradual decomposition of the aqua-regia there is produced chlorine together with chloro-sub-nitrous acid and chloro-nitrous acid, which can also give up their chlorine. When the aqua-regia is saturated with chlorine its decomposition ceases, and only begins again with a fresh production of chlorine, or of the two above-named compounds, when the free chlorine first evolved is taken up by hydrogen or any other body that absorbs chlorine, such as ferrous chloride. According to the quantity of hydrogen evolved by the action of the element, the development of chlorine is proportional to the absorption of the existing free chlorine, and this lasts as long as any aqua-regia exists. With the presence of ferric chloride the depolarising process may be considered as consisting in the reduction of ferric chloride to ferrous chloride by the hydrogen, with formation of hydrochloric acid, the ferrous chloride being, however, at once reconverted into ferric chloride by the chlorine of the aqua-regia. This takes place as long as there is any trace of the aqua-regia present. Only after this has disappeared does a permanent formation of ferrous chloride begin, combined with an increase of resistance in the element. But this does not occur as long as all the iron is present in the form of ferric chloride. It is, therefore, advantageous always to have an excess of aqua-regia present. The addition of ferric chloride has, therefore, the important object of enabling the element to be utilised to the fullest possible extent without increasing the resistance, which explains the reason why a mixture of aqua-regia and ferric chloride renders the element more constant than when aqua-regia alone is used. The addition of the ferric chloride has, however, also the important advantage, that by means thereof a too rapid mingling of the inner and outer liquids is prevented. This is particularly important when a carbon cell is used in place of an earthenware cell, in consequence of the greater porosity of the former. On the ferric chloride mixing with the soda lye in the walls of the porous cell, oxide of iron is formed which fills up the larger pores without materially interfering with the necessary contact and without increasing the resistance, which is rendered very small by the good conduction of the carbon cell. In addition, the oxide of iron assists the depolarisation, and, therefore, also acts beneficially in this respect. As the hydrochloric acid is always formed afresh, it is advantageous to use aqua-regia containing much nitric acid, or, in replenishing only to supplement the nitric acid consumed. The very high electromotive force of the element is caused by the fact that to the electric tension between metal and carbon there is also added that existing between the aqua-regia with ferric chloride and the soda lye. If it is desired to avoid all smell during working, the hydrochloric acid of the aqua-regia may be replaced by chromic acid or a chromate. In this case no production of free chlorine ensues, and any nitrous acid fumes are at once absorbed by the chromic acid. The depolarising action of the nitric acid will then be assisted by that of the chromic acid. In this case platinum or aluminium may be used in place of carbon.

FIG. 5



THE STEREOSCOPE AND ITS APPLICATIONS.*

(Continued from p. 384.)

A VERY simple form of instrument, and one of great convenience, which leaves the hands perfectly free, and which anyone can adopt to his own interocular distance, is that of spectacles with stereoscopic semi-lenses, or, as I have found equally effective, ordinary spectacles of about 6in. focus, simply widened by inserting a piece in the bridge, so that the eyes may look through the margins of the lenses instead of through the centres. But, it may be asked, if the instrument does so much, what becomes of the criterion of muscular effort in the movement of the axes? We will see that there is still residual work of this kind to be accomplished, because of the impossibility of the exact superposition of dissimilar pictures. Let us see, therefore, in what this dissimilarity consists, and how it may be best stated for our purposes. Let us take as a very simple subject the screen of vertical lines as our background, for convenience of reference, and the rod with an arrow of black cardboard several feet in front of it.

Upon looking at it first with one eye open, and then with the other eye open, while the head is kept in a fixed position, it will be noticed that the projection of the arrow referred to the same line on the screen, will be further to the left when looked at by the right eye than when looked at by the left eye. Or we can say that in right-eye pictures objects in the foreground are further to left of the same object in the background compared with the left-eye picture. So in the diagram (Fig. 5) the upper pair of diagrams would represent right and left-eye drawings of a concave frustrum of a cone, because the centre of the smaller base in one case is further to the right, and in the other further to the left compared with the centres of the larger bases, while the lower pair of diagrams, for similar reasons, represents a convex frustrum. This rule applies, of course, to the most complicated subject, and would enable anyone to assort unmounted photographic stereographs, as has often been my own practice. But it will answer our purpose better to describe the completed stereograph—the pair of pictures mounted properly upon a card. In this case, we see at once that similar points in the foreground will be nearer together than similar points in the background. Thus, we might say that in the stereoscopic diagram of the convex frustum of the cone the centres of the smaller circles are nearer together than those of the larger circles. Thus, as we measure with a pair of compasses the distances between the similar points of a more complicated stereograph, passing from objects in the immediate foreground, there will be a gradual, slight, but very perceptible, increase in the distance.

Now, to return to our simple diagram (Fig. 2, p. 383), and regard both sides of it. Two of the squares will be seen to be nearer together, and in the stereoscope binocular combination will take place, and the difference assert itself by invariable, uncontrollable, persistent location of that square in front of the other. This rule, which serves to test the correctness of the mounting of the pictures of a stereograph, serves just as well to answer a very natural query that arises here, as to the effect of incorrect mounting — of transposition of the pictures, thus presenting the left eye the right-eye picture, and at the same time the right eye the left-eye picture. This would simply reverse the order of the distances between similar points. Objects in the foreground would now be further apart than objects in the background. The binocular combination of these by means of the stereoscope, by its inexorable method, would reverse the natural distances of the objects from the eye. Objects in the background would be brought to the front, and those in the foreground be caused to recede into the distance. Forms would be inverted. Elevations would be converted into depressions, and depressions into elevations, relief into intaglio. This false effect, called pseudoscopic effect, to distinguish it from the ordinary stereoscopic effect, is one of the most interesting facts, and one most strongly corroborative of the theory of the stereoscope. It also opens up a fruitful field for experiment and investigation, sometimes disappointing us, but oftener affording remarkable surprises in spite of all ground for anticipation. In Fig. 5 you will readily notice that the transposition of the diagrams of either pair will produce the other, with the reversed stereoscopic effect. So the most complicated photographic stereographs, with every variety of object, and all their wealth of detail—landscapes, interiors, statuary, apparatus—if cut apart and transposed, should manifest a similar effect. The ordinary stereographs in the market answer very well for experiments. But all will not be found to respond to our statement. In many cases, especially when persons have not been apprised of the change, and are unaccustomed to critical use of the instrument, the stereoscopic effect will apparently persist, not as strikingly, perhaps, there may be an expression of dissatisfaction on the part of the observer in comparison with some other stereographs, accompanied, it may be, with the statement that it appears better with one eye than with both; but the trees in front of the cottage refuse to recede behind it, the portico will not move to the rear, and the sloping lawn in front not slope to the rear, at an opposite angle, as they all should. Neither will a face appear as a mask. This results simply from the struggle between what is usual, and natural, and anticipated, and what is unusual or unnatural, and often even impossible; between the single binocular criterion and the

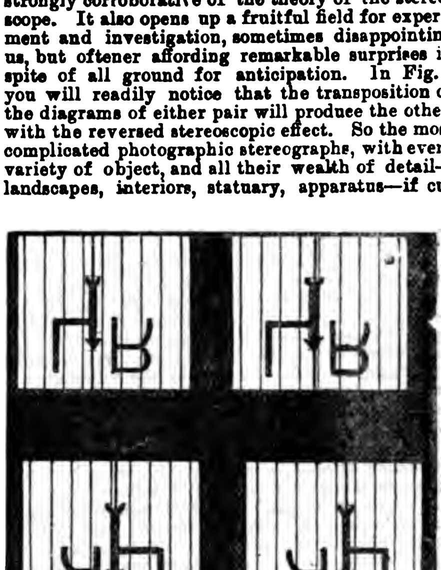


FIG. 6

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* Extracted from a lecture by Prof. CHARLES F. HIMES, Ph.D., delivered before the Franklin Institute.

cumulative effect of all the monocular criteria of distance and form. Thus, that the trees should recede beyond the cottage, implies not only a violation of ordinary perspective, but an unnatural appearance of transparency in the cottage. But often after prolonged examination, the absolute character of the binocular criterion, its entire independence of the conditions of ordinary perspective, manifests itself, first in a recognised persistence in the disposition of some object in the background to start to the front, as binocular perspective overbears all ordinary perspective.

At first it may be such objects as do least violence to our preconceived notions of position, and finally all will come into the most unnatural positions as demanded. But this control over us of what is usual in appearance, which we found applied to the objects themselves, when viewed with one eye, as in the mould which I exhibited which appeared to be a relief, applies, in many cases, even to the stereographs of the objects. The stereograph of the mould, even to experts, does not, at first, manifest its true character, and, of course, it would be expecting too much that the transposed stereograph of the medallion should appear as a mould. But frequently when difficulty has been experienced by individuals in obtaining pseudoscopic effect, I have succeeded in causing it to appear at once by placing the familiar object in an unusual position. By simply turning the pseudograph, as we may call it, upside down in the stereoscope, its true character will often appear. Thus the stereograph of the mould upside down occasions no difficulty, and then, generally, when placed in its proper position, it retains its character as a mould. So, too, the mould photographed in a horizontal position I find is more likely to maintain its character in the stereoscope. Again, by taking advantage of accidental features, for example, the tacks by which it is fixed to the support or the knot on a cord, these readily assume their proper positions, and, insignificant as they are, drag the whole picture into proper relief. Nothing exhibits more clearly than such facts as these the effect of the most minute conditions in stereoscopic vision. In the photograph upon the screen, a combination has been made upon a table of objects of wood, metal, and glass, some with peculiar lustre, of familiar and unfamiliar forms and sizes, and without marked background. It forms a beautiful stereograph. But, when mounted pseudoscopically, at first it is very unsatisfactory, persons sometimes stop and wipe the glasses of the stereoscope; but finally, as a rule, the objects arrange themselves in inverse order, suspended in mid-air, on a plane with the reversed slope of the table. The effect is magical. When great difficulty is experienced in obtaining it, simple inversion of the pseudograph will produce it, and it will be retained after it has been properly placed. The photograph of the old jelly mould on the screen is an excellent subject that yields its proper effect at once. It is a suggestion taken from Dr. Carpenter. There is little familiar about it.

Now, the differences between the binocular pictures, minute as they must necessarily be, would entirely escape representation in any ordinary drawing, and in a subject of any complexity, even with the greatest care could not be rendered, might even be reversed in character. The infinitesimal character of the differences between the binocular pictures, which the eyes can take hold of and translate into distance and form, can hardly be appreciated from mere statement. If a slip, about 2¾in. by 2¾in., is printed from ordinary type, and the type is then distributed and reset, as nearly as possible in the same way, an impression from the latter combined in the stereoscope with one from the former, will manifest differences in the projection of some letters in front of the plane of the paper, and the recession of others behind it, or even of words inclined at different angles to the plane of the paper—effects due to varying distances between the similar letters. It has been proposed to test bank-notes in this way. If similar halves from the same plate are combined in the stereoscope, they will remain flat, whilst if halves from different plates are combined the minutest differences will manifest themselves, as in the printed slips alluded to. So the celebrated Chimenti pictures in the museum at Lille, which Sir David Brewster regarded as stereoscopic mates, on close examination only exhibit such differences as might be expected between any original and its copy, as they give mixed pseudoscopic and stereoscopic effect.

But just at this point photography comes to our aid, rendering, with mathematical accuracy, minutest differences. All that would be necessary would be to take two pictures from points of view about 3in. apart, either with the same camera in succession, or with two cameras simultaneously; or, with what is practically the same, the so-called stereoscopic camera, in which case the two pictures are on halves of the same plate of glass. One advantage of the double camera is, that moving objects are included in its range. But when the negatives are on the same piece of glass, the paper prints made from them must be cut apart, and transposed in mounting for the stereoscope. This has puzzled many, for is not the right-eye picture on the right half of the glass, and the left eye on the left half? Even Sir David Brewster seems to reason somewhat in this way in his description of what he calls a camera stereoscope, which he recommends very highly. He says, that by combining the two pictures on the ground glass of a binocular camera, by means of a lenticular stereo scope attached to the back of it, groups of figures, and so forth, may be seen in relief—upside down, to be sure, but in relief. It is not easy to test this statement with the ordinary stereoscopic camera, because the lenses are more than the interocular distance apart, and the similar points of the ground-glass pictures are too far apart; but by cutting a strip out of the centre of the negative taken with one of these cameras, as I have done, and thus bringing the similar points within 2¾in. of each other, and then supporting the halves on a piece of plain glass, just as they present themselves to the eye on the ground glass, and introducing them into the stereoscope, the same effect should be produced. It will be found to be pseudoscopic. If the subject has been carefully selected, unmistakably so; if a landscape, or a portrait, the difficulty before alluded to, in obtaining it, will be experienced. As this fact has a bearing on other interesting applications of the stereoscopic principle, we may take more time to make it apparent. Let us test it by our simple rule, that similar points of the pictures nearer together will appear nearer the observer. Any change in the position of the pictures that does not affect this condition will not affect their binocular character. Now, what is the character of the picture on the ground glass? First, let us note what presentations of a transparent picture can be made. On the screen will be recognised a negative of our screen of vertical lines and arrow. The letters have been introduced to indicate changes. First, then, we have the normal position, next simply turned upside down, next in an upright position, but as if seen from the other side, or looking upon the face of type—say type inverted, and lastly, both upside down and type inverted. Now, the image of an object thrown by a lens appears upside down and type inverted to an observer upon the same side of the screen as the lens, or as it would appear to you if the lantern were projecting images from objects in their natural position, Fig. 6, *a*; but if these same images upon the screen were looked at from the other side of the screen, they would still be upside down, but the type inversion would be corrected; they would only be upside down, like a negative, upside down, and with the film side from you, which, by simply turning right side up, becomes normal, Fig. 6, *b*. Now, the two pictures thrown upon the ground glass of the binocular camera have the same character; seen from behind on the ground glass, they are simply upside down. Thus we see that by taking two stereoscopic pictures, which are properly placed, and turning each for itself upside down, we can change the relation between the distances of similar points in the pictures; those that were nearer together before will now be further apart—the combination will be pseudoscopic. If it is a glass stereograph, and we fasten the pictures in their new positions, no turning of the whole combination, no mode of looking at it from front or rear, can change this condition—it is pseudoscopic, and will remain so until each picture is inverted for itself, or until they are separated and transposed, which would bring the same edges of the halves together as separate inversion would. Thus the pictures on the ground glass of the stereoscopic camera are simply upside down, Fig. 6, *b*; if each could be turned right side up for itself the combination would be stereoscopic; unless that is done, the combination must be pseudoscopic.

(*To be concluded.*)

THE PHOTO-SALTS OF SILVER AND PHOTOGRAPHY IN NATURAL COLOURS.

THE researches which Mr. Carey Lea, of Philadelphia, has recently published, having reference to the identity of the photo-salts of silver with the material of the latent photographic image, are of much interest, although they do not lead us much further towards that much-desired, but seemingly impossible, result, photography in natural colours. We make the following extracts from a paper by Mr. Lea, in the *Photographic News*:—If we expose silver chloride precipitated with excess of HCl to light, we get a deep purple black substance which, boiled with dilute nitric acid, gives up a little silver, at the same time somewhat lightening in colour, and forming a dull purple material which closely resembles some of the forms of photo-chloride; mostly those produced by the action of sodic hypochlorite or of ferric-chloride on metallic silver. It shows the same reactions with ammonia that they do. The brighter coloured photo-chlorides are not formed by the action of light on silver chloride. But these brighter coloured chlorides can also be shown to be formed through the action of light. Most salts of silver darken by exposure, and when these dark products are treated, first with HCl, and then, after thorough washing, are boiled with dilute nitric acid, we can obtain results perhaps as varied as those arising from purely chemical action. *Silver Oxalate* exposed for two days to sunshine, covered with water, and with frequent agitation, changed to a deep brownish black, which, by treatment with HCl, became a little lighter. When this product was washed and boiled with strong nitric acid, it acquired a fine deep copper-red colour, the acid taking up silver. This red substance dissolved in ammonia readily, leaving a small amount of black residue; the same with sodium hyposulphite.

(This examination, made a year ago, has recently been repeated with a view to obtaining a quantitative determination of the proportion of Ag_2Cl contained in the red product. The exposure was for about a day; the oxalate at the end of the exposure seemed absolutely black. After treatment with HCl, it assumed a purple black shade. After thorough washing and boiling with dilute nitric acid, which removed a large quantity of silver, perhaps twelve or fifteen per cent. of the entire quantity, it had a fine lilac purple colour. Analysis showed that it contained about one-half of one per cent. of sub-chloride, or, more exactly, 0·45 per cent. Ag_2Cl was found.) The red chloride thus obtained from silver oxalate not only closely resembles the red chloride obtained by means exclusively chemical, but shows the same behaviour to reagents. Treated with ammonia it dissolves, leaving a black residue. The formation of this residue takes place precisely in the same manner with both substances. As fast as the material dissolves the liquid becomes clouded, and an extremely fine black substance seems to form within it, which gradually falls to the bottom. Treated with solutions of the alkaline haloids, the red chloride derived from exposed silver oxalate remains unchanged, after twenty-four hours' contact with potassic chloride, and becomes paler and more lilac under potassic bromide; under potassic iodide becomes grey. These reactions correspond with those of the photo-chloride.

Silver Phosphate belongs to the more sensitive silver salts, and easily darkens in sunlight. In a few hours it becomes greenish all through, after which further exposure produces little visible effect. This product becomes with HCl quickly grey, and by treatment with nitric acid after washing, light pink. *Silver Tartrate*, by exposure to sun, became quite black. With HCl this changed to reddish grey or dull pink. This product well washed, and let stand with cold nitric acid 1·36, became first lavender, and then light pink. *Silver Carbonate*, by prolonged exposure, became greenish black, and with the above treatment yielded a dull pink photo-chloride. *Silver Pyro-phosphate*, even by several days' exposure to winter sun, did not blacken, but assumed an ochreous or buff shade. With HCl this passed to a sort of salmon pink, and by heating a few minutes with dilute nitric acid, to a beautiful copper shade. *Silver Acetate* was singularly little affected by sunlight; it looked blackish, but on closer inspection was found to be very little altered. By the same treatment as above it yielded a pale pink photo-chloride. So far as examined, all silver salts thus treated yielded pink or red photo-chloride.

These facts may serve to show the identity of the photo-chloride with the principal product of the continued action of light on silver chloride, and on other salts of silver subsequently converted into chloride. I should wish, however, to use this word identity in a somewhat limited sense. When the photo-chlorides are formed by different methods without the aid of light, hardly any two forms can be considered absolutely identical. They differ in colour and in proportion of sub-chloride; but they also differ in other respects, especially in resistance to reagents. Some forms are far more easily destroyed by nitric acid. Those obtained by the action of sodium hypophosphite are amongst the most easily destroyed by nitric acid; there is variation, too, in the degree of their resistance to ammonia. Very similar differences are found in the stability of the photo-chlorides obtained by the action of light. Some are much more readily attacked by nitric acid than others; the product obtained by the action of light on silver chloride resists ammonia more strongly than that obtained by the action of HCl on exposed silver oxalate. This last is quickly attacked. Generally, I think, the dark-coloured forms are the most stable. At a future time it may, perhaps, be possible to distinguish more exactly between these varieties.

I next pass to the consideration of the identity existing between the photo-salts and the material of the latent image. Before entering, however, on that matter, it is necessary to describe a reaction leading to the formation of these photo-salts, somewhat differing from the reactions already mentioned, and which has important bearing on the subject. The remarkable action which an alkaline hypophosphite exerts on salts of copper was described many years ago by M. Wurtz. Its action on silver salts, though there is no parallelism between the two, has enabled me to find a key to some of the great difficulties of the latent image. A dilute solution of sodium hypophosphite, if poured over a mass of chloride, bromide, or iodide of silver, formed in the absence of light, produces no visible effect, but has the property of bringing these substances into the condition in which they exist in the latent image. Applied in strong solution and with the aid of heat, it produces brown purple photo-chloride, bromide, and iodide of silver. I will here briefly describe the first of these compounds, in order to continue the series of photo-chlorides, and then pass to the consideration of the latent image.

Photo-Chloride of Silver by Sodium Hypophosphite.

Silver chloride freshly precipitated with excess of HCl and well washed, placed in a flask with a strong solution of sodium hypophosphite and heat applied, begins to darken before the boiling point is reached. Actual boiling for ten or fifteen minutes gives a deep chocolate colour. This product, well washed and freed from traces of metallic silver by cautious boiling with very dilute nitric acid, has a pink, red, or brown colour, varying in intensity according to the length of the action. Sometimes a lavender shade is produced, and this is more apt to be the case when the silver chloride has been precipitated with excess of silver nitrate instead of excess of HCl. Silver determinations of two specimens of the purified product were made, indicating the presence in one specimen of 1·77 per cent. of sub-chloride, in the other of 3·53. By the continued action of heat for many hours, a complete reduction to metallic silver takes place. Photo-chloride obtained in this way has generally a brown or dull purple colour. Boiled with nitric acid it is apt to break up in as many minutes as some other forms would require hours for decomposition, yielding white chloride, whilst the nitric acid takes up small quantities of silver.

Identity of Photo-salts with the Material of the Latent Image.

It is proposed here to show: 1st, That in the entire absence of light, sodium hypophosphite is able to affect a sensitive film of silver haloid exactly in the same way as does light, *producing a result equivalent to a latent image formed by light*, and capable of development in the same way as an actual impression of light. 2nd, That these two effects, the impression produced by hypophosphite and that by light, comport themselves to reagents exactly the same way, and seem every way identical. 3rd, That the image produced by hypophosphite on silver chloride always gives rise to a positive development; but on silver bromide may give rise either to a direct or reverse image, *both of these effects corresponding exactly with those of light*. More than this, sodium hypophosphite may be made to reverse the image produced by light on silver bromide, and conversely light may be made to reverse the action of hypophosphite. So exact a correspondence in these remarkable properties can scarcely be fortuitous.

If we form a film of chloride, bromide, or iodide of silver, and with a glass rod dipped in solution of hypophosphite make marks upon it, these marks can, with the utmost ease, be developed in precisely the same way as an image produced by exposure to light.

A very simple mode of operating consists in imbibing photographic paper with a solution of an alkaline haloid, drying, applying a silver solution, and then thoroughly washing, all of course with careful exclusion of active light. If the silver solution is acidulated with nitric acid, a drop to the ounce, the result is brighter, but this is not important. In any case the washing must be thorough. Marks made on this paper can be developed with the oxalate developer with the utmost facility. If a strong solution of the hypophosphite is applied cold, it may be washed off at the end of a minute; but a stronger impression is obtained by allowing it to wait half an hour before developing; or the action may be accelerated and increased in strength by laying the freshly-marked paper on a hot surface—or, better, by steaming it before applying the developer. A convenient mode of steaming it is to lay two pieces of glass on a small water-bath, kept boiling, with a space between them. Over this space the paper is rested for two or three minutes. Paper prepared with a solution of KCl, KBr, or KI, dried, and floated on acidulated solution of silver nitrate, and well washed, if marked with strong solution of hypophosphite and steamed for two or three minutes, will develop the marks as black as ink on a white ground. The use of heat simply gives a blacker development; but a very vigorous image may be got without. A similar result may be obtained by substituting for the hypophosphite a dilute solution of potash and an oxidisable organic substance. With milk-sugar the action is very energetic, and heat is quite superfluous. Both these are the initial steps of reactions which, when prolonged, result in the visible formation of the coloured photo-salts. It is a matter of interest that sodium hypophosphite, which produces the above-described effects, has no developing power whatever.

The two impressions, that formed by light and that by hypophosphite, are similarly affected by reagents. As an example of this identity of effect produced on the two impressions, I first take the action of nitric acid. Chloride, bromide, and iodide papers were exposed to moderate diffused light, under a screen with openings, for a proper time to form a latent image, the chloride and bromide for four or five seconds, the iodide for twenty or twenty-five. They were then cut into halves, and one half of each was soaked in strong nitric acid for five minutes. These halves were then washed for some hours, and were developed along with the halves not so treated. Result was, latent image on silver chloride almost, if not quite, uninjured; on silver bromide, somewhat affected, but still strong; on silver iodide, entirely destroyed. Similar portions of the same papers were then marked with hypophosphite, and were cut into halves, and one half was subjected to the action of nitric acid in exactly the same way as the previous. The result was exactly as before. The hypophosphite marks on the half of the chloride paper that had been treated with acid came out in development as vigorously as on the half that had not been treated. The bromide paper showed the marks weakened by the acid, but still strong; on the iodide not a trace appeared. In all respects the result was the same; what the one resisted, the other resisted; what destroyed the one, destroyed the other.

The impressions produced by alkaline hypophosphite upon silver chloride always give rise to direct images darker than the ground on which they are formed. The same substance produces an impression on silver bromide which may, by development, produce either a direct or reverse image; so that there is a perfect parallelism with the action of light. The reverse action of light, sometimes called solarisation, shows itself as follows: A film of bromide being exposed to light, part covered by an opaque screen, the exposed portion receives an impression capable of development, and this impression grows in strength to a certain point, then recedes and reaches a condition in which it less susceptible of development than before exposure. All bromide films, even unexposed to light, will darken in a developing solution in time. The portion that under the action of light has reached the reverse stage resists the reducing action of the developer better than that which was not exposed at all, and consequently appears after development as light on a dark ground, and is, therefore, a reverse image. As to the cause of this action, we are as yet wholly in the dark. If the continued effect of light was simply to restore the affected part to its original state, we might attempt an explanation by affirming that the continued action of light undid its own work. But the fact of the resistance to reduction being greater than before exposure shows that some as yet unknown action of light is in play. The reverse action cannot be due to oxidation, as has been suggested, because hypophosphite reverses, and certainly cannot oxidise.

The reversing action of light on silver bromide finds its counterpart in the action of sodium hypophosphite. If we take bromide paper (it is immaterial whether in making it the bromide or the silver solution be applied first; but for these experiments on the reversal of the image it is essential that a pure neutral silver solution be employed, and that after the second solution has been applied the paper should be thoroughly washed, all the operations being, of course, performed by inactive light), if we take such paper and make marks on it with a strong solution of hypophosphite, and then throw the paper into potassio-ferrous oxalate, we shall get a direct development; the marks will be stronger than the ground.

If, now, we continually weaken the hypophosphite solution, we shall presently reach a point at which these marks are, in development, indistinguishable from the ground on which they were made; but, continuing the dilution still further, we presently reach a point at which the marks reappear, but this time reversely, as lighter marks on a darker ground. This result is obtained with about a two per cent. solution; the first mentioned effect comes with a solution of 25 or 30 per cent., so that according as we use the hypophosphite solution stronger or weaker, we obtain exactly opposite effects. Here the parallelism is striking, but not perfect; at least, it remains to be explained why the action in the two cases proceeds in a reverse order. All the other reactions show a perfect identity.

Time will also sometimes produce the same effect as dilution. Paper marked and put away for twenty-four or forty-eight hours, giving at first a direct image, may, after that time, give a reverse one. This effect is extremely uncertain, and, I think, exceptional. I have kept very many pieces for periods from a few hours to several weeks, which first and last gave direct images only. A few became reversed; but the experiment itself, the opposite effect of strong and weak solutions, is liable to no such uncertainty.

Again, we may make light and hypophosphite interact, and each reverse the other's action. To make hypophosphite reverse the action of light, I take a piece of silver bromide paper, expose it to the action of diffuse daylight for a few seconds, then, taking it to the dark room, make marks upon it with a glass rod dipped in solution of hypophosphite. On developing with potassio-ferrous oxalate the marks appear lighter than the ground. Or, what is perhaps more striking, we take two pieces of such paper, retain one in the dark room, and expose the other from five to twenty seconds to diffuse light, then make marks on both with a glass rod dipped in strong solution of hypophosphite, and then, after allowing a few minutes for the hypophosphite to act, place them both in a solution of potassio-ferrous oxalate. The marks will develop, in the one case, as dark on a light ground, in the other (that exposed to daylight) as light on the dark ground.

We have here made the hypophosphite imitate the action of light; it has reversed the image in the same way as would result from a prolonged exposure to light. It will next be shown that light may be made to imitate the action of hypophosphite, and reverse the effect already produced by that or other reducing agents.

If we take the red or purple silver bromide, preparing it with exclusion of light, and the same precaution as in the case of a dry-plate, and extend it over paper (it is best, though not essential, to mix it with a little gelatine to enable it to retain its hold on the paper in the subsequent treatment), dry it, and expose it to light under a screen, such as a piece of opaque stiff pasteboard with openings cut in it, then apply potassio-ferrous oxalate, we shall obtain a very remarkable effect: all the parts exposed to light take a reverse development, and appear as lighter spaces on a dark ground. And this goes so far that we may expose till we get a visible and quite strong image, darker than the ground, and yet in development this darker portion will come out lighter than the ground. Indeed, I have one specimen which shows almost white figures on an intensely black ground. Before development these light figures were brown, by exposure to light, on a rose-purple ground. I have seen few more curious results than this.

It then appears that in all the numerous ways in which it is possible to compare the photo-salts with the material of the latent image, they are found to be identical. The proofs based on development generally, and especially on the reversal of the latent image, seem very strong, and these receive additional support from the exact identity of reactions shown by the photo-salts, and by the material of the latent image.

ALCOHOL IN DISSOLVING ANILINE DYES.

THE greater part of the aniline pigments are at present made "soluble in water." Many kinds of blue, however, especially the phenyl-violet and blue, are almost invariably introduced into commerce as soluble in alcohol, and repeatedly the complaint has been heard that these dyes did not dye as they should. The reason why was unknown for a long time, until finally a Crefeld manufacturer succeeded in discovering the male factor. The cause was due to the alcohol used, which did not permit the aniline to do its full duty. The writer was also prompted by several scientific men to institute experiments, and found that, especially the amaranth, if not treated with the best alcohol, free from fusel oil, became very irritable. The method of the dyer when using alcohol for dissolving aniline is to employ it of 90 or 95 per cent. purity, and to heat the corresponding colour for a longer or shorter period with it; others boil it. If he uses a pure alcohol no change of colour takes place, even after continued heating (the writer prolonged it for from eight to ten hours). But when using an alcohol containing fusel oil a change of colour occurred in a proportionally short time. Many colours, especially the above-mentioned amaranth (reddish violet), were completely destroyed, and brown decomposition products were thrown down. In order to avoid these effects the alcohol to be used for dissolving the aniline pigments must invariably be tested before being used, and herewith are several methods, easily performed by every dyer.

(1) *Rubbing Test.*—This test is performed by pouring a portion of the alcohol to be examined into the hollow of the hand (which, of course, must have been previously washed and thoroughly dried), then rubbing it with the other hand, and after evaporation smelling them. If the alcohol con-

tained fusel oil this, of course, will betray its presence by the smell.

(2) To 10 cubic centimetres of the alcohol add 10 drops coloured aniline oil and 2 or 3 drops of hydrochloric acid. If fusel oil is present, even if only $\frac{1}{10}$ of 1 per cent., the alcohol will be coloured perceptibly red. Should, however, the percentage of fusel oil be still smaller, dilute a larger quantity of alcohol with about 100 cubic centimetres of water, agitate with chloroform, and let the latter evaporate. Test No. 1 is then performed with the residue. I can recommend this method of testing, which was proposed by A. Jorisson. The following can also be relied on:—(3) A percentage of fusel oil in the alcohol can be recognised by permitting a sample to evaporate from a saucer. The residue of pure alcohol has no smell, but it will have if containing fusel oil. (4) A very good method is to add 1 per cent. of chemically pure caustic potash, and heat. Pure alcohol must only colour to a very pale yellow. (5) Dr. Tillmanns proposes to dissolve one part red violet in fifty parts of the alcohol to be tested, and to heat it for some time, after having compared it with a standard sample of the same colour dissolved in a known good alcohol. After heating for one half hour the colour should not have altered—that is, have become dirty-looking or reddish. (6) Finally, the following method is very reliable:—Make three marks on a test tube; the lower two are to be located equally far apart; the upper mark, however, stands so far above the central that the distance between the two is double that between the lower and the central marks. The test tube is next filled with alcohol up to the lower mark. Upon this is poured ether, reaching up to the central mark, and distilled water is finally filled in to reach the top mark. The test tube is then closed, and thoroughly shaken, and then set vertically in a quiet place until the contents have separated into two plainly perceptible strata of fluid, which will occur in about five minutes. The lower stratum consists of water and alcohol, the upper of ether, which contains all the fusel oil formerly present in the alcohol. By inclining the test tube carefully, the ether is decanted from the mixture of water and alcohol upon a small, flat porcelain evaporating dish. This, of course, must be perfectly clean. The small porcelain dish is then set upon the flat of the hand, whereby the ether quickly evaporates. This operation can still be accelerated by a gentle to and fro motion. When the ether has evaporated, there will remain upon the dish an aqueous fluid, which is void of odour if the alcohol is perfectly free from fusel oil, but will smell strongly of the latter if the alcohol is impure.

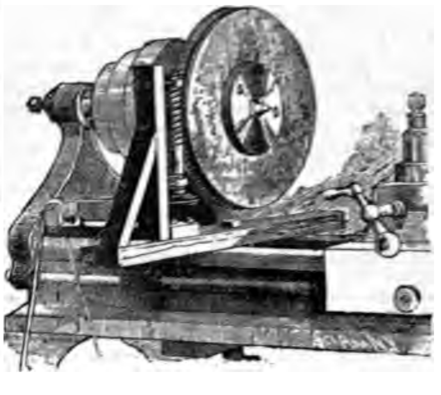
It is very probable that the manufacturer has had to listen to many complaints, due altogether to the use of impure alcohol. Let the dyer be careful, therefore, to test the alcohol he uses for dissolving aniline pigments, first, to see whether it is pure, and second, whether the alcohol is really of 90 or 95 per cent. purity, because the more dilute it is the greater the quantity necessary for dissolving.—H. KRATZER, translated in *The Dyer*.

THE PATHOLOGY OF FATIGUE.

PROF. ANGELO MOSSO, of Turin, with the aid of coadjutors in his laboratory, has for some years been working at the physiology of fatigue, and now he has turned his attention to the pathological manifestations of that physical condition. Fatigue carried beyond the moderate stage, at which it is decidedly beneficial, subjects the blood to a decomposing process through the infiltration into it of substances which act as poisons—substances which, when injected into the circulation of healthy animals, induce malaise and all the signs of excessive exhaustion. The researches which seem to justify this finding are embodied in an elaborate paper recently submitted to the Accademia dei Lincei, and shortly to be made accessible in its printed *Transactions*. Fatigue, according to Prof. Mosso, when incurred within limits regulated by the resisting power of the subject, has its pleasures and even joys—these being the expression of the organic consciousness that the active destruction of tissue is normally balanced by its reconstruction, a process yielding the sense of reinforcement and exhilaration. It was on the soldiers of the Italian army that Mosso's experiments were made, and he has convinced himself that he has arrived at practical regulations as to the amount of exertion to be put forth on the march, as to the best distribution of the halts and of sleep, and as to the lightening of the weight each soldier has to carry. The tent, for instance, which the Italian linesman has to take in his knapsack might, he thinks, be advantageously dispensed with. Again, the vexed question of the comparative strength of the much-extolled Roman legionary and his modern counterpart has not been neglected by Prof. Mosso, who has even traversed the archæological field in order to settle it. He has examined the richly-furnished museums of antique Roman armour and *impedimenta scattered* through the Italian cities, and he comes to the conclusion that in point of stature and staying power the modern soldier is in no way inferior to the ancient. The Roman armies under the ablest disciplinarians had their stragglers and their physically distressed upon the march; while the treatment available for the wounded on the battlefield and the ambulance-tent was comparatively rude and ineffective. And yet they were the conquerors of the then known world.—*Lancet*.

SIMPLE BACK GEAR FOR FOOT LATHES.

IT often happens that the owner of an ordinary foot lathe desires to accomplish work beyond the capacity of his lathe. For example, he may desire to bore an engine cylinder or turn an iron wheel, or turn or bore a large piece of wrought iron or steel. Any of these operations requires slow speed and strong driving, both of which are impossible without back gear or its equivalent; but back gear is expensive, and most foot lathes would not warrant its application. The engraving shows a simple and inexpensive device for securing a slow, strong motion, which is adapted to much heavier work than that commonly done on small lathes. Of course, there is a limit to the size of work possible with a light lathe, even though provided with back gear, the limit being determined by the strength and rigidity of the bed and other parts; but almost any lathe worth possessing should be sufficiently rigid to permit of boring the cylinder of a one-horse power engine and doing all of the other work on such an engine, with the exception, perhaps, of boring and turning the flywheel. The attachment is so simple that little more than a glance at the engraving is required to convey the full idea of its construction and application. To the back of the face plate is secured a disc of hard wood, such as maple, cherry, or mahogany, as large in diameter as can be swung in the lathe. The wood may be fastened to the face plate by means of ordinary wood screws passing through the plate into wood, or by bolts. Two small straight lag screws, or coach screws, or large wood screws, are selected; one of them to be used as a tangent screw for driving the wooden disc, the other to be fluted like a trap and used for cutting the edge of the wooden disc, so as to convert it into a worm wheel adapted to the tangent screw. In the edge of the wooden disc is turned a groove, formed on a circular curve of a little greater radius than that of the screw. The screws are centred in the lathe and trued, and a journal is formed near each end of each screw. A small grooved pulley is fitted to the shank of one of the screws, and the screw is journalled in wooden or metallic boxes, secured by small clips to an upright supported by a cross bar extending across the lathe bed and held in position by a bolt. The screw is now fluted either in the lathe or by means of a file, the flutes being preferably formed on a spiral. The screw is then heated red hot, plunged into powdered prussiate of potash, again heated to a red heat, and finally plunged into cold water. This operation casehardens the iron, so that it will cut the wood without being easily dulled. The fluted screw is now placed in its journal boxes, and a round belt is passed from the drive wheel of the lathe over two small guide pulleys, supported as shown, and around the pulley on the screw. The screw is rapidly revolved, and the frame by which it is supported is driven forward by the taps of a hammer until the threads engage the periphery of the wooden disc. When the disc has made one revolution, the marks of the screw are examined, and if they coincide where they overlap, the operation is continued by gradually tapping the frame forward until the screw has cut as deeply as possible into the wood, when the fluted screw is replaced by the entire one, and the attachment is complete. Should the threads lack much of coming together after the disc has made one revolution, the disc must be turned down a very little. The wooden worm wheel should be saturated around its periphery with a heavy oil, or what is better is to rub on tallow and melt it by means of a gas flame or lamp, so that it will be absorbed by the wood.—*Scientific American*.



USEFUL AND SCIENTIFIC NOTES.

Hydride of Nitrogen.—A brilliant discovery is announced in the current number of the *Berichte der Deut. Chem. Ges.* by Dr. Theodor Curtius, who has succeeded in preparing the long-sought-for hydride of nitrogen $(NH_2)_2$, amidogen, diamide, or hydrazine, as it is variously termed. This remarkable body, which has hitherto baffled all attempts at isolation, is now shown to be a gas, perfectly stable up to a very high temperature, of a peculiar odour, differing from that of ammonia, exceedingly soluble in water, and of basic properties. In the course of his work upon the diazo-compounds of the fatty series, Dr. Curtius treated diazo-acetic ether with hot, strong potash, and obtained the potassium salt of a new diazo-fatty acid, which on addition of mineral acids yielded yellow tabular crystals of the free diazo-acid. On digesting the yellow aqueous solution of this acid with very dilute sulphuric acid the colour disappeared without the usual evolution of nitrogen; and on cooling a magnificently crystalline substance separated out, which was shown by analysis to be no other than the sulphate of amidogen $(NH_2)_2 . H_2SO_4$. These crystals remain unchanged at 250°, but on strongly heating over a flame melted with explosive evolution of gas and deposition of sulphur. On warming this salt with potash solution the free diamide $(NH_2)_2$ was expelled as a gas which changed red litmus into blue, and rendered itself evident by its irritating odour. The gas fumed in contact with hydrochloric acid forming the hydrochloride, and on leading it into sulphuric acid reformed the sulphate. It possessed energetic reducing properties, reducing Fehling's and ammonical silver solutions in the cold, gave a dense red precipitate with neutral copper sulphate, and formed crystalline compounds with aromatic aldehydes and ketones. It is very seldom that chemistry is enriched by the discovery of a new gas, and the intrinsic value of the isolation of amidogen to both organic and inorganic chemistry renders the communication of Dr. Curtius one of exceptional and of far more than passing interest.—*Nature*.

Death by Electricity.—A number of interesting experiments have just been made with such electrical machines as are employed in industries, with the view of determining under what conditions they may become dangerous. These have been conducted by M. D'Arsonval, who has already established the fact that what is truly dangerous where these machines are used is the extra current that occurs at the moment the current is broken, and in order to annul this extra current he proposed to interpose a series of voltameters containing acidulated water along the conducting wire. The new arrangement now employed is at once more simple and efficient. It consists of a V-shaped tube made of an insulating substance, which, after being filled with mercury, is interposed in the main current. In order to close the latter it is only necessary to turn a tap which is arranged similarly to the tap on a gas-pipe. In this way the machine is unprimed without its being able to give an extra current spark. Another arrangement is also made use of, a glass tube being filled with mercury and dipped into a reservoir containing the same substance. This tube is provided with a ground stopper, this not only permitting the suppression of the extra current but also interposing any sort of resistance in the current. Although these details appear rather techical, they relate to a most important matter. The use of electrical machines is increasing, and it is of practical use to know that currents are not dangerous until a power of 500 volts is reached. It is also of interest to know that the mechanism of death varies with the nature of the electricity used. Thus, with the extra current or with alternating currents, there is no anatomical lesion, and the patient can usually be brought back to life through the practice of artificial respiration, as employed in cases of drowning.

Huamanripa.—The plant known by the name of huamanripa amongst the natives of Peru is made use of by them in cases of bronchitis, catarrh, and slight hæmorrhages. It has been recently examined by Dr. Zapater, who employed an infusion made of 25 parts of the leaves of 1,000 of water. In small doses it quickens the cardiac pulsation, and augments the secretions, especially the saliva. In larger doses it produces vomiting and sweating and diminishes the cardiac beats, the respiration, and the temperature. In cases of pleurisy and pneumonia it appears to exercise almost a specific action. It is, besides, an excellent sudorific.

SCIENTIFIC NEWS.

AN amended orbit of the Great Southern comet (1887 *a*) has been computed by Mr. Chandler, and the elements are now found to agree closely with those deduced by Mr. Finlay and published in the *Monthly Notices* of the R.A.S. for March last.

The Rev. T. E. Espin, F.R.A.S., has issued a circular announcing that his arrangement with the Liverpool Astronomical Society ceases on July 8 next; but the 17¼in. equatoreal will be employed as heretofore in the observation of red and variable stars, and stars with remarkable spectra, &c.

According to the observations of Prof. Asaph Hall during the present year, the position angle of the companion to Sirius is 24·18°, distance 6·508"; 1887·238.

The death is announced of Mr. John Gibson, assistant to the Keeper of the Natural History Department of the Museum of Science and Art, Edinburgh, and a frequent contributor to magazines and serials of articles on popular scientific subjects, some of which have appeared in a collected form. He was also the author of many of the natural history articles in the new edition of the "Encyclopædia Britannica."

The death is also announced of Prof. von Schroff, the Viennese pharmacologist.

The third annual general meeting of the Marine Biological Association was held last week in the rooms of the Linnean Society. The report for the past year stated that the attention of the council had been chiefly devoted to the superintendence and fitting of the laboratory at Plymouth, and to making arrangements for the future work of the association in connection with that laboratory. It is expected that the laboratory will be ready for partial occupation in the present summer; but the tanks and circulation of sea water cannot be completed for some months to come. The council has decided to issue to members of the association in the form of a journal the annual reports of the council and other information which it desires to place in the hands of members of the association. It is thought that such a journal will serve not only for the circulation of the official publications of the council, but also as a means of inquiry and exchange of information among those who are interested in marine biology in its relation to the sea fisheries of the United Kingdom. A first-rate biological library is one of the most important appliances which the Marine Biological Association must possess in its Plymouth laboratory, and the council trust that members and friends of the association will assist in the formation of such a library by gifts of books. The association is willing and anxious to co-operate with individuals or associations in any part of the British Islands who are engaged in the study of the natural history of marine fishes or in researches in marine biology.

At the meeting of the Royal Society of Edinburgh last week Prof. Geikie read a paper by Prof. Sacco, University of Turin, on "The Origin of Great Alpine Lakes." In this paper the author brought forward a new explanation of the origin of the lake basins of the Alps. He is of opinion that these great troughs are the direct result of that great movement of upheaval which brought the Pliocene period of the Alpine regions to a close. They owe their origin, he thinks, partly to fractures and foldings of the strata, and partly to local subsidences and elevations. Prof. Geikie said he could not agree with the author that the post-Pliocene elevation of the Alps and Apennines had produced any notable amount of fracturing and folding. The Pliocene strata occur in approximately horizontal and undisturbed positions along the foot-slopes of the Alps. And there was good evidence to show that the great Alpine valleys were much older than the Pliocene period, during which period they existed as fiords. If the lacustrine troughs, with their irregular depths, were due to earth movements—to fractures, foldings, or local elevations and depressions — there should be abundant evidence of such movements in the geological structure of the ground; but Dr. Sacco had not adduced any evidence of the kind required in support of his views.

At the same meeting Mr. A. W. Hare, M.B., read a paper on "Organic Matter in Drinking Water," chiefly with reference to the biological side of the question. He stated that even in distilled water there are certain forms of organism which survive for a considerable time; but such water is always perfectly safe for drinking purposes. Water taken from deep wells is very free from microbes, but when left for a time in the open air it becomes more crowded with them than river water, according to Mr. Hare. In regard to river water, he pointed out that it is a popular fallacy that water from a rushing torrent is safer for drinking purposes than water from a sluggish stream. He stated that the reverse is the fact, and in the case of water contaminated by sewage he said that after ten or twelve days there is a smaller number of organisms present than in river water, the reason assigned being that during the first two or three days they had multiplied to such an extent as to exhaust the pabulum in the water.

The committee appointed by the Local Government Board to inquire into the efficacy of Pasteur's treatment for the prevention of hydrophobia have delivered their report. It is a unanimous and complete expression of confidence in the system, and it goes so far as to assert that rabies and hydrophobia might, in the opinion of the committee, be stamped out altogether, both in animals and man, if suitable measures could be stringently enforced. The committee consisted of Sir James Paget, Sir Joseph Lister, Sir H. Roscoe, Prof. Burdon Sanderson, Dr. Quain, Dr. Lauder Brunton, Dr. Fleming, with Prof. Victor Horsley as secretary. Three members of the committee and the secretary visited Paris to witness Pasteur's proceedings, and since their return Prof. Horsley has carried out a series of control experiments, which, with the evidence previously gathered, have convinced the committee of the value and efficacy of Pasteur's system.

Some doubt has been thrown on the evidence adduced by Dr. Klein in reference to the communicability of scarlet fever between human beings and cows (see p. 307) by the researches of Drs. Jamieson and Edington, of Edinburgh; but apparently it is only a difference of opinion as to the specific organism which is supposed to cause scarlet fever. Whether it is a streptococcus or a bacillus, there is no longer any doubt that the contagium can be transmitted from the bovine to the human organism by means of milk. Bacteriology has in recent years made great strides, and it is not improbable that before long the organism which is the cause of scarlet fever will be specified beyond dispute. A committee has been appointed by the Edinburgh Medico-Chirurgical Society to inquire into the results of Dr. Edington's researches, and it is probable that some report will be made on July 20.

The Photographic Convention of the United Kingdom is to be held this year at Glasgow from July 4 to 9. The detailed programmes of the excursions and local arrangements are now ready, and will be forwarded on application to the hon. sec., J. J. Briginshaw, 128, Southwark-street, London, S.E.

The cameras without lenses are becoming quite common in France, especially amongst amateurs and tourists. They have undoubted advantages, because there is no outlay for a lens, and no fear of breaking it or the ground-glass, which is discarded as well. Independently of those considerations, photographs of objects can be readily obtained which few lenses would take in, and they can, moreover, be taken more accurately.

Lieut.-Colonel Reynolds and Prof. Ramsay have communicated to the Chemical Society the result of a series of twenty-nine experiments, conducted with great care, with the object of determining the exact equivalent of zinc. The zinc used was prepared by electrolysis from sulphate of zinc, the final sample being so nearly pure that dilute acid would scarcely act on it. The equivalent arrived at was 65·4787 + 0·016135.

The diatom earth or diatomite of Loch Quire, in Skye, is being worked. The loch has been drained, and the bed is now fairly dry. The diatomite, which lies about 18in. below the surface and extends downwards to a depth of 25ft., is cut with an ordinary peat spade, in blocks about 10in. long by 3in. broad. It is taken on hand-barrows to the drying-sheds, where it is left till dry. It is then put into the stores. When cut it has a greenish appearance, and is pretty heavy. After being dried, the colour changes to white, and the weight is much decreased. Until such time as a permanent road from the seaside to the works is constructed the diatomite will be conveyed on horseback to the shipping place, at a cost of about 15s. per ton. There is apparently an almost inexhaustible supply of pure diatomite, and it is reported that an attempt will be made at Loch Callumkill to work the deposit there, which is said to be more accessible, but it is not quite so pure as that at Loch Quire.

At the meeting of the San Francisco Microscopical Society on May 11, the secretary announced the receipt, from Dr. Thomas Taylor, Microscopist of the Department of Agriculture, Washington, D.C., of the last annual report of that department, accompanied by a number of coloured plates, photo-engravings and photo-micrographs, illustrating the crystallography of butter and of other animal fats. A great deal of work is now being done by Dr. Taylor, in regard to this important subject, and his investigations, thus far, show that the fats of different animals differ in their crystallisation. For example, if small quantities of butter, of lard, and of beef-fat are separately boiled and slowly cooled for say twenty-four hours, the resulting crystals will show very marked differences under the microscope. The normal butter-crystal is large and globular, polarises brilliantly, and shows a well-marked St. Andrew's cross. That of lard shows a stellar form, while that of beef-fat has a foliated appearance. In course of time, as the butter loses its freshness, the globular crystals degenerate and gradually merge into peculiar rosette-like forms. These different stages of the crystallisation could be plainly seen in the photographs sent. Specimens of butter-crystals had been prepared by the secretary, and were shown as resplendent objects under polarised light. At the meeting on May 25 the secretary reported that the diatomaceous earth recently received from St. Helena had proved to be very rich, but was refractory and difficult to clean. Various suggestions were made as to the best methods of treating such deposits. On May 28 the "annual reception" of the society was held, when, we learn, "never before has such a display of microscopes been seen on the Pacific coast," for, arranged along seven rows of tables, there were no fewer than 64 instruments, embracing examples of the skill of all the leading opticians in the world.

In the *Proceedings* of the Geologists' Association, Dr. H. Hicks has a paper on the explorations now being carried on in the caves of Ffynnon Beuno and Cae Gwyn, N. Wales. He is "perfectly convinced" that they must have been occupied by man and animals before the climax of the Ice Age; that the stalagmite was formed during that age, was broken up by marine action during submergence, and that the caverns were afterwards covered over by materials deposited from floating ice.

We do not know exactly what is meant by the "Jubilee Medal"—there are so many of them—but the following is published by a contemporary, and it may be of interest to a few of our readers:—"The model from which the Jubilee Medal was made was electrotyped in iron, the bath used being one containing sulphate of iron and sulphate of magnesium in equivalent proportions, the solution having a specific gravity of 1·155, and when the bath is acid it must be rendered almost neutral by magnesium carbonate. Two Smee cells coupled for intensity were used."

A SERIES of experiments recently made by a French metallurgist are stated to have proved that steel loses weight by rust about twice as rapidly as cast iron when exposed to moist air. Acidulated water was found to dissolve cast iron much more rapidly than steel. This would indicate that steel bridges are less affected by the acids contained in the smoke of locomotives than iron ones.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

THE VISITATION OF THE ROYAL OBSERVATORY.—THE ALMUCANTAR.—A CATALOGUE OF NEW DOUBLE STARS.—STARS VISIBLE IN DAYLIGHT.—THE HELIOSTAT.—VELOCITY OF A BODY FALLING FROM SPACE.—TELESCOPE.—THE GREAT LICK TELESCOPE.—COMETS AND METEORS.

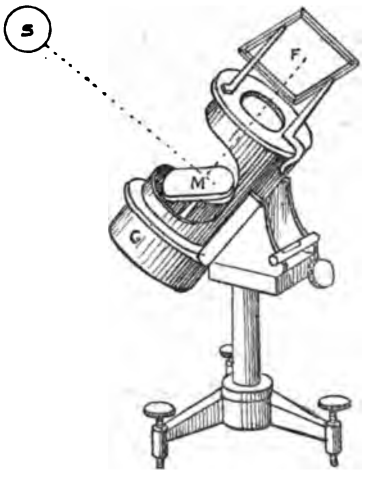
[27515.]—THE interesting report of the Astronomer Royal, from which you make such copious extracts on pp. 359 and 360, undeniably testifies to one thing: and that is that, let the demands for extension of the apparatus and methods of astronomical observation grow as they may, our national observatory will always be found ready and willing to meet them. The bearing of this on the mendicancy of the gentry who, with one word for science and two for themselves, are clamorous for the establishment of new institutions (with well-paid billets attached for themselves) needs no insisting on here. Under such supervision as that of Mr. Christie, the nation possesses the certainty that any money voted for the advancement of astronomical science will, at any rate, furnish us with an adequate return;—an assurance which must be lamentably wanting in, at least, one well-advertised scheme for the establishment of an observatory from the Consolidated Fund.

Vol. XVII. of the "Annals of the Astronomical Observatory of Harvard College" contains an exhaustive description of a perfectly novel form of instrument, which may yet play an important part in observational astronomy. It is called the Almucantar, and its essential principle is that of the floatation of its working parts in a cistern of mercury, with the immediately obvious result of the rigid preservation of the objective at any altitude to which it may be set; since as long as ever the angle between the telescope and the float is constant, the conditions of equilibrium remain unchanged while the instrument is rotated through 360° of azimuth. Put in another way, this simply means that the telescope being clamped at any given altitude, the line of sight will mark out a rigidly horizontal circle in the heavens. For reasons specified in his most instructive volume Mr. Chandler, the inventor of the instrument, employs the horizontal circle passing through the pole for general purposes, and this he christens the co-latitude circle: its zenith distance being, quite obviously, equal to the co-latitude of the observer's station. Into the details of the construction and employment of this most ingenious contrivance it is simply impossible to enter here. I must refer all interested in practical and spherical astronomy to the volume itself for them. There will be found the fullest account of the application of the Almucantar to the determination of time, latitude, and longitude, with a complete development of its mathematical theory, and a mass of tables of observations illustrating its practical use. I doubt exceedingly if, size for size, we have anything approaching to Mr. Chandler's instrument for minute accuracy in the determination of latitude. It forms a real addition to our observational appliances.

From America, too, comes a "Catalogue of 209 Double Stars," by Prof. G. W. Hough, the Director of the Dearborn Observatory at Chicago. It is quite needless that I should say anything here of the work of so well known and accurate an observer as Professor Hough, further than to remark that—*malgré* the somewhat heated discussion which has taken place on the subject of Small v. Large Telescopes—he, for one, has succeeded in showing that one big telescope at least has done work of perennial value.

Either "Dubitans" or myself must be more than commonly obtuse, if I may judge from letter 27431 (p. 366), for I fondly imagined that I spoke of γ Draconis (as in letter 27347) as the only tolerably bright star visible close to the Zenith of *Sheerness*, whereas I appear to have conveyed the *impression to your correspondent* that Sheerness was "this country," an assumption which, however flattering to the inhabitants of that Kentish town, will scarcely hold water as a bald geographical fact. Now, α Cassiopeiæ passes close to the zenith of Carlisle, and very near to that of Berwick; θ Ursæ Majoris occupies a similar position as regards Bury, Cambridge, Northampton, and Warwick; γ Ursæ Majoris is as nearly as possible right over head at North Allerton, Sedbergh, and Windermere; while β Draconis is in the zenith of Coventry, Kidderminster, and Ludlow, and close to that of Thetford—and so on. The places in the South of England over which γ Draconis is vertical at its transits, need no enumeration here. Moreover, I have yet to learn that the opening of every mine, shaft, well, or chimney in the kingdom subtends an angle of only 1° as viewed from the bottom. While, thirdly, I would humbly point out that 1° is 1° of a great circle, and not of the small circle described by (say) γ Draconis in the sky (which is only 0·66252 of that of the celestial Equator). Had "Dubitans" the merest smattering of practical astronomy, he would know that in a telescope in which an Equatorial star took four minutes to cross the field, one with 51° 30′ of North Declination would occupy six minutes and nearly twenty-six seconds in passing over it. Scientific doubt is a wholesome and commendable mental attitude; that of "Dubitans" rather suggests the story of the sailor's mother who reproved him for lying when he described flying fish, but who listened with the most reverent and implicit trust to his yarn of the anchor fouling one of the wheels of Pharaoh's chariot in the Red Sea and bringing it to the surface. [Since this was written I have seen letter 27473 (p. 389). I think that so admittedly able and practised an observer as Mr. Lewis Swift would render a service to science if he would—at the proper season—make arrangements for testing whether Capella and α Cygni can be seen in daylight from the Warner Observatory through a sufficiently long tube blackened internally. But for the fact that Venus never passes anywhere near the zenith in this country, and that the shafts of our mines are vertical and not inclined, Mr. Swift's suggestion that it is Venus that has been seen would be by far the most probable one; but as neither of these conditions obtains in any part of the United Kingdom, it unfortunately is inadmissible. I fancy that Aristotle was the first to assert that stars are visible from the bottom of a well. I must add that I attach great importance to the *circumscription* of the field of view in looking up a narrow shaft. In bright twilight, and even during a total eclipse, rays are falling on to the retina from a very large area of the heavens indeed. Moreover, at the time of totality during a solar eclipse there is very much more diffused light than people imagine. I know that I myself have distinctly seen the seconds hand and seconds on a watch under these circumstances, without any artificial light at all; and that, moreover, with the most perfect ease and without straining my eyes.]

If "Solar Radiance" (letter 27462, p. 371) would tilt the end E of the mirror in his illustration downwards until it reflected the solar rays in the direction C A, and set his clock going, such reflected ray would preserve an invariable position from sunrise to sunset, and he would have a heliostat in every legitimate sense. In practice, however, it is usually inconvenient to have the beam of light we are using inclined at an angle of 50° or 60° with the horizon, and so it becomes necessary to have a fixed mirror, by a second reflection from which we obtain our rays horizontal. The manner in which this is effected will be best understood, I think, in the form of heliostat devised by Reusch, of which this is a sketch. Here we see a stand levelled by three foot-screws, in which a species of hollow Polar axis is made parallel to (and hence practically coincident with) the axis of the earth. The mirror M is carried round by clockwork in C, and moves, of course, with the sun S. F is the fixed mirror, placed at such an angle as to reflect the ray S M F in any desired direction, usually horizontally through a hole in the shutter of a darkened room. I trust that this will make the whole matter clear to my querist.



If Mr. Moore will turn back to Vol. XXXIII., he will find on its eleventh page (in letter 18446) as simple and intelligible an explanation as it is in my power to give of the reason why a body falling from an infinite space can only acquire a finite velocity. A body falls at the sun's surface very approximately 445·5ft. per second; and a little study of the letter to which I have referred my querist ought to clear up his difficulty, and make it plain why anything descending from space upon the sun by the mere operation of gravity alone, can never acquire a velocity exceeding about 380¼ miles. I give the distance in miles because I am writing in English, in the ENGLISH MECHANIC, and presumably to an Englishman. Were I in Paris, I should employ kilomètres.

Mr. James (query 62626, p. 377) will find that a 2¾in. achromatic telescope with a pancratic eyepiece giving powers of from 35 to 65 for terrestrial work, and a Huyghenian one of 100 for his lunar work, will answer his purpose capitally, especially as, if he gets interested in celestial observation, he can at any hour add a low-power Huyghenian eyepiece for comets and nebulæ and a higher one for stellar work.

I have from time to time communicated such news of the Great Lick Telescope reaching me from America as I thought would interest my brother readers of the ENGLISH MECHANIC. The latest intelligence I have received of the monster Californian equatoreal is scarcely of a scientific character: in fact, the Lick Observatory's latest difficulty is in connection with those "opes" which Ovid calls "irritamenta malorum." In devoting 700,000dols. of his fortune to the establishment of this observatory, there can be no doubt that Mr. Lick was fully persuaded that that amount (something approaching £146,000) would be ample, not only to erect the necessary buildings and furnish them with such an instrument as the world has never yet seen, but also to endow it amply for ever. It seems, however, that 525,000dols. have already been expended, and that the great telescope is not yet in its place, nor are all the buildings completed. Now the serious question arises: How much will be left when the Lick trustees are prepared to hand over the institution to the University? Will the interest on it suffice to pay one astronomer's annual salary, to say nothing of assistants, repairs, care of the buildings, quarters for those invited (under the original scheme) to make observations, publications, &c.? This looks as though, after all Mr. Lick's more than princely munificence, the University would have largely to support the Observatory. And suppose—it is a terrible but not absolutely impossible supposition—that, after all, the Great Telescope should prove no more successful than some other optical monsters (albeit even of inferior size) have done before it . . . . What then?

To anyone interested in cometary and meteoric astronomy who can obtain access to the American *Popular Science Monthly* for May, I strongly recommend the perusal of an article by Mr. R. A. Proctor on the "Origin of Comets and Meteors"; since, in the existing state of our knowledge, its author's reasoning seems to me irrefragable.

A Fellow of the Royal Astronomical Society.

α SCORPII.

[27516.]—IN Webb's "Celestial Objects" the 7 mag. companion of α Scorpii (*Antares*) is stated to have been measured as distant 3″ in 1864, while Messrs. Clark and Sadler, in their "Star Guide," give the distance as 3″. Last night (June 22nd) this close *comes* was not to be seen; but a companion of about 8th mag. was staringly visible with 4in. aperture at a distance of 12″ to 15″, the position angle being the same as that given for the closer companion—namely, about 270°. Like most London observers, I have had comparatively few opportunities of examining Antares on account of its low altitude; but I have never seen the above named companion before. Can any of my fellow readers of the "E. M." give me any information respecting it? **M.**

STRUVE'S DIVISION—REQUEST.

[27517.]—I READ Dr. Terby's letter of 20th May, in which he said he then saw Struve's division in C; but I especially referred to his letter, "E.M." March 25th, and *Observatory*, April, 1887, and *Astronomische Nachrichten*, No. 2781, in which he says he saw Struve's division in February *between* B and C, and he draws a very wide division between these rings. I did not intend to throw

›n Dr. Terby's observations in my letter of ıne, my object being only to point out that . division exists there is a radical change. :lot gives *no division* in C or between B and s exhaustive treatise and drawings of Saturn *lletin Astronomique*, November, 1884, and y, 1885. Prof. Newcomb, in his "Astro- 1883 issue, writes: "With the Great ıgton equatoreal 26in., *no one could for a* ' suppose there was a separation between rings C." It should be remembered Bond, with [erz, could never see Struve's division; yet ɜllence was such that Webb wrote it divided ·3" apart, and 5th star in Trapezium was in it *after sunrise.* Struve's division must ›re now be very plain to be seen so easily in ·ilight of a summer's evening with an 8in. Terby, and at a very low altitude. Perhaps rby will be so kind as to give us a list at uture time of those observers, *with aperture · telescopes*, who have seen Struve's division ar; so this interesting feature may be closely l by practised observers armed with tele- of equal power in England.

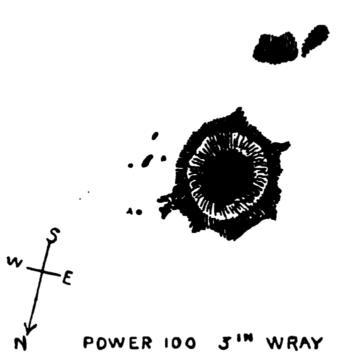
ˈtuyvaert, who saw a division *in C* in Feb- used, I understand, the 15·2in. refractor of ussels Observatory.

› 25th. **H. Watson.**

LARGE SUNSPOT.

18.]—I SEND a sketch, made on the 9th ;, of the sunspot, visible through a dark o the unaided eye, which has recently passed : sun's disc. A remarkable feature in con- ı with this spot was the brilliancy of the : the penumbra surrounding the nucleus as red with the outer portion. This peculiarity, gh not of uncommon occurrence, is, I be- seldom so well marked as in the recent ɔe.

group of spots south, referred to by "Ex- " in letter 27465, p. 372, are shown in the



, as well as some small spots and two curious cences preceding.

lay (19th instant) I observe another group, ›sed of a number of small spots, near the › of the sun's disc, and it would certainly that, after a prolonged state of quiescence, a l of solar activity has set in.

Geo. B. Hallowes.

·LIME AS A FERTILISER AND INSECTICIDE.

519.]—I WISH some of our chemical friends l tell us definitely something about the :stry of gas-lime, and point out in what way ıy be used to advantage on land which is ded to carry crops. I ask for this information e more readily because I find that some of est known horticulturists, who should under- the subject from experience, seem to be quite ·iance. I find it stated that gas-lime contains ›nia; but as it must not be applied to growing I do not see how that ammonia can be utilised, ı the first place, there cannot be much of it; in the second, what little there is must be rated and lost by the time the gas-lime is .ently ameliorated to be placed on the land. then, again, about its powers as an insecticide, ı are said to be due to some compound of ur and cyanogen. Will not that also be ·ially changed by the time the lime is in a fit tion to put on the land? According ›me statements, gas-lime is a "hydro- uret" of lime with a little ammonia, and exposure to the atmosphere it "becomes e sulphate of lime or gypsum." It can never ıe gypsum, though it may become chemically ical—which, however, I doubt, and therefore nformation in the columns where I am most to find it given accurately. I remember years ago an accumulation of gas-lime under .ilway arches adjoining the gas-works on Bow ıon was sold or given to some one, who had it ›d with sulphuric acid and spread out to dry, I was told it would sell for 30s. a ton; but what need was there for adding the sulphuric acid, if the lime would by exposure to the atmosphere be converted into the sulphate? I have been led to inquire about this matter by reading an article in the *Journal of Horticulture* from the pen of Mr. G. Abbey, who is in the front rank of professional gardeners, and who says that gas-lime "in its ameliorated state is a mixture of lime and gypsum, and as such is more advantageously used on light soil than simple lime, the latter being most suitable for heavy land, though success attends its application to heavy soils; indeed, there is no soil to which this form of lime may not be applied with good results. In action it is much more efficacious than simple lime, on account of the direct nourishment afforded by the gypsum (sulphate of lime), and indirect, by the lime decomposing substances which afford a supply of potash and soda, besides decomposing animal and vegetable matter, thereby supplying ammonia, carbonic acid, &c., independently of the lime itself, an element of the food of plants. Gas-lime is also useful in preventing the escape of ammonia from the soil through its sulphuric acid, a property it (in the sulphate state) possesses in proportion to the moisture, but most unaccountably is not so beneficial (as before stated) applied to heavy as to light or sandy soils, and plants containing but a small proportion of sulphate of lime derive greater benefit from it than those containing much more. This is a well-known property of many substances, and which cannot be satisfactorily accounted for, and shows, if it were necessary, the importance of comparative experiments.

"The value of gas-lime, after it becomes by long exposure to the action of the air and water converted into a mere mixture of gypsum and lime, is not unimportant, being in fact equivalent to a dressing of gypsum and of lime, therefore of enduring benefit. In that state we lose all or most of its ammonia, unless we make it when fresh into a compost by mixing with soil, and even then there is waste, unless there are substances in the compost on which ammonia can form, otherwise it will combine with carbonic acid and escape. In using gas-lime for mixing with compost resulting of road sidings, pond-cleanings, ditch-scourings, or other *débris*, the substances essential as bases for the formation of nitrates will be present, as also in the accumulated *débris* or rubbish heaps of gardens; but to make sure, some wood ashes, old mortar rubbish, which are obtainable about most places, should be mixed with the compost, or the rubbish sprinkled as the mixing proceeds with a little salt, kainit, or superphosphate, so as to form bases on which the ammonia can form as nitrates. A ton of gas-lime to six of compost is ample, which turned over twice, so as to thoroughly incorporate the materials, will, at the end of six months, be an admirable dressing for grass, applying twenty-four to thirty-six loads per acre, equivalent to from three to five tons of gas-lime, which is a suitable quantity. The best time to apply it to lawns or grass land is in February, whilst on arable land it may be used at any time prior to putting in the crops. In that way we get the full value of the gas-lime as a fertiliser without any of its injurious effects.

"*Anti-fungoid and Insecticidal Properties.*—For this purpose the gas-lime should be fresh. If applied to the surface and left there oxidation will take place rapidly, and the ammonia escapes. It should, therefore, be lightly harrowed or pointed in so as to retain the ammonia, or a portion of it, as well as that resulting of the conversion of the cyanogen, which takes place, provided there are substances in the soil containing bases for the formation of nitrates. As some time is required for oxidation to alter the poisonous properties of the cyanogen, the gas-lime must be applied on bare ground or fallow in anticipation of the crop. On ground intended for spring sowing or planting it should be applied in autumn—on stubbles after ploughing, or garden plots after digging, lightly harrowing or pointing in, whilst for autumn sown or planted crops it should be applied two or three months previously, and for turnips, &c., it may be applied up to February or early March, and this will allow time for its oxidation, and conversion of the injurious matter into assimilable food for the crops, whilst fungoid and insect pests in the soil have been destroyed, and there are the remains of the gas-lime, equal in value to a dressing of gypsum and lime, for the benefit of current and succeeding crops.

"In the whole of my experience with varied substances I have not found any equal to gas-lime in effectiveness against fungoid and insect pests harbouring in the soil. Against grubs, club, maggot at the roots of Brassicas, finger-and-toe in turnips, slugs, and predatory vermin of all kinds, there is no agent so effective for destruction as gas-lime. Year after year whole fields of turnips succumb to finger-and-toe, which could have been prevented by a dressing of gas-lime, clover is galled at the roots, and crops of all kinds are prejudiced by fungoid and insect pests in the soil, and many which exist on the plants find their refuge in the soil, which are mitigated in the severity of their attacks on the crops by a dressing of gas-lime. Never were turnips infested by finger-and-toe, Brassicas with club or grub, onions with maggot, clover with galls, or cereals withered by grubs, to say nothing of cankers and blights without end allowed to increase on land to which a dressing of gas-lime has been applied.

"As an anti-fungoid and insecticidal agent gas-lime is invaluable. In cleansing the land of pests preying upon its crops it is unequalled (so far as I know) in efficacy and cheapness. For land having a slight tendency to produce in its crops any of those maladies attributed to fungoid or insect pests, a light dressing of gas-lime will suffice, or 3 tons per acre, which is equivalent to 42lb. per rod (30¼ square yards). That is a minimum quantity to be of value, even on clay soils, which require a less quantity than light or sandy soils. Clays contain more abundant bases for the formation of nitrates, are more retentive and less affected by atmospheric influences than sandy soils, so that a less quantity suffices. In case of light soils the quantity should be proportionately increased; indeed, the dressings should be in proportion to the texture of the soil. If for a heavy soil, 3 tons are employed per acre, it may be increased to 3½ tons at the dividing line of a clay from sandy loam, and at the extreme the other way, or a sandy loam 4 tons, which gives a difference of a ton between a very heavy and a very light soil, or of 14lb. per rod. At those rates it may be given every third or fourth year, according to the rotation, with very beneficial results as regards the bulk of the produce and the freedom of the crops from disease.

"When, on the other hand, the land is foul, recourse must be had to more drastic measures—i.e., increase the quantity of the gas-lime. Five tons for heavy, and six for light soil per acre, may be taken as a sufficient quantity to rid land of pests injurious to its crops. That quantity will effectually save the turnip crop from finger-and-toe. I saw whole fields of turnips in 1886 a putrid mass, whilst gas-lime could be had for next to nothing at the works within two miles. The cultivators attributed the disaster to the peculiar season, but smiled and shrugged their shoulders in contempt at the mention of gas-lime. In some cases whole fields succumbed, and many had their crops much depreciated in value by a very severe attack of Brassica aphides. Had those fields been given a dressing of gas-lime on the stubble fallow in February or early March at the rate of five or six tons to the acre, and lightly harrowed in, I am certain the 'peculiar' weather would have had no effect in inducing finger-and-toe, nor would the aphides have appeared—to destroy the crop in the first case, or reduce its bulk by half in the other. Seventy pounds per rod effectually cleanses the soil of gardens; but owing to the follow-on system of cropping that prevails, it is difficult to apply it so as to prove efficacious without prejudice to the succeeding crops, and not only that, but there are fruit trees, &c., near the vegetable quarters, to which the gas-lime incautiously used would prove injurious, if not fatal. In mixing gas-lime with compost, it must be kept away from the roots of trees, or it will kill them, and it will kill them, and it is highly poisonous to box edgings, &c. In its fresh state it must be used upon bare ground or fallow, and two or three months in anticipation of the crop. This is repeated to prevent disaster by its injudicious use. Perhaps the best time to apply gas-lime to gardens is as soon as the soil is cleared of its crops, disposing it evenly on the surface, and pointing in lightly, or scratching the surface over well with a fork. After it has lain for a few weeks, six to eight, it may be dug in and the ground cropped. Gas-lime, however, is best applied and kept near the surface; therefore, it should be applied when practicable, as advised, on bare ground that will not be required cropped for two or three months. The only other agent comparable to gas-lime is fire or charring. It is the remedy of the scientists albeit one long pursued by horticulturists."

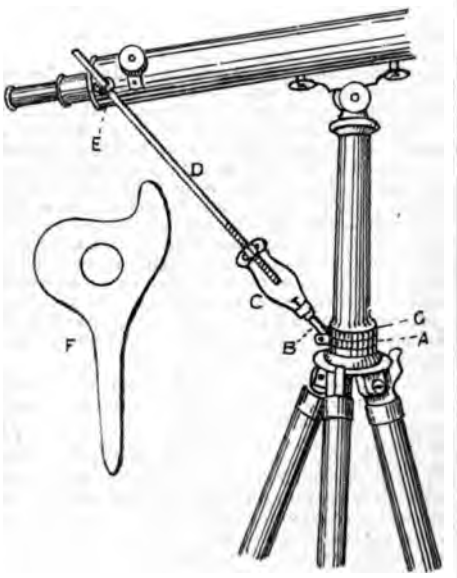
But I need not extract Mr. Abbey's subsequent remarks, which have nothing to do with gas-lime.

Hortus.

A CHEAP STEADYING ROD AND GARDEN STAND FOR SMALL TELESCOPES.

[27520.]—MANY amateurs with small telescopes, mounted on the ordinary pillar-and-claw stand, are prevented from enjoying the advantage of a steadying rod with fine adjustment in altitude by the cost of the rackwork fittings. My telescope is an excellent 2¼in., purchased about nine years ago from Messrs. Lancaster, of Birmingham, for £5. Some time since, feeling the want of a steadying rod, I designed the following arrangement, in which the fine adjustment is obtained by a coupling screw as a substitute for the rack and pinion, and though not working quite as smoothly as the latter is practically as good. The cost of the entire fittings was about 7s.

A brass collar A, with two short arms projecting from the side, encircles the lower end of the pillar, so as to turn freely on it, and is prevented moving upwards by another collar G placed above it. One end of a brass rod B, 2½in. long, is hinged between the two arms by a rivet passing transversely; the other end turns in a hole in one end of the coupling screw C, and is kept in position by a head beaten on it, or, better still, by a small nut. The rod D is 14½in. in length, and has a fine screw thread on one end which turns in a hole, fitted with a corresponding thread in the upper part of the coupling screw. A brass eye E is brazed to the side of the telescope near the eyepiece, and is fitted with a binding screw. Through this eye the upper extremity of the rod passes. In observing, the telescope is moved up or down on the rod D till the object is in the field, when the instrument is clamped by the binding screw in the eye E. To keep the object in the field it is only necessary to turn the coupling screw G as required.



To make a folding garden stand, I removed the three claws, and substituted three oak legs each 4ft. long. A blacksmith at my request forged three iron eyes, each with a shoulder of the shape as shown in the full-size diagram F. The spike is driven home in one end of each leg, around which a collar has been previously fixed to keep the wood from splitting. The same screws that the claws worked on are now passed through the iron eyes. To steady the stand, three pieces of strong paling wire, with hook and eye, pass between the legs about 2ft. below the base of the pillar. Should the shoulders of the eyes not allow the legs to open out below as much as desired, they can easily be altered by the application of a file.

Edward Murphy, L.K.Q.C.P.I.

Ballyroan, Abbeyleix, Ireland, June 22.

HOW TO DO BLACKSMITH'S WORK.

[27521.]—I AM sure many of us would be glad to hear a little more of "how to do blacksmith's work." There is a remarkable dearth of information on this subject, although belonging to one of the highest of the mechanical arts. The admirable papers on the amateur workshop closed, as usual, with a very cursory description of the blacksmith's art. Here are a few amateur hints that might be useful. Before starting a piece of work, try to go over the whole process involved mentally first, and if anything is not clear, take a piece of clay, pat it into the shape of your rod. By trying your process on the clay rod, you will see what will require upsetting, what stretching in length, what in breadth, etc. You can then go to work *without hesitation*—a great point with blacksmith's work. The secret of lighting your fire straight off is to pull out slag, put on shavings and a few dry sticks, light up, and do not put on blast till sticks are *all but burnt out*; then heap on coal, and blow away sharp. An essential point to grasp is that for all great heats *reverberation* is necessary; in fact, welding is hardly possible without a reverberated heat—that is to say, there must be a coke surface to throw back the hot blast on those parts of the iron not in direct contact with it; otherwise the heat will be lost on the unexposed side of the iron by radiation as fast as generated on the other side. If you have managed a sound and ship-shape job in iron, but still find some places difficult to dress with the hammer, take a heat, put in vice, and apply a rasp to the places whilst hot. You will find them as easy to remove as if of lead. In a curved piece of work it often makes a neat job to finish the piece straight with a file, then heat and bend over a piece of drain-pipe or other curved pattern. Never attempt to draw down a piece of iron without first taking a welding heat on the end. Dab against the side of anvil, and then draw down square. Never draw down steel rod without first filing or hammering the end to a rounded shape, otherwise there will be a hole in the end of your work, and probably cracks. File or rasp out cuts and cracks before touching with the hammer, as they spread and undermine the work. Work at white heat for a good job in iron, at red for one in steel. The most useful form of hammer (for a single hand) I find to be one having the pane at right angles to the handle, and about ½in. thick, instead of the usual narrow pane, the face of the hammer rounded like a large rivet head. Figs. 1, 2, 3, 4 show this shape and its effects. I made mine by battering an ordinary hammer into this shape. The handle should be 15 to 17in. long. A great deal may be done with brass rods in the way of cold forging, thus saving casting for small things. During this kind of work the brass requires repeated annealing—viz., heating and quenching, and must not be hammered hot. As soon as it becomes hard under the hammer, annealing is necessary.

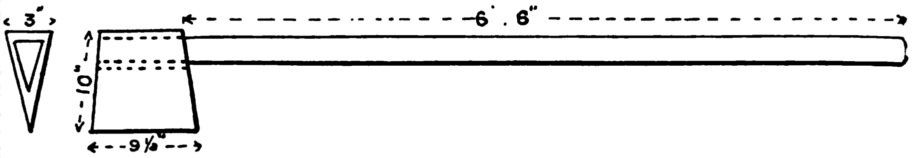


FIG 2

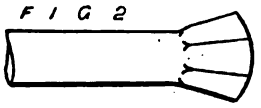


FIG 1

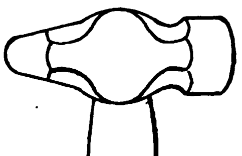


FIG 3

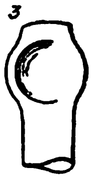
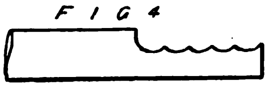


FIG 4



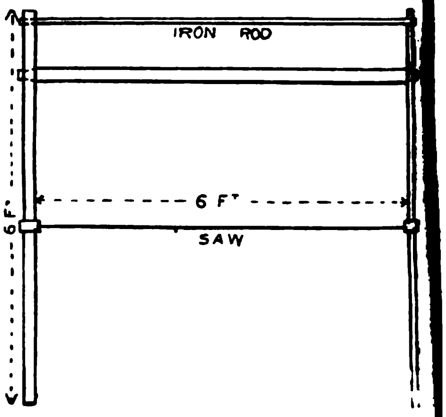
If neighbours object to the ring of your anvil, a good plan is to have a small coil of sheet lead or a bit of large lead pipe, and slip this over the beak, tying it back to the body of the anvil. I hope some of your readers will give us a few practical papers on the work of the forge—not merely about what to do, but how to do it in the best way. In the country here I rarely come across a really sound weld, yet some work absolutely requires such a condition. Cannot some rules be laid down on this head? I find most of the queries on smith's work remain unanswered, though answerable by many of your readers, and the subject must be of interest to the majority of them. It would seem that the more skill an art requires the less there is to *say* about it.

Silke.

EASTERN WORKMEN.

[27522.]—IT has been my fortune at different times to have seen, and taken part in, a good deal of "bush work." I have seen prodigious feats of rude engineering performed by little parties of timber getters in the cedar scrubs of Queensland, and the vast timber of the Dandenong ranges, but I never saw means and tools apparently so inadequate to their ends as those of the Chinese sawyers. At Deli, Sumatra, where Chinese labour and a lucky accident of soil has created for the Dutch those tobacco plantations whose astounding profits are the envy of the Far East, saw-mills do not exist, and planks must be had. To import them from the Straits Settlements, and cart them at a fearful expense through miles of mud, is not to be thought of, so a gang of Malays or Bataks are hired and proceed to fell the required timber by weeks of laborious hacking. When they have finished, arrives the Chinese "tukang pappan," or plank cutter, with seven or eight brawny Chinamen in cotton jackets and trousers and gigantic rattan hats. They proceed to where the "mèrban" or "mivanti" lies like a fallen lighthouse, and cross-cut the log into lengths of 12ft. or so, using a European saw, which, when, as is often the case, the trunk is 6ft. thick where they commence, 30ft. from the butt, has to be lengthened by strips of iron neatly riveted on, and worked by four men aside. This done, the Chinese tools come into play. If my friends, Terrible Billy and Jack the Whaler, were requested to undertake a "cedar contract" on the Daintree river with such implements, the reply would be a verbal consignment of the requester to a very tropical region indeed; but the Chinaman knows what he is about. First he mounts the section of log with the axe figured, and swinging it right and left, pendulum fashion, the long handle projecting over his shoulder, chops out a deep notch at intervals of 2ft.; then beginning again, splits off the wood between the notches until he completes one side of the square. The log is then rolled over, and the other sides squared with surprising exactness in the same way. Then a young tree is cut for a lever, and all hands, with as many additional coolies as required, raise the end of the log, packing up as it rises until it is elevated at an angle of 45° on a pile of split stuff. Lines are marked out with a wet string and charcoal for as many planks as the log will give, and then the sawyer mounts the inclined surface and, single-handed, saws from daylight to dark, under rain or sun, with scarcely a pause. The saw is figured here. It varies in length, but is about [illegible] width, with very little "set." The blade is shifted along the handles as the work proceeds until the centre is reached, when it is reversed and moved back as it again approaches the side. When all the lines have been cut as far as possible, the other end of the log is elevated and sawn in the same way till the cuts meet, which they generally do to a hair's breadth. The instrument, however, makes wild work in English hands. I once tried it, and in half an hour had nearly liquefied myself without getting more than a foot very irregularly into a 4ft. square log, while a Chinaman alongside had done over 5ft.. The Chinese have a curious liking for long and unwieldy instruments, and the handles of their hoes, bill hooks, &c., are always three or four times as long as those used by Malay or Japanese labourers. They always contrive to get rid of the "dogleg" handles of the American axes supplied them and replace them with straight sticks. I have had as much experience of the Chinese labourer as most people, and the result of it is that while you can teach him anything except morality, he never originates anything, and is all at sea in an emergency. One instance of originality I can recollect. While seated in a rickety old steam launch about to start for a 30-mile trip up a river swarming with crocodiles, I overheard the Chinese engine-driver explaining the engine to a Malay who was asking the use of the pressure gauge. "Then," said the latter, pointing to the 150 at the end of the scale (the stop pin was gone), "when the hand gets there you stop?" "No," said the Chinaman, with a grin of superior knowledge, "*it goes round again.*"

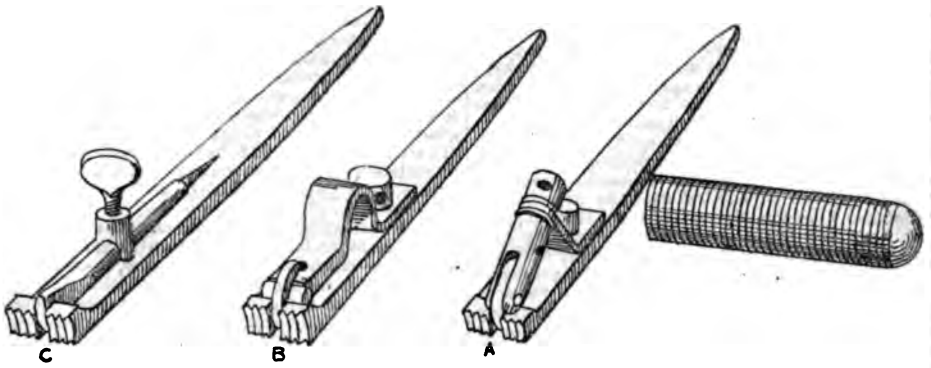
Tukang Besi.



PITCH STRIKER.

[27523.]—IN partial fulfilment of the promise made in my letter No. 27467, I inclose the engravings cut from Greenwood's circular, and also append the whole of the descriptive matter as given by him:—

"The above are three self-leading screw tools or chasers. A is constructed so that the circular V-cutter can be set to any angle. It may be taken off and fixed on other pitches of screw tools. The cutter-holder has a screw at one end, with a round



nut fitted on it, with a tommy hole in both the nut and cutter-holder, so that it can be fixed at any angle. The bracket which is fixed on top of the screw tool is steel, and made so that it will spring back a little when full pressure is put against the tool, so that it will both give the direction to the screw tool and, at the same time, allow the cutting-points of the screw tool to come forward into the material. The top of the screw tool is drilled or countersunk, to give clearance to the cutter; a space is filed out in the centre to allow the V-cutter to stand a little prominent, so that when a good pressure is put on it makes a slight indentation, and leads the chaser or screw tool according to the angle it is set at.

"The engraving, showing a part-cut screw, has been cut with the tool A; it is a true thread, and nearly half the depth of the thread at once going over. It is not intended to finish the thread with these tools, only to start them, and finish with the ordinary screw tools.

"The tool B acts on the same principle as the tool A; it is simpler, but only suitable for the tool it is fixed on. In this case the V-cutter is turned out of a piece of round steel, and left solid with the axle bearing at each side. The swan-necked spring bracket fixed on top of the screw tool is made with a recess at the end for the V-cutter to work in, and is made to fit the sides of the cutter; the ends at each side of the cutter are hollowed to fit the axle on each side of the cutter, to act as bearings for the V-cutter to revolve in, and must be fitted so that the V-cutter stands at the angle required for the pitch of screw tool it is fixed on; then it can be used in the same manner as the tool A.

"And the screw tool C is guided on the same principle as the other two, only the cutter or guide is stationary, and intended to be used for softer material than the revolving cutter, such as ivory, bone, and hard woods. The cutter is a piece of round steel flattened at the end, and the round part is fixed in a V-groove made on the top of the screw-tool; the cutter-holder is round with a cheese-head at the bottom, fitted flush with the bottom of the screw tool; the bottom side of the hole in the holder must be filed to give clearance, so that by tightening the thumb-screw the round part of the cutter will bear against the sides of the V-groove and point of the thumb-screw.

"Though the above tools are a novelty in the trade, they will be of little service to a turner well up in the art of cutting screws by hand—they are not all that I could wish them for the amateur; having introduced the subject in my book, I felt in a manner bound to get out a better tool, and the above is the best I can think of for self-leading screw tools. I shall be glad if anyone can improve on it; then no doubt a large number of the tools might be sold, both to persons in the trade and to amateurs."

The above extract speaks for itself. I regret that circumstances (viz., that my drawing tools are all packed away, and not get-at-able for a couple of days), compel me to postpone the drawing of the other chaser till next week. **Goolwa.**

WORKSHOP SCRAPS—CASTOR-OIL AS A LUBRICANT.

[27524.]—THE Asiatic wire-drawers have very long ago used this oil in preference to any other kind. Their dexterity is surprising; the wire for the Trichinopoly chains of gold and silver being like hair, and every good workman draws his own. A man made me a plate for the fine gauges from a flat rasp of English steel, which I still possess; he drew copper, zinc, and brass equally well. This oil, being one of the cheapest in India, is used to soften harsh leather shoes and ropes. The fresh leaves of the castor-oil tree, too, are gathered, bruised, and rubbed in the hand, then stuffed tightly into stiff European boots, male or female, and so remain all night; the leather then becomes quite supple! For feeding large drills I like this oil mixed with soft soap. **Eos.**

"WHAT IS A SLEEPER?"

[27525.]—APROPOS of the little facetia from the *Engineer* in your last, it is well to remember that the word "sleeper" in every sense used is literally correct. The French word "sommier," from which some pretend it is derived, means both a beam of wood and a mattress; it also means to bear a burden, from which we have "sumpter mule," or pack mule. In this latter sense may be found its use as bearing rails; in this sense also it is used in bretsumer or bressumer, a beam bearing the front of a house over a shop, &c., this word being a compound of a Saxon and French word, each signifying a beam. **J. B.**

KEY-BEDDING APPLIANCE.

[27526.]—THE sketch shows the nave of a wheel A, which is to be keyseated ¼in. by 3-16in. The bore is 1in. and the depth 1¼in. A bolt B is turned to fit the bore of wheel, a slot, S, tapering towards the smaller end of bolt, receives the tapering cotter C and the cutter D, the function of which can be seen without further explanation. The pin P retains the cotter during the time the cutter is driven down by means of a hand hammer and punch or drift, after which it is shifted to the next hole. The bolt must be filed away, as shown at G, for clearance. When a tapering key-seat is required a strip of tin must be placed between B and C. This is best done after the seat is finished parallel. The cutter must have clearance enough to prevent it setting fast, and I have no doubt your querist, "H. H." (62620), will succeed in making a good job with very little expense. Some years ago the writer used a similar appliance to cut oil gutters in cast-iron bearings, ¾in. by 3in. long, used for rollers revolving at a very high velocity. In this case the oil-hole A was first drilled, Fig. 3, and the gutter slotted from both sides successively, starting from nothing to about one-eighth of an inch in the centre. The cutter in this instance had no tail, as shown above, to guide it, and did its work admirably.

FIG. 1

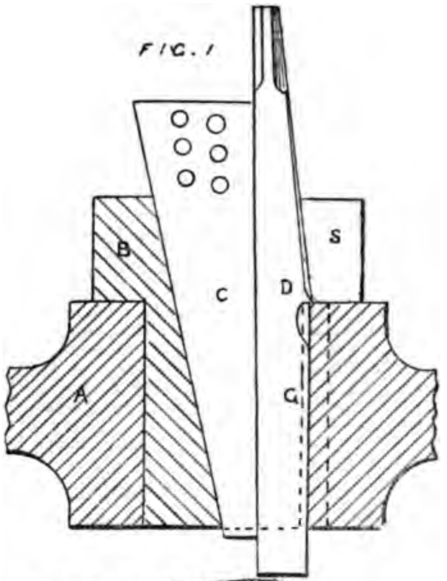


FIG. 2

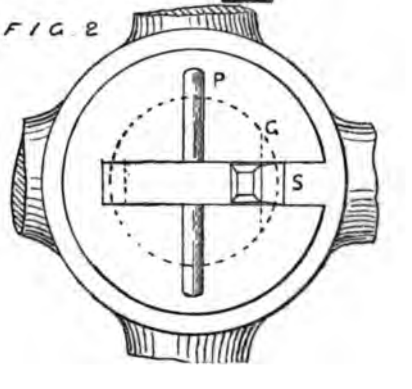
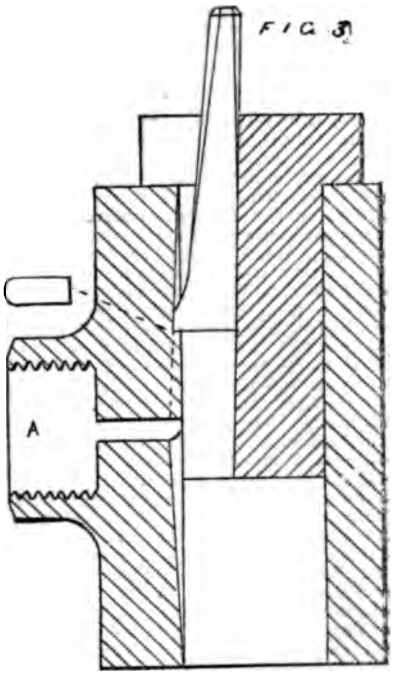


FIG. 3



Liverpool. **P. F. Otto.**]

JOINTS IN CARPENTRY.

[27527.]—THERE are two other joints in carpentry not commonly met with which, nevertheless, are practically good. I noticed them in my room in Venice, and they were evidently very old, yet quite sound joints still. Fig. 1 is the outside framing of a window; Fig. 2 the window sash. **Silke.**

FIG 1

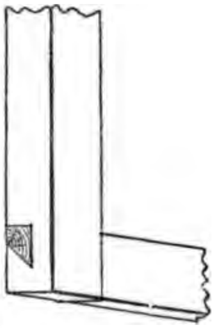
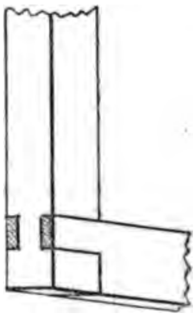


FIG 2



PROPELLING STEAMSHIPS.

[27528.]—I THINK the engineering world owes Mr. T. J. Torrop (letter 27433) hearty thanks for his great improvement in the above. He states that the screw is clumsy and inefficient. Is this so? I thought if you increased the revolutions sufficiently, and used a small pitched screw, there was next to no slip (see experiments with the launch *Electricity*). He also states that it is irreversible. What does Mr. Torrop mean by this? Does he mean that the vibrations will be heavier running astern than ahead? If so, I can quite believe it. The backward bend given to the blades in many high-speed large screws to check vibration, I have always thought liable to cause it when running backwards. But this is of small moment, as the ship does not often go full speed astern except in action. Checking vibration in forward gear is sufficient; of course, if we could suppress it altogether, so much the better. He then goes on to say that it has a long breakable, vibrating shaft. Well, really, Mr. Torrop, I don't exactly see where you have got a short unbreakable shaft. If you have, please bring it out; marine engineers await its advent. Let us examine this paddle matter a we bit. Let us suppose the ship is going ahead, and that the paddles only make 30 flaps per minute. When rocking forward to make ready for a second flap aft, it will of course have to go edge on; it will, therefore, have to be feathered or turned a ¼ circle 60 times per minute (what will the strain on the feather shaft be like?) When flapping aft it will, of course, have to rock on a hinge on the feather shaft—hinge No. 1; and it will have to rock forward on edge—hinge No. 2. We have now got a universal joint under water, also a long breakable shaft, and a stuffing box and gland, that is always under water, and can by no possibility be got at except by docking the ship, and that would require taking the flappers off, and also the breakable shaft. Now we have to pull the flapper fore and aft. Oh, that's only a detail. Very true; but let us examine the details. The flapper, vibrating on a fixed point on the ship's bottom, changes its position (vertically) with regard to another fixed point moving to and fro through the ship's bottom (the piston-rod); this, therefore, requires a more or less complicated system of links and parallel motion, and two complete sets to each flapper, and under water. These piston-rods also require to be packed. (Three glands and stuffing-boxes already—the thing seems to be growing.) There are 8 of these; therefore we have at present 8 flappers, 16 packed piston-rods, 8 universal joints, 16 parallel motions; so I think we have already got more than one long breakable, vibrating, and corrosible link, in place of the said shaft, of which even the tail end can be replaced, if necessary, without docking in many cases, whilst all this flap gear is under water.

But to continue. In a large steamer the flapper cylinders will be at least 12ft. apart (Query: What will the engine-room be like with 16 cylinders?), and these 16 cylinders will have to be connected by long lengths of steam-pipe, not to mention the valve gear. In addition to all this simple (?) mechanism, we have still the disadvantage that the after flappers are working in the backwash from the forward ones; so we have merely transferred it from the pan to the fire, and also the whole of the power expended does not reappear as speed. If the end of the flapper describes an arc, a large proportion of the propelled water merely washes the ship's bottom, and only for an infinitely short time is the water propelled in a direction parallel to the ship's keel. Also there is the reversing-gear, for you require to reverse the motion of the feather-shaft, as well as 16 valves instead of 4 as at present, and 24 under-water stuffing-boxes instead of 1 as at present; of course, you could further simplify (?) the mechanism by building 8 wells in the engine-room, and making the flappers work in guides on the ship's bottom with feather shafts in the wells. Also, How would you manage in shallow harbours where the boats lie on the ground at low water? There would have to be pits dug, and called flapper pits, and before opening dock gates you would have to "set" the boat. How would you dock it for repairs? You would have to get a crane and lift it bodily out of water (I would like to see the crane lift the *Umbria*, for instance).

Supposing the boat was driven ashore with steam up, would it not be rather like springing a steam mine under the bridge? What would it cost to replace the flappers and gear after such an accident? I have not touched half the points, Mr. Editor, but I am too long already, I am afraid. I sincerely hope Mr. Torrop is joking.

I should think this simple mechanism would make James Watt turn in his grave.—I am, &c.,

Govan. **G. T. Pardoe.**

PROPELLING STEAMSHIPS.

[27529.]—I NOTICE "A., Liverpool" (27492), says "The problem awaiting suitable solving is, How to retain the screw as the best method of propulsion possible; but to do away with the objectionable length of shafting necessary to the present arrangement." Has any of "ours" ever seen the screw amidships. I remember seeing a toy boat worked by clockwork with the screw in that position. I cannot at present tell how the concern was arranged, but I know it would swim across a large pond very quickly. If anyone knows if anything of the kind has been tried, it would be interesting to hear. **Only a Blacksmith.**

[27530.]—I HAVE read with special interest in the last issue of the ENGLISH MECHANIC an account of Mr. Marshall's patented invention of a new method of propelling ships. Nearly twenty years ago I made drawings of exactly the same method, and submitted them to the Editor of the *Engineer*. By a very elaborate argument he tried to prove that it would never succeed. Although I was not convinced, it had the effect of stopping further proceedings. I shall watch the development of the invention, and shall be surprised if it *does not fulfil expectation.*

Henry Allen.

86, Cromford-road, Wandsworth, June 25.

MARSHALL'S METHOD OF PROPELLING VESSELS.

[27531.]—THE following statement may prove of interest to others as well as to Mr. Marshall, whose propositions I note upon p. 381. This idea is a very old one in various forms. There is mention made in Rees's "Encyclopædia" of some boys astride of an old wooden pump floating in a dock at, I think, Portsmouth, propelling themselves about the dock by working the handle, observing which, induced an admiral to make experiments thereon. More than fifty years ago, I learned probably my first lesson in mechanics, watching as a youngster the construction by my father, with the help of an engine-fitter, of a 3ft. block-tin boat as well as the high-pressure steam-engine (which is in existence now); also, the old-fashioned unwieldy boiler intended to work the pistons of two brass cylinders of, say, 3in. diameter by 5in. stroke, which were placed as low down as possible at the stern. The steam could not be raised sufficiently to work same in the open air; and then a boat of about 9ft. by 2½ft. by 2ft. was built and fitted with a mahogany box divided into two cylinders of, say, 8in. diameter by 16in. stroke. These had square pistons edged with leather. The piston-rods worked in stuffing-boxes, and were actuated by a pair of vertical hand-levers by the occupant of the boat. I well remember accompanying this craft to a canal at 4 a.m. one morning, and the result of all the trials and alterations "was that, if worked slowly, the boat moved ahead slowly and steadily; but on attempting to increase the speed of these pistons they could be drawn in quicker than the water would follow after them, and the boat being lighter than said water, seemed to move as if attached to an indiarubber rope, which allowed her to make impulses forward, and then partly pulled her back." But there are other deficiencies equally as fatal to the plan as this one. Thus in the paddle wheel we have a large superficial area of floats moving under the most advantageous conditions as regards speed; but this discounted by their shallow immersion and consequent slip, as well as by the fact that they only act in the exact line of motion for the moment that the float is exactly vertical. The screw has the advantage of working in deeper and denser water, therefore it has much less slip, and were it not for its unwieldy shaft might be driven at a much increased speed, and as I have elsewhere pointed out, "it never for a moment relaxes its thrust." I have visions of a screw boat with, say, four or more blades to her propeller, and a short shaft at the level of her water line, as at this level the machinery could be brought much nearer to the stern: one half of the propeller would be in the water whilst the other was in air; the diameter to be, say, doubled, much increasing the speed of the blades, as well as taking the objectionable boss, &c., out of the water. Has Mr. Marshall considered what area of pistons a large vessel would require, and at what speed they would have to be driven to equal that of paddle or screw, also what would be the drag upon a vessel with, say, two of said cylinders facing her bows? It is evident that he has not thought upon the absurdity of talking anent the sudden stopping and reversing the motion of heavy bodies, or of making them move through water at railway speeds.

A., Liverpool.

CONTINUOUS BRAKES.

[27532.]—HOW can Mr. Kiernan, p. 395, say that, at the Burlington brake trials, Eames's vacuum gave best results?

The following resumé of these trials is published in the *Railroad Gazette*:

Continuous brakes on 33 loaded, and 17 empty, cars = 50. Brake-blocks ⅛in. from wheels. Corrected to 20 and 40 miles an hour.

—	Speed, 20 miles an hour. Distance run in feet.	Speed, 40 miles an hour. Distance run in feet.
Westinghouse...	202	927
Carpenter.........	247	1,365
Eames............	463	1,651

Surely your readers will note that Eames was a long way in the rear.

Mr. Kiernan says that the triple valve years back had been used with vacuum brakes. Will he say *when*, and who it was that tried it?

Mr. Davies, p. 395-6, seem running wild, and not keeping to the point. The vacuum brake on engine and tender does fail when the two break loose. The Westinghouse is the quickest brake. The Westinghouse brake saved the lives of a train full of people at North Wootton, and it was not the cause of the accident at Bow. The Government Inspector gave his report that the accident was due to the fault of the signalman giving "clear" and taking off signals at a time when a train stood on the line. Upon this subject I observe the following in a contemporary:—

"Some of our correspondents are evidently so over-vigilant in discovering the defects of the rival brakes as to become unfair. Block system, by which railways are worked, affords every protection to a train, let it stop where it may, and as effectively guards the train from danger as if it was standing at a station platform. If the block rules happen to be violated on such an occasion, and a collision ensues, it is grossly unfair to charge the brake with the blame."

This just gives my own views. As a railwayman, I know trains come to a stop from numbers of causes—signals from platelayers, passengers pulling cord, failure of engines, vehicles getting off line, persons being run over, and brakes going on. In all or any such instances trains must be pulled up. Does anyone think that those trains ought not to be safe to stand on any part of the road under the block system?

If a train may not come to rest and stand at any part of its journey, it would not say much for the block system!

A fortnight ago, on the North-Eastern Railway, the 2.35 from Newcastle, on entering Ferry Hill Station at a fair speed, was turned on to a line where another passenger train was standing; but being on the alert for any emergency, the driver (Harrison) soon detected the irregularity, and with promptitude applied the Westinghouse brake, and stopped his train without causing the slightest commotion. For this he has received a reward of £2 from the company.

By the way, would Mr. Davies or Mr. Kiernan explain or account for there being 84 failures of vacuum brakes in the return, and only nine of all other kinds? **Practical.**

[27533.]—SOME of your correspondents have justly remarked in a previous issue that the smallness of the exhaust openings of the Westinghouse brake prevents the blocks from leaving too quickly the wheels. The time of release varies generally between fifteen and thirty seconds. On inclines over which gravity is sufficient to keep the train running at the timed speed, it is not at all necessary to keep the brakes constantly on. This would be unwise, as these gradients are what might be termed economical inclines, and the maintenance of the speed does not require any particular consumption of fuel or block friction to check it down. Only on approaching loop or sharp curves the brakes can be applied.

I cannot reconcile the statements contained in "Lowmoor Driver's letter." Let me tell him that I have observed the same facts as those he mentions, but I could always find the cause and remedy at once. Besides, if the brake is properly attended to, such occurrences are exceedingly rare, and are only met in the case of new carriages.

If a triple-valve should not work on one carriage that is of very little importance, as it can be at any time easily remedied. In most cases the fault lies more in the brake gear than the brake apparatus proper. **E. Gobert.**

7, Ducie-street, Longsight, Manchester.

[27534.]—THE discussion on this subject is getting rather loose and rambling; the quibbling about areas and contents of pipes is merely scratching the surface of the matter. Some correspondents also, whilst informing us what brakes can and cannot do, are at the same time *at a loss to know* this and that, and are asking questions and for information, about them. What is wanted is a knowledge of the actual working of brakes at the present time.

It has been acknowledged that "the battle of the brakes" (if not already over) lies between the Vacuum Brake Co.'s Automatic Ball-Valve Brake and the Westinghouse Automatic Air-pressure. All other forms of vacuum brake are practically dead, and are being, or will shortly be, replaced by the vacuum automatic, and are therefore out of this discussion.

Mr. Gobert said recently: "I am not prepared to say anything against the latest form of the automatic vacuum brake, which I consider has reached a high state of perfection, &c."

The Board of Trade return on brakes for half-year ending 31st Dec., 1886, just published, shows the following:—

Westinghouse Brake: 533 faults and 1,879min. delay for 400 faults, the G. E. Co. and Hull and Barnsley Co. not giving the delays.

Vacuum Automatic (Ball Valve): 132 faults, 755min. delay.

Westinghouse, one fault per 38,957 miles.
Vacuum Auto. „ „ 65,564 „

Westinghouse, one minute delay per 8,464 miles.
Vacuum Auto. „ „ „ 12,176 „

In these two latter comparisons the G. E., Hull and Barnsley, L. and Y., and S. E. companies are not reckoned, as the two former do not give the delays, and the two latter the mileage.

With Westinghouse, 352 hose-pipes burst. There were thus 352 chances in the half-year of a repetition of the Manor Park collision on 1st Jan., 1886, in which 88 persons were injured.

With vacuum automatic, seven hose-pipes "leaked" only, and caused the blocks to rub the wheels.

With Westinghouse, seven trains were stopped in tunnels by the brake itself. With vacuum automatic none were so stopped.

With Westinghouse, five hose-pipes were blown off nipples, or five repetitions of the cause of the Blea Moor Tunnel collision on the 19th August, 1880, in which three persons were injured. With vacuum automatic this is impossible.

Now, Sir, with these 352 pipes burst and five blown off, besides many cases of metal pipes breaking and pumps stopping, it would be interesting to know how much brake power was cut off, and how many miles the trains ran in such a condition.

The Board of Trade most certainly ought to see that the returns give this information.

The supporters of the Westinghouse have said that this might, that should, and this and that could be done to make the Westinghouse less erratic; but the fact remains that half-year after half-year trains are stopped in all sorts of places, and against the wish of the train men, and passengers and railwaymen are rendered liable to injury by more or less of the brake power being cut off owing to the faulty principle and the complicated mechanism of the Westinghouse brake. As against this, I have to say it is well known here at Leeds that the Leeds, Nottingham, and London expresses (which are amongst the fastest trains in the world, and make a total run of about 2,000 miles a day) have been for more than a year working probably the latest form of ball-valve brake without one single minute's delay being caused either by or with the brake. This brake, Sir, can make as quick, if not quicker, and certainly much smoother, stops than the Westinghouse, and can be graduated, without acquired "skill" or "dexterity," as well in its release as in its application. It does not stop trains unnecessarily, and it has very little mechanism about it; and in proof that railway companies have found out that it is the brake alike for them, their servants, and the public, it may be noted that during the half-year before mentioned, the following stock was fitted with the brakes, or, for engines, with apparatus for working them—viz.,

Westinghouse,	56 engines,	260 coaches.
Vacuum automatic,	159 do.	1,356 do.

Leeds. **Samuel Davies.**

THE CONTINUOUS BRAKES RETURN.

[27535.]—THE return relating to railway brakes for the second six months of the year 1886 has only recently been issued, and I have drawn up therefrom the following tabulated statement, showing at a glance the amount of stock fitted and unfitted on the 31st December, 1886 :—

—	Engines Fitted with Brakes.	Engines Fitted with Apparatus for working the Brakes.	Carriages, &c., fitted with Brakes.	Carriages, &c., Fitted with Pipes or Chains only.
Total amount of stock returned as fitted with brakes which appear to comply with conditions of Board of Trade.	2,579	1,701	22,978	4,679
Total fitted with brakes which do not comply	1,323	1,643	13,386	3,371
Total fitted	7,246		44,414	
Not fitted with any continuous brake	737		8,011	
Total passenger rolling stock therefore	7,983		52,425	

From these figures it will be seen that out of a total of 7,983 engines and 52,425 carriages, &c., only 2,579 engines and 22,978 vehicles have brakes which even appear to fulfil the conditions of the Board of Trade; and from my own examination of some of the brakes, I am able to say that a large number of those classed as efficient are not so in daily practice, and would be of no value in case of accident.

During the past six months only 250 engines and 2,477 carriages have been fitted with continuous brakes; and further examination shows that a considerable portion of this stock was provided either with non-automatic brakes, which make no claim to comply with the Board of Trade requirements, or with "leak-off" vacuum brakes, which are inefficient and dangerous.

The following table shows the amount of rolling-stock fitted with two complete systems of brakes, so that both act on the same block :—

Railway. N.E.	Twelve Engines.	Westinghouse automatic. Smith's vacuum.
	Vehicles.	
West Coast Joint S.	281	Westinghouse automatic and Webb vacuum.
Caledonian	45	
L. and N.W.	176	
Midland S. J. S.	85	Westinghouse automatic—automatic vacuum.
Midland	118	
G. and S.W.	*	
East Coast Joint S.	125	Westinghouse automatic—Smith's vacuum.
N.E.	51	
N.E.	13	Westinghouse automatic—Midland vacuum.
N.E.	22	Westinghouse automatic-L. and N.W. vacuum.
L. and Y.	2	Westinghouse automatic—vacuum automatic.
Total	918	

*G. and S.W.Co. number not given.

During the half-year one collision is reported as caused by the failure of continuous brakes—namely, the serious accident at Carlisle, which resulted in consequence of the non-automatic vacuum brake on a North-Western train being frozen, ice having formed in the pipe; and upon the same date (21st December, 1886) another North-Western train ran past Nuneaton, owing to the vacuum pipe being full of ice between engine and tender.

It would be a very great advantage if the total number of failures of each brake, under each heading, were placed in a summary tabulated form, as at present the information extends over a great many pages of the return, and therefore cannot be easily compared. The London, Brighton, and South Coast Railway reports that four accidents have during the half-year been avoided by the use of the Westinghouse automatic brake.

The very unsatisfactory state of the brake question, and the incorrect way in which the returns are made, show how necessary it is that a committee of experts should be appointed by the Board of Trade to decide which brakes do, and which do not, comply with the conditions, as the continued use of the words "appear to comply" permits all kinds of incorrect statements to appear in what should be an absolutely reliable Government document.

Amongst the "instructions for working brakes," to which reference has been made in these columns, will be found, p. 110, the only order relating to the use of hand brakes down the Lickey incline, and a similar order by the Lancashire and Yorkshire Company that the tender and van hand brakes shall be used down inclines running into Victoria Station, Manchester, and Bradford.

Clement E. Stretton,
Consulting Engineer A.S.R.S.
306, City-road, London.

RAILWAY BRAKES.

[27536.]—"KAPPA," last week, mentions the fact that engines going on the Lickey incline stop at both top and bottom. That is so; they are quite right to do so. If they only had to slacken and trust to the vacuum it might fail, and let them go full tilt down 1 in 37. They are very wise not to trust it. The reason they do not is a result of a trial by the M.R. officials. They know it would not be safe, so order hand-brakes to be used.

I am rather surprised at some of your correspondents in their style. They leave on one's mind the painful impression that they are not trying to consider the lives of people, but seem to be trying to write up the Vacuum Brake Company's brake.

I am sorry to say Mr. Stretton, according to last issue of the *Railway Review*, is very ill, and so I presume will be out of the discussion for a while, so Mr. Davies may say on until he recovers; but, no doubt, he will get put right when that happens, and I sincerely hope it won't be long. Perhaps when he does write again, he will have something very pertinent to say on both North Wootton and Bow, as I find by looking back he went and reported on both. Mr. Gobert was not rough on Mr. Stretton, "Loco.," and myself, as Mr. Davies (page 395) thinks; but agrees with what these writers put forward, and as to "little knowledge," &c., the boot is on the other leg. Mr. Davies still persists in the Crook case being a failure of the Westinghouse, and quotes further from the return. We have been told the second driver *did not* put his handle *in proper position*. What more is wanted? The quotation proves nothing; he destroyed the air in the reservoirs by not keeping his handle in the neutral position; the wonder, therefore, is not that there was not air, but rather that he expected there would be! Nobody but Mr. Davies would offer to bring this forward as a brake failure; so evidently he is without "a case," and rather unfortunate in his selection of material on this question. Mr. Kiernan is evidently "humbugged," but I am not surprised at him, because, after what has been said, and the way he disposes of the facts brought before, he too has "no case." The vacuum brake does fail under similar circumstances, as was demonstrated at Lazonby a few days ago, when two Midland vacuum engines coupled together overran the platform just owing to this very cause; so Mr. Kiernan had better take the "sheerest humbug" (27499) out of that, and explain it away if he can. I don't say it was the brake's fault, mind; it was an oversight of the second driver, who is well known to Sam Davies.

The answers given to "Loco.'s" questions are highly amusing. In another paper last week we had the report of an L. and Y. engineman, who made a practical test as to No. 1 question, and reports that if the engine and tender part, the brake fails. Very well; Mr. Davies, in face of this, says it don't fail if fitted according to Vacuum Company's drawings. That's what he means, yet this is the result of an actual test by an engine fitted with the newest design of vacuum brake, and according to drawings of Vacuum Brake Co. Do they know how to fit it themselves? No doubt, like Mr. Davies's theories, it fulfils every condition *on paper*. Mr. Davies had better answer the questions. He answered one contrary to fact, and evaded the other six like his friend Mr. Kiernan, who has been so displeased at their pertinency as to call them assertions. Surely he will disprove them by actual facts instead of merely asserting, like Mr. Davies, a lot of bosh contrary to every experiment.

Mr. Davies is very unfortunate in his selection of the Bow accident. The Government Inspector, in his report, said "he had no doubt the brake was put on by the guard." The engine should have been fitted. Again, what is the block system for? Surely not because one train stops to let another run into it? It ought to be safe for a train to stop anywhere. If not, what good is the block; why go to the expense of it?

I want to ask Mr. Davies *when*, *where*, and *who* were the disinterested parties that made the experiments, and found the vacuum quicker than the Westinghouse?

At North Wootton, the Westinghouse brake went *on*, and saved the lives of passengers. The Government Inspector reports that, and it is true; so Mr. Davies may talk or say what he likes.

It would be interesting to learn what vacuum advocates think of Board of Trade returns for half-year: total, 89 failures of brakes to go on—80 due to vacuum alone, and 9 to all other systems. Only 80 actual failures of vacuum in six months! Not a great deal, was it, Sam?

I would just, by way of suggestion, ask Mr. Kiernan and others to reserve their views on Burlington until it is reported, and till we know what we are talking about. Speeds and distances were different, and until reduced to a standard no one can say which gave best results. Besides this, the trials were not practical: electric currents were used to open valves in various parts of trains. This was special electrical apparatus, and special valves, &c.—not what is or what would work in every-day running. Besides the brake pipes, are we to have two telegraph wires through a train? It is very pretty, no doubt; but it is not railway engineering. Then, note, if your non-automatic electric current fails, as it did on the Carpenter train, your automatic brake arrangement is done, or partly done; so that won't do. **Rover.**

RAILWAY COUPLINGS.

[27537.]—YOUR correspondent "W. F." (27446) has taken exception to my remarks in answer to "Silke." I am perfectly willing to own that when a coupling apparatus has become general on our railways it will be an automatic one, but at present are we prepared for such a form of apparatus? I happen to think not, and for this reason, that before an automatic apparatus can be applied the waggons will have to be prepared to receive it, and this preparation will have to be gradually brought about. "Rome was not built in a day," neither will railway companies go to the expense of changing all their stock at once, and this I think would have to be done if "Silke's" apparatus, which he acknowledges "*is not perfect*, and does not think it possible to make a perfect one" (27447) were adopted, but having by gradual progress established a uniform compression of buffer, draw-bar hook, and standard height of waggon along with non-automatic appliances for working the same—that is for working the links—then inventors may take courage and persevere in automatic couplings. I don't see that my remark about knocking the waggon end in (27405) is exactly "senseless," because with the present unequal compression of buffers, 5ft. out of "play" is required for some waggons, where others again only require some 18in. Come, "Silke," how if a long buffer and a short one meet, or how if two short ones meet, or, if you don't give them this room, how if two long buffers meet? Why, either you knock the waggon end out, or they won't couple. Now let us set about the thing practically. Mr. Hill has an automatic model in the Newcastle Exhibition, but it is not a bit of use, owing to the defect existing in it that exists in "Silke's"—viz., liability to knock waggon end out, as anyone may find if they take the trouble to press the spring buffers in on one side of the model. **Rover.**

HARRINGAY PARK ACCIDENT.

[27538.]—YOUR correspondent "Nun. Dor." (27498) seems to want a little more information on how to prevent a driver going back on the wrong road. There are various ways that this might be done. There could be runaway catch points, and there could be levers on the engine and on the road to open whistles, ring bells, and put on brakes, but I don't agree with them, excepting the first.

Years ago a man set the Scotch express back at Kibworth for three-quarters of a mile, and did not know which way he was going. Now, that shows a man has gone on wrong road. Neither of these I hope will ever occur again in our lives. You can make all sorts of inventions to *help men*, but yet men must work railways. **Rover.**

WOOD DYEING.

[27539.]—FOR a long time I have used the chips and splinters of East Indian redwood, which appears to have been imported in Holtzapffel's time (1846) for turning as "Red Sanders Wood." I put an ounce or two in a whiteware preserve jar, then pour in a half-pint or more of boiling rain-water, putting the jar into a metal saucepan half full of water, put on the fire till the splinters begin to soften, add some carbonate of soda to draw the colour; then remove the saucepan to a hot hearth or trivet, so as to simmer and no more, until the liquor be reduced to half. Wash all your white woods over once with a tepid solution of carbonate of soda. When dry, sponge your work over with the dye, quite cool; you can apply several times in the same day. I have been doing much work lately with this stuff. Tool-handles.—A heavy hexagonal bar of ash looks like old mahogany after being rubbed with linseed-oil; a new trout-rod of lancewood, after receiving two or three applications of above, I treated with a wash of dragon's blood tincture, thereby giving a tint of new mahogany; when I have mounted this rod I shall rub into the joints a mixture of one part copal varnish in two parts of linseed oil.

This useful wood supplies the place of logwood in the East. It enters largely into the composition of home-made shoe-blacking and writing-ink, as used by Europeans, some of the last so superior that the amateur maker could get two shillings for a nominal quart bottle. The trees (*Pterocarpus*) producing this dyewood grow abundantly in Southern India. **Eos.**

THE EDMUNDS LATHE MANDREL.

[27540.]—DR. EDMUNDS thinks my propositions regarding the friction in bearings require reconsideration ("E. M.," 1156). Those propositions, as stated in the "E. M." 1151, are as follows:—

In the case of a journal rotating in a bearing with a given velocity, increase of the diameter increases the force required to maintain the velocity in three ways:

1. The friction acts at a point further from the axis, and its efficiency is thus increased by leverage.
2. For a given angular movement, the length of arc, i.e., the space traversed, is also increased.
3. The surface velocity, i.e., the velocity with which the friction is overcome, is also increased.

We have, then, three factors by which the force required is increased—viz., leverage, space traversed, and surface velocity, and these three factors vary directly as the diameter. The force, therefore, varies directly as the cube of the diameter. With regard to the leverage there can, I think, be no question, nor with regard to the two other factors substantially; but the form in which the propositions are made may be altered with advantage.

The third statement should read as follows: "The area of film to be ruptured is also increased."

The resistance to be overcome is that of continuously rupturing the lubricating film. This film *increases as the diameter of the* bearing, and the resistance is proportionally increased thereby. But we have not only an increased area of film, but the distance traversed by any point on the surface of the journal is also increased in the same proportion. Let us take an actual example. Let the diameter of one journal be 1in., that of another 2in., and let both be the same length, and both revolve at the same speed.

Imagine that half the circumference of the larger journal is removed, and that the remainder is caused to rotate in contact with its bearing. It is obvious that the area of lubricating film is the same as in the smaller bearing; but this film is continuously ruptured and reproduced through double the distance, and the resistance overcome is therefore doubled. Now replace the half of the circumference. We have double the area of film, and this double area will be ruptured and reproduced through double the distance in the large journal as compared with that in the smaller, so that the resistance will be fourfold. This fourfold resistance is doubled in efficiency by leverage, so that an eightfold resistance has to be overcome in the case considered, in which one journal is twice the diameter of the other. But eight is the cube of two; therefore the force required to maintain equal velocities in journals differing in diameter varies as the cube of the diameter.

I have to thank "J. K. P." for pointing out a clerical error in my letter ("E. M." 1158). The second "buttress-thread," in the last paragraph, should read "cylinder-base."

It appears to me that the principle of cylinder and face-fitting should be applied not only to chucks, but also the centres of our lathes. By substituting this fitting for the usual cone-fitting we should get rid of the uncertain alignment of the latter. Even first-rate makers mark their centres and mandrel-noses so that the centres may always be put in in the same position as when ground. Nothing could be clearer proof that such makers distrust the accuracy of the cone-fitting for this purpose. With the wide nose proposed for the "Edmunds" mandrel there would be no objection on the score of weakening the nose to have a screw-thread inside the nose to hold the centre. The centre could then be fitted to a cylindrical recess, and to an accurate abutment against the face of the nose; the back-centre could also be fitted in the same way; and all centres so fitted, if made to standard sizes, would be interchangeable.

A. Gray.

BUTTRESS THREADS, LATHES, AND INTERCHANGEABLE CHUCKS, &c.

[27541.]—THE buttress thread first came under my notice about 1838 or 1839, when Brunel had some bolts cut with the same for something in connection with the Thames Tunnel. In 1849 and 1850 I made taps, right and left hand threads, about 1⅜in. diameter, pitch 2½ threads to the inch, for tapping nuts 2½ deep for loco. couplings, and a quantity of screws for same, for the L. and N.W. Railway at Wolverton. In 1859 I found the same doing good work.

Lathes, interchangeable mandrels, and chucks have cropped up many times in "Ours"; but the whole problem is solved in very few words. All mandrels, or running gear of that description, should be turned upon dead centres, and until that is made a practice of you cannot expect to have a lathe or tool with any truth in it, for in my experience of the last fifty years I have only come across two lathes that I could do a true job in or get chucks with any truth, and they were made on dead centres. And another thing, give me a bone bush before any steel, iron, case-hardened, or metal bearings, more especially for amateur or light manual labour. If the value of these were known there would be very few without them. There is not one lathe in a hundred, or five hundred, that you can turn a spindle and put a chuck on that, when in its place, it will run true; and for truth in screw-cutting give me the Holtzapffel sharp V-thread.

I may add that I have seen the buttress thread used for lathes, as well as square and obtuse round top and bottom; but they were found a mistake. So very few are to be seen; give me Whitworth's.

Jack of All Trades.

LATHE MATTERS.

[27542.]—SOME may be interested to hear of my visit to the works of Messrs. G. Birch and Co. I was greatly pleased with all I saw, and should prefer one of their lathes to any I have yet seen. The work seems to be done *con amore* for its own sake, more than for the sake of profit, and I was not surprised to hear that none of the amateur lathes hitherto turned out had more than paid their expenses; now, however, that the type is fairly fixed, and the lathes can be made in half-dozens, some profit may be looked for. The business has already outgrown the premises where it is being carried on, and Mr. Birch has been overtaxed by the overtime he has made, so that I fear we may not look for any descriptions from him at present; besides this, the second mandrel has turned out to be a more valuable appliance than was at first anticipated, and some of its uses are to be made the subject of a patent, so that they cannot just at present be made public. The work appeared to me to be done most conscientiously, and the shop-foreman employed is a man who was a foreman at Whitworth's.

I was anxious to get Mr. Birch's opinion of the front and vertical-slide lathe design, and submitted the drawing to him. I found he fully admitted the value of the vertical-slide; but that like many of your correspondents who kindly criticised the design, he feared a want of stability, and a wearing down of the narrow front slide. While not feeling these objections quite so strongly myself, I am still trying to modify the design so as to meet as far as possible the objections referred to, and intend to adapt it to receive the second mandrel and medallion machine. **F. A. M.**

AMOUNT OF WIRES ON DYNAMOS.

[27543.]—I AM obliged to Mr. Bottone (27483) for answering this query. He is quite correct, and I can't think how I managed to overlook this; even the authority I gave Mr. Bottone is against me. I must have mistaken feet for yards. Of course, the length of wire on an armature at a given speed depends on the magnetic field; but the greater the ratio between armature and field, the smaller will be the variation of lead.

Govan. **G. T. Pardoe.**

MAGNIFYING POWER OF MICROSCOPE OBJECTIVES.

[27544.]—SOME years ago I undertook such an investigation as F. R. Brokenshire (letter 27482) is desirous of conducting, and the results you were good enough to publish on May 26, 1882. "F.R.B." may perhaps find them useful in his own contemplated analysis. **Antares.**

OLD VOIGTLANDER LENSES.

[27545.]—I AM sorry my experience of these good lenses is so limited that I cannot help "Abaete" in his difficulty, but if he will address the same query to the Editors of the *British Journal of Photography* he will be sure of a satisfactory reply. I know of no one who has given so much time and attention to the study of all makes of lenses as Mr. J. Traill Taylor, and the courtesy he extends to all inquirers is well known.

I can corroborate "Abaete" in his appreciation of the washing soda and carbonate of potash developer, and also as to the difficulty of obtaining density with Beach's well-known formula. Somehow there is a difficulty either in getting sodic sulphite pure or in keeping it pure. I use now in its place the metabisulphite of potash (weight for weight of pyro), and find it keeps the pyro better and more constant than soda sulphite; note, however, that almost double quantity of soda and potash are required to bring the developer into action. **B.Sc.**, Plymouth.

ORIGINAL ELECTRIC EXPERIMENTS.

[27546.]—ON page 396 I described an experiment for exploding petroleum oil (the paraffin of the oil-shops), since which, having had a dangerous and dirty explosion, it may be well to describe "how to perform the experiment in a safer manner." Take some inches of gauge-glass tubing of, say, 1in. bore; turn up an ornamental wood base, having a plug of an inch deep to cement the tube upon it; take a couple of inches of ⅛ brass wire, put a blunt point upon one end, bore a hole down centre of plug and stand, bore a cross hole intersecting this, and insert another piece of said wire into this, and then force down the first one until it makes connection with the same; let the pointed end project above the plug about ½in., attach the glass to plug with a composition of rosin, a little pitch, and some fine plaster of Paris, melted and mixed in a ladle, dip the plug base into this, and fix in place, carefully pour in, say, melted rosin, having a little paraffin wax mixed with it until level with the brass point inside; procure an old champagne cork (being made of superior corkwood), put in a teakettle, and boil for ten minutes (and, if never before done, you will be surprised to find a large cylinder the result); cut this to fit the glass, and pass another pointed wire through the same; this can be slid nearer or farther from the other point in experimenting, as it is extremely important with statical electri[illegible] experiments, "that no points be exposed in the neighbourhood." I drill a small hole in these wires, in order to insert the ends of copper wire connections, and if the utmost power be desired no im[illegible]fect connections, such as chains, must be u[illegible]. Now pour in petroleum oil to cover the b[illegible] point for, say, ⅛in., adjust the other so as [illegible] quite touch the surface, stand it in any con[illegible] place, and connect top to inside of Ley[illegible] and bottom to outside, having, of cours[illegible] moderately tight; a revolution or two will cause a violent explosion. If sparks be passed through without being directly connected to outside foil of jar, something is formed speedily connecting the two points so as to form a conductor. Note.—The petroleum must not be left after experimenting in the tube, as it disintegrates the cement if left in it overnight. Another curious experiment is to place common dry salt in it, and watch it building itself up for, say ⅜in. from one point to the other, when sparks are allowed to pass through; another is to put petroleum into an ordinary shrimp pot, hang a in. wire from horizontal arm of Leyden jar so as to touch into the liquid in the centre; the blowing action and commotion set up is extraordinary. In fitting up a pair of glass discs of 3ft. diameter inding that belts of any kind are a great nuisance, I adopted most successfully the following arrangements:—First, there is a frame standing ft. high, and 3ft. 6½in. broad outside measurement, made of deal, 5½in. by 1½in. stuff, supported upon feet 30in. by 2½in. square, two cross-pieces dovetailed and tenoned, and having a ½in. groove at ⅜in. from the edge, to take a sheet of glass 40in. square; n the centre of this glass is a hole 1½in. in diameter; the discs work one on each side of this sheet, the inside one is attached by four screws to a cast-iron face-plate on a piece of ⅜in. gaspipe 3½in. long, revolving in cast-iron bearings 4½in. high, carried on a wooden shelf 6½in. by 1½in. Upon this spindle, secured by a pinching screw in a brass boss, is a mahogany wheel turned out of in. stuff to a ½in. edge, 5½in. diameter, also an oil-hole is provided for inside spindle, which is of steel, say $\frac{9}{16}$in., which passes through to front, and also carries a cast-iron face-plate, to which is attached the outside disc. This spindle carries a corresponding mahogany wheel, a third wheel, and having one face covered with leather glued to it and carried by a piece of ½in. gas-pipe having a piece of iron screwed into its end and turned up to, say, $\frac{3}{16}$in. diameter, and resting in a hole drilled in the outer cast-iron bearing in line with the centre of spindles, and another bearing at outside edge of the main frame. This carries a spiral spring bearing against a movable collar for purposes of adjustment, and upon its end carries a handle of only 6in. throw, and revolves the discs beautifully by the friction of the flat edges upon the leather. The reason for my adopting this not strictly mathematical plan was that in the ordinary bevelled edge plan the pressure would draw the plates together, and this, added to the attractive force already existing, would be objectionable. Two of the contact-making wires are attached to the horizontal shelf, the other two are carried by a length of ¼ brass tube attached to top of frame, and it adds much to the efficiency of this large machine to make connection by copper wire between these and the gaspipe or walls of the room. This machine gives powerful sparks direct from the sectors in favourable weather, such as at present, of 2in. or 3in. long, and painful. Upon applying a number of coats of lac varnish to the inner ends of the sectors, and to a diameter of 19in., and two coats upon all exposed parts of the glass extending in upon each sector for, say, ¼in., each one of which measures 11 by 3¼ by 1¼, and 16 upon each disc, and ⅜ from the outside edge of disc, I find an at present unaccountable result, as the electricity comes on with a rush and then gradually subsides greatly, and on again in a wonderful manner. There was no sign of this phenomenon until the inner parts of the sectors were covered up with the lac varnish. It would appear to me as if there were more developed upon the outsides of the iscs than is the case upon the insides, similar o the effect produced by insulating a Leyden jar nd attempting to charge same, when upon applyng a knuckle it will be found that the electricity going on in proportion to the inside charge; and wanting this knuckle or earth connection, it will take same more slowly from the atmosphere and he imperfect insulation. I may state that there no lac upon the insides of any of the glass, which were merely rubbed with a rag moistened with etroleum oil. Neither do I use the afore-mentioned ubber upon this arrangement, because if there be ny hesitation in starting, a few rubs upon the xed glass will set her off at once. I repeat more ecidedly than before, That there is that difference etween the discs revolving in opposite directions which renders it useless to endeavour to combine he two electricities upon a mutual surface, and, herefore, I only take it from one disc at a time. Any experimenter who adopts my single fine wire nstead of the Wimshurst bundle will have his iews much extended upon these matters.

A., Liverpool.

SHOULD WE EAT SALT OR NOT?

[27547.]—IN a long lifetime of observation at home and abroad I have decided in favour of salt as a necessary condiment. I can speak in propriâ personâ. I am a great consumer, and have been so from early years, and my kindred before me. I often empty a small salt-cellar at a meal: it contains at least half an ounce. A near relative (a female) frequently ate salt alone between meals, yet lived to over 90 years, with scarcely a wrinkle, and undimmed eyesight; her demise was accelerated by the breakage of bones in a fall downstairs, thus depriving her of outdoor exercise. When Asiatic cholera raged in Europe and India 30 or 40 years ago, the promising experiment was tried of saline injection of the veins; the temporary results were astonishing and encouraging: the patient rallied, and for a brief period recovery seemed to begin, then suddenly relapsed into the former stage. Science failed in making the effects progressive. The salt duties in British India were declared on high medical authority to be productive of a rising rate of mortality among the pauper classes, so the imposts were modified and considerably reduced; but recurring famines obliterated sanitary statistics—salt or no salt, the demon of hunger exterminated them alike! The regular use of this antiseptic auxiliary to digestion in tropical climates and sunny lands is well marked by a natural craving for the supply; even the beasts and birds, wild and domestic, throng the lonely salt springs and efflorescent waters, to rid their stomachs of accumulated entozoa—those of the pachydermatous quadrupeds being awful snake-like worms, expelled by Dame Nature's medicine. I have seen the great zoological collection of the Shan frontier assembled along the Poong (or "Salt Licks"), fear, suspicion, and jealousy prevailing among the different communities. From my ambush in dense vegetation, overhanging the stream to leeward of the herds, I have crouched in noiseless admiration. The elephants select the softest ground, not only imbibing continually, but boring pits in the soil, and devouring the saline earth; the bold but cautious bisons (*Bos frontalis*) expelling the morose buffaloes (*Bos Arnus*) from their own shore, all the lesser beasts of the forest creeping about individually on the same tour of health, seeking to avoid a collision. Great flights of *Columbidæ*, from the noble forest pigeon to the doves of all sizes and hues (of birds the most subject to intestinal parasites), arrive from all points of the compass. The whirring of wings disturbs the air continually, but the beasts and birds seem on good terms; occasionally a roving jungle cock runs almost against my boots, flutters, screams, and cackles, alarming every creature within hearing. I must hide like a hare, for on the rising ground I and my attendant guide might be perceived by *one* pair of the many far-piercing glances on the alert. Silence again reigns; every creature is taking physic, according to his size and wants, and so time passes away, till the roar of my two No. 5 barrels, aimed at the king of the *Bovidæ*, changes the woodland scene to a ridiculous caricature of Noah's Ark broken loose. About the time of full moon is the usual period of resort. Tigers being many and hungry in the virgin forests, all quadrupeds know the perils of darkness; even the infant elephant falls a victim to the combined attack of a feline family; hence the *Poongs* are deserted by night-feeding fauna, except during that monthly interval. "Our elephants are eating earth" is a frequent observation of their guardians; so he is sent off (sometimes a whole stud at once) to the nearest *Poong*, and kept there till his stomach be restored to health. Where no natural saline deposits exist, the denizens of the wilderness allay their cravings of appetite for such diet on the deep rich ashes resulting from the conflagration of tracts smothered with reed beds and giant grasses. I have stalked the rhinoceros, buffalo, wild boar, and many of the deer tribe in the white residue of such burnings. The word "salt" enters into national sayings and expressions of the Indian population. "Ungrateful" is "eating unhallowed salt"; "Faithful," eating consecrated salt; "salt and food" is "daily bread"; "provider of salt" means "employer," or "patron," &c.—showing, I think, the important position it holds as a dietary article; besides, old literature, sacred and profane, makes frequent mention of its general use.

Poisons and pernicious products rapidly effect their own publication and warning. Would salt-eating nations persevere in their addiction for centuries on centuries? For if the term of human existence had been perceptibly abbreviated, there were sage elders who would surely have tracked the enemy. There are salt lakes in N. India and S. Africa yielding a large return of the product by solar evaporation, which have been worked from time immemorial; there are mines of rock salt in the British boundary of Afghanistan yielding a large return. Every valuable herbivorous domestic animal in India receives a certain allowance of salt; every ox, horse, and sheep becomes unhealthy without such addition to their food. The horned cattle and sheep of villagers may be often seen breaking and licking the nitrous coating of house walls, or even devouring fæcal residue in despair; and there are horses that will actually *eat their own dung* (as I have witnessed) when hard-pressed for salt! How did the hordes of wild men—savages without written language, bordering the slopes of the N.E. Himalayas (or Indo-Chinese regions)—acquire the savour of salt, even using it in their crude preparation of tea as we do sugar? Most of those tribes have been brought to abject submission when guilty of offensive inroads by a strict blockade cutting off the trade supply; it was the "one thing needful" to a flesh-eating, robust mountaineer. The staple goods of frontier barter, too, merely packages of pure salt, whether exchanged for a prime canoe, roughly cut; for a kidnapped child on safe return to owner; or a fat young bull-bison of the domestic breed. "Salt, more salt!" was the cry from the Upper Brahmapootra.

Carnivorous quadrupeds, as the *Felidæ*, *canines*, &c.; the omnivorous, as swine, rats, mice, &c.; and the herbivorous, as hares, rabbits, &c., have a natural disgust to salt, and the same may be said of many fresh-water fishes. Hence, entozoa are so frequently found among them all; even the domestic ox in India, when neglected in his food, becomes a vehicle for cysticercus, as the diseased beef of the native markets demonstrates, where a Government inspector needs to keep strict watch. I end with the analytical fact, that healthy "gastric juice," the digestive fluid, contains free muriatic acid—*cui bono*, if salt be not necessary to life?

Eos.

[27548.]—ABOUT 1880 whole districts became vast *morgues* for dead sheep killed by the rot or liver fluke. One large grazier in Lydney threw into the Severn upwards of 1,000 carcases, while in the adjoining counties one, and one only, instance of immunity from the disease was reported by the larger flock owners—viz., that of Sir Edward Cockburn, of Ross, Herefordshire, and this he secured by placing rock salt in boxes (secure from the rain) in all the fields into which his sheep were turned, while the eager licking of these salt lumps by every individual sheep conveyed an instructive lesson to every spectator. As to the physiology of this—well, call it parasite—an admirable illustrated description by Dr. Jabez Hogg appeared in the "E. M." about this time.

When a boy I often visited the stables of a relative who had a *penchant* for supplying Government with the motive force for conveying her Majesty's mails over some 50 miles of road. In the mangers between each pair of horses was always to be seen a lump of rock salt, often licked into the most fantastical of shapes. What, short of instinct, could have induced these horses to eat this dirty-looking rock? One of the stages had an incline of three miles, ascending to over 1,000ft., while the standard pace of the mail coaches was 10 miles per hour. Dr. A. will, therefore, see that condition, pace, and stamina were essential in these horses, many of whom had had some 15 years of continual service. Why do horses so rejoice in licking the coats of each other but for the salt they thus get?

In a former query I asked why horses who exist purely on vegetable and on cereal food suffer from diseases numerous enough, and notably from those of the digestive system, and specially that most offensive disease known as "the grease"; but I have had no reply.

The Lydney Dispenser.

RIBBED BOILER TUBES.

[27549.]—WITH reference to the above, I see in letter 27423, p. 347, issue June 10, Mr. Thos. Fletcher claims to be the first in the field with the proper application of ribs or studs, &c., to boiler flues and surfaces for increasing the steaming powers of boilers, and I fancy he is rather inclined to the opinion that the patent he refers to, anent the same subject in a previous issue (June 3, p. 311), must be a copy of his invention. Now, it is quite possible for two persons to conceive similar ideas and work them out to a practical issue in complete ignorance of each other, as exemplified in the case of George Stephenson and Sir Humphry Davy and their miner's safety lamp, and other cases may be cited.

I may also state that 20 years ago I made a boiler for a small steam launch with studs in the flues to act as collectors and conductors of heat (and the result was very satisfactory); that certainly was not an attempt at copy, being before Mr. Fletcher's time.

St. Mary Church, Torquay. **Engineer.**

TO "JACK OF ALL TRADES."

[27550.]—I AM indebted to Dr. Cooper, who takes the aural cases at the Great Ormond-street London Homœopathic Hospital, for the application of glycerine to the nostrils in dry coryza and in some other cases of nasal trouble; but I claim the simple method of dropping the glycerine into the nostrils with a small oil feeder, the subject being extended on the floor and the face looking up to the ceiling. By this means the glycerine flows over the surface of the nasal and part of the pharyngeal membrane. Probably poor Jack may find some relief from this simple process, repeated, say, every other day. I found considerable and prolonged sneezings follow. As to his irritability, Bryonia strong tincture would earn his gratitude. I will send him some gratis on receipt of his address. Vaseline made hot in a teaspoon and poured into the nostril is also advisable, but its action is quite different to glycerine.

As to the sensation in eyeballs, I suggest calcarea as a remedy calculated to afford him benefit, also arsenicum, or the salt formed by the chemical union of these two elementary bodies, and known as arseniate of calcium, in doses of 0·001 of one grain; while as to the concluding portion of his letter, it can be described simply as intense nervous tension and irritability. Probably, his case as an out-patient, costing 1s. per month, at the above institution, would be appreciated and benefited; there he need not dread drug action.

Vaseline has obtained, and justly obtained, a world-wide celebrity for its healing power on the external skin, the heat of the body melting it and causing some absorption thereof, but when introduced even in a hot fluid state into the nostrils the nasal secretion chills it considerably. Now, seeing that vaseline is a hydrocarbon waste product of crude petroleum, I see no reason why the petrolene of commerce should not have a similar healing action; in fact, I have personally tried petrolene to my own nostrils, the result being that I can commend the use of any of these superior mineral oils (free from taste and odour), obtainable, I conclude, in London.

Under various names many substitutes for the so-called vaseline have been introduced by the manufacturing chemists, the active healing principle in all being *petroleum*, and this is cheap enough for the very poorest of sufferers even.

If poor Jack will look out for the summer excursions into South Wales *viâ* Great Western Railway, my house and grounds shall be at his disposal for a week, and I will endeavour to make him happy *pro tem.*

Archibald Fry, Lydney.

NOISES IN THE EARS.

[27551.]—I HAVE read with interest the various letters in the "E. M." about noises in the ears, and having been a sufferer from this complaint for some time, I first had my ears syringed, thinking it might have arisen from accumulation of wax; but, finding none, I had them examined by several medical men; but the noise continued until I was nearly deaf with one ear.

One day I had a severe attack of indigestion, and finding the noise much worse, I at once came to the conclusion that it proceeded from indigestion. Being a chemist, I took some appropriate medicine for that complaint, when the noise and deafness soon vanished, and I have never had a return of it except when my digestive organs were out of order.

June 24. **W. P. Davies, Ph.C.**

ARACHIS HYPOGÆA.

[27552.]—*Earth Pistachio* is the vulgar designation of this nut (or rather pod) by all Anglo-Indians. On reference to a large botanical book, printed in 1842, I find it so called! Probably this name was applied from a very common dessert-dish. The arachis is roasted in its shell, served up hot, and eaten with salt, like the true pistachio. Northern India annually receives an immense importation of the latter from Afghanistan; the trees grow wild in the ranges of the Hindoo Koosh. During the cold season strings of camels continue to arrive for many weeks heavily laden with camel-hair sacks; probably half of these contain pistachios, freshly gathered, in their strongly-scented pericarps, balsamic and resinous. Whole streets in native towns give out the peculiar odour. They are so cheap that nearly every man in the place can buy them. Europeans always roast them, and add salt to help their digestion. The seeds of *Pinus Gerardiana* are also occasionally met with, but the bulk is consumed on the spot where they grow by the people of the N. Himalayas: they are sweet and nutritious.

A lamb stuffed with pistachio nuts is a favourite Mohammedan dish, ranking with our roast goose.

Eos.

BRASS LACQUERING.

[27553.]—THE intelligent native foreman of a Government manufactory, having turned out a useful chuck to pattern for me in brass, proposed that I should see him lacquer it. He put some red-hot embers of charcoal in a light metal tray, and having mounted the brasswork in his lathe, he placed the fire on the shears rather near the work. He revolved the same very slowly, occasionally testing the heat of his metal by holding a finger near it without touching. He then put a few drops of gold lacquer on a silk rag, smoothing it gently over the surface; withdrew it, and went on at slow speed till the lacquer had assumed a *dazzling gloss. It was* beautifully done, and lasted *well.*

Eos.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61903.]—**Harmonium.**—I note G. Fryer's reply to me (page 373). He advises me to replace broad with narrow reeds? I have already done so. Now we come to the point (my query, page 42). Is there any difference in the make of pans for broad and for narrow reeds. I hold now that there is a difference, for the "mystery" is solved, at least, in my case. I have replaced 16ft. row broad with narrow reeds, with a very satisfactory result. I found no difficulty in the setting of the tongues, and I am satisfied with the tone, and, flattering myself as being a judge of tone, I doubt if it can be far surpassed by an Alex., or any other ordinary harmonium. I don't intend to replace the 8ft. and 4ft. broad reeds, for there is sufficient space for the wind and vibration. Again, I find that the notes in 16ft. row are much more reed-like than the notes in 8ft. broad, which are of a "woody" tone. I think the two rows give a better effective tone than if all were narrow reeds. I cannot close without referring to "Organon's" remarks (page 87): "Whether broad or narrow, it makes no difference in that matter." Well, perhaps it may not if the pan be made for broad reeds; but, if made for narrow reeds, I think he holds a wrong opinion. I thank G. Fryer for his kind offer to set the tongues; but the fault is not there. The reeds are all right. The "real cause," without doubt, is the reed and pallet holes being too small, the pan having been made for narrow and not for broad reeds.—QUEEN.

[62382.]—**Deliquescency (U.Q.)**—Calcium chloride is considered to be the most deliquescent; but I cannot say in what relative degrees. Calcium chloride is cheaper than magnesium chloride in commerce.—PRINCIPIA.

[62396.]—**Purification of Mercury.**—On my question, how to purify mercury, many answers have been sent in, for which I must thank the senders; but the hints given are not of much value to an amateur, as the quantity he uses seldom exceeds a few pounds, and the process of distillation is a dangerous and difficult one when he has not the necessary instruments. I tried, therefore, another method, and succeeded so well that I think it worth while to make it known to my fellow amateurs. The quantity of mercury which I wanted cleaning was about 2lb., intended for chemical instruments. I had in a bottle some sulphate of mercury with water and sulphuric acid. I put my mercury in it and shook it all together. At once all the mercury was divided in very minute globules, which were prevented from recombining by their coating of sulphate of mercury. After about four hours I poured the liquid off, washed the mercury with clean water, tried a portion of it by shaking it in a test-tube with sugar, and was astonished to find that after two or three minutes' violent shaking, the mercury kept bright and limpid; in fact, it was quite freed from all foreign metals. I purified after this some more different quantities with the same result; but with my last trial I am not so successful; a little hydrochloric acid was by accident poured along with the mercury in the bottle; this prevented the mercury from dividing into small globules; consequently, it will take a long time to clean this lot, as the sulphate of mercury has now not the chance of attacking the mercury on such a large surface as before.—HOLLAND.

[62411.]—**Calcium Light.**—It is much to be regretted that querists, before sending their queries, do not endeavour, at least, to state definitely what it is they wish to know. As "H. B." specifies "spirit," he may be told that it is the common methylated alcohol; but if he likes to purchase spirits of wine, that will do—and cost him a great deal more. The limelight is produced by a jet of oxygen blown through a hydrogen flame on to a piece of lime (I am not particular as to details), and the "oxy-calcium" light is understood to be much the same thing with the oxygen blown through the flame of alcohol instead of hydrogen. Then there is the ethoxo-light, in which ether is used in place of hydrogen. All have been fully described in back volumes.—NUN. DOR.

[62414.]—**Engine for Canoe.**—Somewhere in a back volume, not very far back, a correspondent offered to send particulars privately to another, how to put an engine into a canoe; but if "F. E. A." expects to drive his canoe by steam at eight miles an hour with any engine that it can possibly carry, I hope he is already prepared for disappointment. A canoe is a boat to be propelled by a paddle, and it is good and pleasant exercise; if steam is required, it will be advisable to have a launch. I won't say it could not be done; but it could not be done with any satisfaction—a 14ft. canoe driven by a screw at eight miles an hour!—SAML. RAY.

[62427.]—**Spectrum Analysis.**—"Ellore" asks whether the distances of certain lines in the solar spectrum have ever been compared with the times that the tints remain on steel while tempering. I don't know; but I should not think they had. Perhaps "Ellore" will explain what possible connection there is between the phenomena, or what purpose it could serve to make the comparison? Surely, the temperatures of the solar envelope must be much higher than those of steel in process of tempering.—NUN. DOR.

[62431.]—**Aerostation.**—A balloon to lift 500lb. is not a toy, and it would seem that the querist should seek information from those who have made such aërostats. He will find much about it in back volumes—that is, of what has been actually done or is known; but as to anyone sitting down to make out the calculations for such a balloon, which not one reader in a million can possibly want to make—it is rather too rich.—SAML. RAY.

[62435.]—**Water Filtration.**—Without specimens of the water it is impossible to give any definite information; but as it is important no doubt to remove organic matter, I should advise the querist to try the iron or the spongy iron process. As 60,000 gallons a day has to be treated, it would be advisable to find out what has been done in similar circumstances, before going to the expense of putting down plant.—**J. T. M.**

[62437.]—**Intensification.**—"B.Sc., Plymouth," has misunderstood me. I did not refer to mercurial intensification solely, but to intensification in general. Does this gentleman believe that by the gentle and regular deposition of metallic silver particles upon those already nuclei and *in situ* that anything other than a proportional opacity ensues? Of course, if the deposition be too rapid the portions that have the greatest attraction for the minute freshly-precipitated silver particles are the most intense, comparatively, prior to intensification, and hence the result is an increase in contrast; because where development has left a diminutive deposit, it (the deposit) has practically no attraction for precipitated silver. Will this gentleman kindly explain (hypothetically) the augmentation of the opacity of the image (not proportionally). Practically, I am well aware that some intensifiers, under special conditions, have a tendency to produce a variance in depth of gradation. The negative I referred to as a flat ill-contrasted one, has a decided deposit in the portions I require transparent, whilst the most opaque localisation is very little denser than the half-tones; so to intensify such a negative is to spoil it. See the first period in my original query. I should like to know, apart from this, why and how does $AlSO_4$ eliminate the last trace of thiosulphate. Please illustrate this by a chemical equation. I hope this will not "waste the time" of our worthy "B.Sc."—SOLAR RADIANCE.

[62441.]—**Luminous Paint.**—Mr. Hart, p. 374, has at last explained why the base of the "Great Pyramid" stood uppermost, and not, indeed, without showing his complete ignorance as to the application of luminous paint to photograpy. Just fancy coating glass plates on the back, and throwing spectra through the glass on to the backing of luminous paint! Perhaps Mr. Hart would expose a gelatine plate in the camera backward, and build castles in the gelatine film next the glass plate, so that it would be utterly impossible to effect "optical contact" between image and printing paper? In this case, the half-tones would be next the plate instead of on the film's surface, and, consequently, a "blurred" image of these portions would result upon printing. A plate coated with luminous paint is exposed in the camera (say, for two or three hours) during the night on some object that has been fully exposed to the sun's rays during the daytime. How would Mr. Hart make an impression on a dry plate from the luminous plate above, assuming the plate to be coated as he directs. Perhaps Mr. Horne will help to answer this.—SOLAR RADIANCE.

[62470.]—**Wheels without Flanges.**—In the case of a six-wheeled goods engine this practice would not be dangerous if the cylinders are inside and the extreme wheel base has a good length. On engines with outside cylinders and a short wheel base, it should never be resorted to.—E. GOBERT.

[62473.]—**Engine Query.**—Many thanks to "T. C., Bristol," for answering my query of compound engine. I have not been able to thank him before this. Would he please enlighten me a little further? He says back-pressure in high-pressure cylinder is about 17lb., while average pressure in low-pressure cylinder = 10. If the average back-pressure in high-pressure cylinder is about 17lb., will the average effective pressure in low-pressure cylinder not be also 17lb., less the 2lb. back-pressure? Please say how you get the 10lb. average pressure in low-pressure equal when average *back*-pressure in high-pre[illegible] is 17lb.

This information will enlighten me very much coming from such a valuable correspondent as "T. C., Bristol." Will he, or any other competent friend, say what would be best books to get for preparing for honours in steam?—ENGINE-MAN.

[62523.]—**Harmonium Vibrators.**—I note the reply to this query by "G. L. B." on p. 398. Just by way of summing up the matter with regard to the prices of reeds, let me particularly call the attention of your readers to the following facts:—1. Reeds vary in price according to quality. 2. Various prices are charged for the same quality of reeds, thus the best reeds vary in price from 10s. to 25s. per set of five octaves. 3. The best reeds can be obtained (as I stated before) for 12s. per set, and you can also pay more, or even less, for them if you merely like to do so. 4. Excellent reeds (constructed of really good metal) can be obtained for 8s. 6d. per set, retail price. Those I refer to now are advertised in the "E. M.," but the price is not given. 5. Reeds of inferior quality can be obtained from 6s. to 10s. (or even more) per set. The above-quoted prices for reeds have existed for some time. I consider a good set of reeds to be worth (if worth is considered) 18s. or 20s.; but if a good set of reeds can be obtained for less (which is a fact), so much the better for people of limited means. I have no wish to be discourteous to "G. L. B.," but I must remark that he has not (fully) answered the query, as he has not told the querist how the blocks are cast, he has only (very briefly) given instructions respecting the fitting of the tongues or vibrators. I consider also that it is somewhat absurd for "G. L. B.," or anyone else, to pretend to tell any man the price of reeds who has bought, sold, and tuned some thousands of reeds. There is no strict price charged for reeds, as the above-stated facts will prove; therefore, "G. L. B." and others interested will understand why I have quoted different prices for reeds; and because of that I am accused (very unjustly) of not knowing the exact prices charged for reeds. Like everything else in trade, some charge more, some charge less. Each individual purchaser must study his own interest in the matter, and endeavour to obtain the best for his money. I am glad, however, that another correspondent has given similar advice to the querist to what I have given. I think it very bad policy on the part of the querist to entertain the idea of making reeds, when he is told that he can get a set of reeds as low as 6s. for 61 notes. I trust that this explanation will suffice in shutting up the long worn-out subject respecting the prices of harmonium reeds.—G. FRYER.

[62524.]—**Gas Cooking Range.**—The use of tiles in gas cooking ranges has been practically discontinued for many years. They are heavy, troublesome to fix securely, and render the oven very slow in heating up. It is not a pleasant thing to say, but my own experience with thousands of gas cooking ranges proves that except in the rarest cases gas ovens, which are so easy to clean, are allowed to get into such a state of filth that it requires a chisel or a scraper to discover whether the inside of the oven is enamelled, tiled, cast-iron, or anything else. There is a complete and permanent coating of charred grease which renders the nature of the surface under it a matter of indifference.—T. F.

[62547.]—**Coins of the Present Reign.**—"And still they come." Your correspondents have overlooked the old copper coinage—farthing, halfpenny, &c., issued in the earlier part of this reign. Then, to make his collection complete, "D. G." should have the "H" pennies, &c., as well; and he should not forget the coinage of New Brunswick, Straits Settlements, Ceylon, Ionian Republic (British Protectorate—coinage has Britannia on the reverse), &c. I am afraid that, after looking at the Jubilee coins, "W. A. G." will find we are still "going from bad to worse!"—AMPERSAND.

[62550.]—**Case Hardening.**—I do not understand what the querist means when he says cart arms and axles. Are not these the same thing? Heat your axles to a cherry red in a clean fire, remove from fire, turn axle upside down, take two pieces of iron (hoop iron will do), put them the long way up axle about ¾in. apart, and between the irons put some prussiate potash (yellow). The heat will melt it and cause it to run down over axle; then take axle and put it in cold water. There are other ways of case-hardening—more effectual, but slower.—J. C.

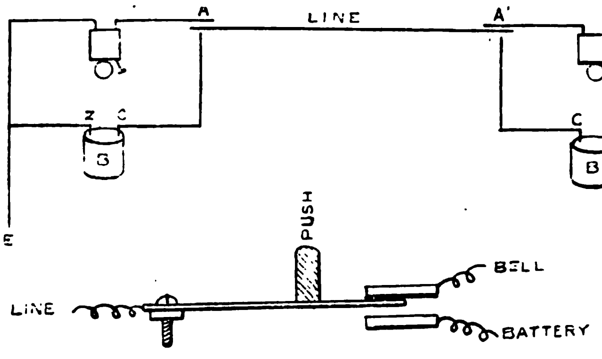
[62576.]—**Locomotives.**—(1) L.B. and S.C.R. Nos. 401 to 420 6-coupled goods engines, 5ft. wheels, cylinders 17¼ × 26, weight 38tons 12cwt.; 421 to 432, same class, with larger boilers, 18¼ × 26in. cylinders, and Westinghouse brake (Mr. Stroudley); 468 to 473, 6-coupled goods engines, outside bearings, 5ft. wheels, cylinders about 17 × 24, date about 1867 (Mr. Craven). (2) L.C. and D.R.: 113 Acis, 114 Calypso, 115 Diomede, 116 Fortuna, 117 Gordius, 118 Pyramus, are 6-coupled goods engines, built by Sharp, Stewart, and Co., 1862; outside frames, 5ft. wheels, and 17 × 24 cylinders, designed by Mr. Martley. Others of this class are 127 Adrian, 128 Trajan, 129 Vespasian, 130 Tarquin, 131 Pertinax, and 132 Constantine, built by John Fowler and Co., Leeds, 1866; 151 to 156, Neilson and Co., 1877, 6-coupled goods, inside framing, 4ft. 10in. wheels, 17½ × 26 cylinders, weight 40 tons (Mr. Kirtley). Others of this class, 135 to 140; Dubs and Co., 1876. (3) L.N.W.R.: 2037, 5ft. 2in., 6-coupled goods engine, 17 × 24 cylinders, weight 27 tons (Mr. Ramsbottom). Nos. of a few of this class are—1079 to 1100, 1221 to 1249, 1301 to 1356, 1366 to 1426, 1447 to 1479, 1490 to 1512, 1533 to 1644, 1686 to 1742, 1770 to 1779, 2007 to 2038. 2297 is Mr. Webb's 4ft. 3in. 6-coupled coal, cylinders 17 × 24, built 1873-1882, weight 29 tons 11cwt. A few of this class are—2071 to 2089, 2110 to 2124, 2160 to 2174, 2195 to 2232, 2256 to 2258, 2268 to 2277, 2337 to 2345, 2365 to 2452, and several more, and would take up too much time to enumerate.—GORGON.

[62578.]—**Organ Pipe Feet Turning.**—"Tyro" can make his feet out of mahogany; odd bits will save cutting longer pieces. Walnut will do, or any of the harder woods, and must be nice straight-grained, or it may lead your boring bit aside. Cut them of 6in. or 7in. long, C C stopped diapason 1¼in. diameter of top to 1⅛in. at bottom of toe, the top of toe shouldered off ¾in. down by 1in. diameter to fit into the pipe, the toes to be all the same length; from C C to F 4½ octaves to be made gradually smaller till you get up to top F, which may be full ½in. at top, and bare ⅜in. at bottom, the hole in the toes from C C to F from full ⅜in. to $\frac{3}{16}$in. at top F, the sizes of holes to be graduated up as well as you can, say 7 or 8 of a size to the top; get them out and square, centre the ends, and bore them in the lathe by means of some nice thin and well-made quill bolts, made quite sharp, tapered off to a point on your grindstone, as those you buy are too blunt to bore nice and clean. If you cannot bore them out smooth enough, get made half a dozen burning irons pointed at ends, and round loop turned at the other end, which you may burn them out nicely with; then turn them on a tapered mandrel 2in. or 3in. long. Being taper will fit every toe, your opposite centre fitting into the bottom part of toe, which must be nicely bevelled off to fit the hole in the windchest.—S. ABLIDGE.

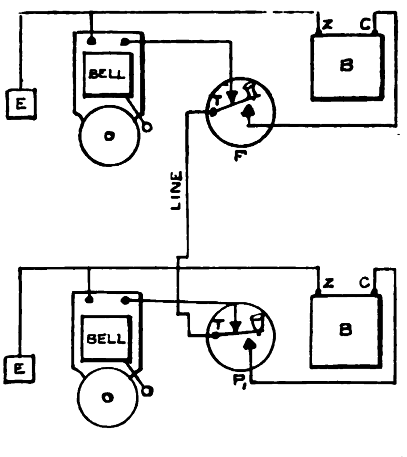
[62584.]—**Norway.**—Probable cost, in my opinion, £1 per day, first class in everything. In the opinion of a fellow traveller, who kept accounts for himself, 12s. per day. Clothes necessary: light tweed suit, great coat, and umbrella, and anything else you wish. Buy latest edition of Baedeker's "Norway." Go to Bergen viâ Newcastle. At Bergen buy a monthly paper called the "Norges Communicationer," which gives all the routes through Norway, and the times for railway and steamer. On arrival at Bergen, go on board steamer to the Hardanger Fjord, and proceed to Odde. From Odde visit the Buarbroe glacier, the Lotefos and Espelandfos, waterfalls near Hildal village, also the Skeggedalfos. Take steamer to Vik, otherwise called Eidfjord, visit from there the Voringfos. Take steamer to Eide. Drive to Judvangen. Passing (through the Nerodal) the waterfalls Stalheimfos and Stivlefos, steamer from Qudoangen to Lerdalsoren, drive to Borgund Church, steamer to Aasdal, visit the Vettisfos. This, and visiting in steamer the various arms of the Sognefjord, which are all worth seeing, and returning by steamer to Bergen, would probably occupy all the time at your disposal. Hotel-keepers, captains of steamers, and ticket collectors on the same generally can speak English; guides who do so can generally be obtained.—R. O. H.

[62597.]—**Turbines.**—I am much obliged to Mr. Pilling for answering this query. I want, however, a *practical* book on "Hydraulics," not so much on steam engineering. Does anyone know anything of Robinson's "Hydraulic Power and Hydraulic Machinery"? It is described as written "for practical engineers and students." Is this so, or is it a highly mathematical work? It seems difficult to get hold of a work on any subject (engineering) giving the physical reasons for the operations described; the mathematical reasons (?) are sufficient for the writers. I have heard people prove the theory of the Wheatstone bridge to their complete satisfaction who had not the ghost of an idea of the physical proof.—G. T. PARDOE, Govan.

[62598.]—**Electrical Connections.**—I send a sketch of arrangement I have in present use. When at rest there is uninterrupted connection from earth (gaspipe) through bell to line wire at each station. On depressing the push at A, the battery is thrown into action and the bell cut out. The same action takes place at A_1, so signals can be alternately transmitted. One Leclanché cell at each end of line is sufficient. Join the carbons and zincs as shown in the sketch.—SM.



[62598.]—**Electrical Connections.**—Connect as per diagram, using a return wire instead of earth (E) if more convenient. P and P' are double-action pushes, and when the button is depressed it puts copper to line, coming back when released by reason of its own elasticity against the contact stud at the back, thus connecting line to bell. For battery (B) use three No. 2 Leclanché cells at each end.—ELECTRA.



[62601.]—**Lancaster Oval Bore Rifle.**—You will find that the removal of lead from iron or from files will be wonderfully facilitated by applying petroleum oil; but keep same away from any soldering job about to be done.—A., Liverpool.

[62606.]—**Dutch Language.**—To answer this question is exceedingly difficult, as I do not know of any English word in which the Dutch sound "ui" is heard. However, if you pronounce the ui like the vowels uoy in buoy, I have no doubt but that they will understand you.—HOLLAND.

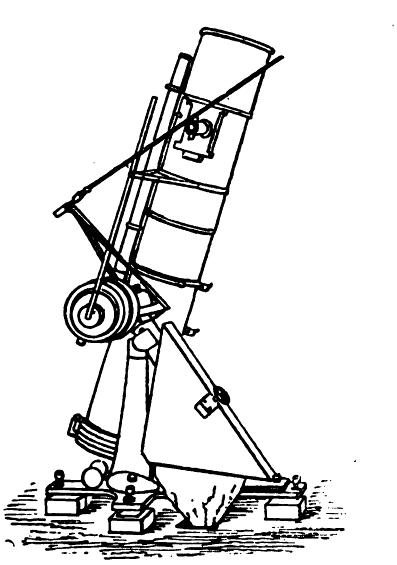
[62606.]—**Dutch Language.**—"Ui" is pronounced in the Dutch language like "eu" in German. "Eu" is pronounced in German somewhat like "euil" of the French language in "deuil." It is impossible to represent this sound with English letters, although some authors give "oy" of toy as the nearest English equivalent.—E. GOBERT.

[62607.]—**Small-Scale Photography.**—During the siege of Paris—I translate from Gaston Tissandier's "Merveilles de la Photographie." "At Tours all the private or public despatches were printed on a large folio sheet of paper which might contain about 300,000 letters. M. Dagron, who had left Paris by balloon, reduced this to a small negative having about one-fourth the size of a playing-card. The proof was printed on a thin sheet of paper, and afterwards on a film of collodion, which though weighing little more than five centigrammes, contained the contents of several newspapers. Several of these films, representing a considerable number of despatches, were rolled up and inserted into a quill of the size of a toothpick. This letter-box, novel and light, was fastened to the tail of a pigeon. On arrival and on departure care was taken to stamp the bird's wing with the postmark of receipt or despatch. A considerable number of pages of letterpress were reproduced by the processes of M. Dagron and his colleague, M. Fernique. Each page contained about 5,000 letters, or about 300 despatches. Sixteen of these pages were contained in a film measuring three centimèters by five, and weighing not more than five centigrammes. The reduction was to one eight-hundredth. Each pigeon could carry in a quill 20 films of a total weight of one gramme. As soon as the quills were received at the telegraph-office they were slit open with a penknife. The films were placed in a basin containing slightly ammoniacal water. In this liquid the despatches unrolled themselves; they were dried and placed (between two glasses) in a photo-electric microscope, an enlarged image being thus projected on to a screen."—J. H. PAYNE.

[62608.]—**Pronunciation of the Irish G H.—Erratum.**—On p. 400, someone has substituted "z" for "y" in Lock Nay.—A., Liverpool.

[62608.]—**Pronunciation of Irish GH.**—The "gh" is in most cases pronounced in the way referred to by the querist as given by Dr. Foster. It is so in "Lough"; but "Neagh" is by most people pronounced "Nay," although I have heard the guttural fully, and the two vowels separately, sounded by the peasantry. I cannot say I have observed much, if any, difference between the Scotchman's "loch" and the Irishman's "lough." In "Drogheda," "Armagh," and "Donaghadee" the guttural is also sounded by the masses, and is probably the proper old form, although always in the two first, and sometimes in the last, it is dropped by "the quality," as in other cases where it would seem to be too inharmonious. In connection with Irish place names, it may be worth noticing that while in English names the accent is usually, if not always, on the first syllable, in Ireland and Scotland it is variable, and often on the last—as in Belfast, Donegal, Donaghadee, Armagh, Attry, Mullingar, Inverness, Tiree, Portree, Dalry; or on the penultimate as Londonderry, Ballyshannon, Ardrossan. Possibly this peculiarity has some Celtic origin. Is the accent on the first or last of Penzance?—J. BROWN, Belfast.

[62629.]—**Equatoreal.**—Inclosed photo is of home-made cast-iron stand for 12¼in. reflector.—SM.



[62628.]—**Critical Velocity of Rotation.**—For purposes of calculation, the grindstone, flywheel, or other symmetrical rotating body may be divided into sectors. The centrifugal force of each sector in pounds = weight in pounds × square of revs. per minute × ·00034 × mean radius or distance in feet of the centre of gravity of sector from axis of rotation. In the case of a grindstone where the sectors are taken as innumerable, they become practically triangles, and the mean radius = ⅔ radius of stone. It will be found that the vertical components of the centrifugal force of all the sectors in one-half of the rotating body (that is, the force tending to tear rotating body in half)

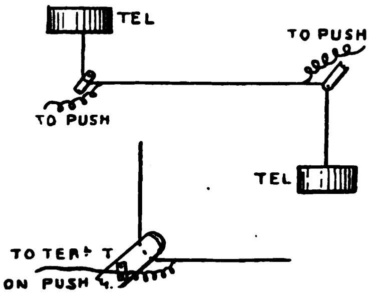
$$= \frac{\text{Total centrifugal force of entire body}}{3{\cdot}1416}$$

In a grindstone the total cent. force in pounds *= weight of stone* in pounds × ⅔ radius in feet *× revs. per minute squared × ·00034.* To find *critical velocity of rotation of any symmetrical revolving body*, let u = revs. per minute, or critical velocity of rotation to be found. And given A = force of cohesion of body in pounds,

$$R = \text{mean radius in feet,}$$
$$W = \text{weight of body in pounds,}$$
$$\therefore \frac{W \times R \times x^2 \times {\cdot}00034}{3{\cdot}1416} = A,$$
$$x^2 = \frac{3{\cdot}1416\ A}{W \times R \times {\cdot}00034}$$
$$x = \sqrt{\frac{9240\ A}{W \times R}}$$

x being the only unknown quantity, the equation is easily solved.—ELAG.

[62631.]—**Call Bell to Acoustic Telephone.**—Use telephone wire as "line," and connect as diagram in query 62598, taking care that none of your supports for acoustic wire are touching any metal connected to earth. Join the wire from terminal (T) on push in diagram to the acoustic wire at about 2in. from the nearest support to telephone as shown in sketch. To do this, take 6in. of naked copper wire of No. 24 gauge, twist into a spiral, and solder one end to the acoustic wire and the other to the wire from terminal (T) on push, bending the joint after insulating to the support, so as to take all strain off the spiral. Wind your bell bobbins with No. 26 silk-covered wire, and use six smallest size Leclanché cells in series at each end.—ELECTRA.



[62637.]—**Compound Steam-Engine.**—You surely have made a mistake when you say there is no receiver to this engine. With the cranks at right angles a receiver is necessary; the cylinders being rather far apart in this class of engine, perhaps the exhaust from h.p. to l.p. cylinder acts as a receiver. The receiver is often in the form of a jacket round the h.p. cylinder, and so may have escaped your notice. In the following calculations I have taken $p \propto \frac{1}{v}$, that is, that pressure varies inversely as the volume—

V^1 = initial volume of steam
V^2 = volume of steam at termination of stroke in h.p. cylinder
p^1 = initial pressure of steam h.p. cylinder
p^2 = terminal pressure of steam h.p. cylinder
p^m = mean pressure h.p. cylinder
p^3 = initial pressure l.p. cylinder
p^4 = terminal pressure of steam in l.p. cylinder
p^{m1} = mean pressure l.p. cylinder
r = ratio of expansions in h.p. cylinder
r^1 = ratio of expansions in l.p. cylinder
R = ratio of cylinder capacity $= \frac{(45)^2}{(29)^2} = 2{\cdot}408$
r^2 = total ratio of expansion in both cylinders

(All pressures taken as absolute)

$$r = \frac{V^2}{V^1} = \frac{72 + 3}{(72 \times \frac{3}{10}) + 3} = \frac{75}{24{\cdot}6} = 3{\cdot}05$$
$$p^2 = \frac{p^1}{r} = \frac{70}{3{\cdot}05} = 23\text{lb.}$$
$$p^m = p^1\,\frac{1 + \text{hyp. log. } r}{r} = 70\,\frac{1 + 1{\cdot}115}{3{\cdot}05}\ 48{\cdot}5\text{lb.}$$

The back pressure on the h.p. piston depends on the capacity of receiver, cut off in l.p. cylinder, and compression in l.p. cylinder. If capacity of receiver is large, the back pressure is fairly constant throughout stroke; but, if small, it fluctuates a great deal, being greatest just before low-pressure cylinder takes steam. To compress steam from 20lb. to 54lb. its volume must be decreased to $\frac{20}{54} = \frac{1}{2{\cdot}7}$, so if clearance = 3in. compression must begin $3 \times 2{\cdot}7 - 3 = 5{\cdot}1$in. from end of stroke.

$$r^2 = r \times R = 3{\cdot}05 \times 2{\cdot}41 = 7{\cdot}35.$$

As you do not give size of receiver, I cannot say what initial pressure in low-pressure cylinder would be; but it would be about the same as the terminal pressure of high-pressure cylinder if there were no "drop." If the capacity of receiver was small, however, the initial pressure of low-pressure cylinder might be considerably higher.
23lb., then—

$$p^{m1} = p^3\,\frac{1 + \text{hyp. log. } r^1}{r^1}$$
$$= 23\,\frac{1 + \text{hyp. log. } 2}{2} = 23\,\frac{1{\cdot}693}{2} = 19$$

and $$p^4 = \frac{p^3}{r^1} = \frac{23}{2} = 11{\cdot}5\text{lb.}$$

To compress from 3lb. to 10lb. with 3in. c
compression begins $\frac{10}{3} \times 3 - 3 = 9{\cdot}9 - 3$
from end of stroke. With large ports ar
acting valves exhaust need only begin ju
end of stroke. There is no definite rule f
ELAG.

[62637.] — **Compound Steam-Engi**
appear to have a large amount of clearanc
cylinders; half what you state should b
with Corliss valves. Taking the clear
account, the cut-off in h.p. cyl. is at
stroke, and consequently expansion is thr
in that cylinder with an absolute terminal
of 70 ÷ 3 = say, 23lb., and average pr
that side of piston = 70 × $\frac{1 + \text{hyp. log.}}{3}$
(and some decimals). The exhaust-pipe
cylinders forms a receiver, and is proba
contents of h.p. cyl. The steam being c
half stroke in l.p. cyl. the pressure in
will have fallen then to about 23 ÷ 1·2 =
the ratio of cylinder contents being as 2
the whole contents of h.p. cyl. being
tained in half the l.p. cyl. This will no
to 9lb. absolute. The back-pressure in
will rise towards middle of stroke to perh
thing like 25lb.; but this depends on co
receiver, so this part had better be left,
all consideration of loss in pressure
cylinders, and from condensation. To
20lb. to 54lb. with 3in. clearance, you m
exhaust at 54 ÷ 20 × 3 = 8in. from end.
expansions = 3 × 2·4 = 7·2 times, and ini
sure in l.p. cyl., as mentioned above, de
receiver and also average pressure, althou
of engine will not be affected by it; the lo
cylinder being gained in the other. I
exhaust should close at 10 ÷ 3 × 3 = 1
end, and if opened at, say, 3in. from en
probably suit. You have probably taken
so you will be able to see the variations in
and losses, which invariably occur in comp
—T. C., Bristol.

[62638.]—**Boring Holes in Gas Tub**
your tubing is intended for gas devices,
to file a notch with the round edge of a
first where each hole is to be bored, the
drill made this way:—Take a piece of ro
rod ¼in. diameter, length to suit brace,
little towards the point, and then file it d
shoulder, allowing the drilling point to
$\frac{3}{16}$ths long. A drill made thus will not bre
it cuts through the tube. To temper,
point to a bright red, plunge into water,
on fine emery cloth, and hold the thick
flame until the part turns a dark stra
then cool again. I have recently drille
quantity of holes (many hundreds) les
32nd diameter, and only had, I thi
breakages. The brace has something to d
too. Mine is a hand brace, fitted wi
wheels, with the handle for turning at the
lot of this class of work is punched o
punch made in the same way as the
shouldered; but drilling makes the best
ENGINEER, St. Mary Church, Torquay.

[626242.] — **Electro-Motor.** — TO M
TONE.—In your position I should w
armature with as much No. 22 d.c.c. as I c
on, having weighed the armature before a
winding. Then put an equivalent amou
times the weight) of the same gauge wir
fields, and connect up as a shunt machine.
do not state the wire space on armature, I
guess at its capacity, but think that you m
1lb. to 1½lb. on. In this case you might
nearly 1H.P., if your motor is properly m
BOTTONE.

[62643.]—**Slide Valve.**—If you have
nary flat valve only, you cannot very wel
at earlier than ⅝ the stroke. If you will g
particulars as to travel and widths of po
tell you how much lap you must give.
Bristol.

[62644.]—**Launch.**—TO "T. C., BRI
This query I must refer to our friend
neering, Manchester," if he will spare t
as I am not at all up in boat work.—T. C.,

[62645.]—**Filter.**—If you have settling
think you would be suited. I should pr
follows:—Have two tanks made of anyth
will hold water, and as tall as possible—
high and 3ft. diam. Pump the feed int
1, and have this connected to No.
from bottom, and take feed from
3ft. below this connecting-pi

catch the settlings, and means must be provided for cleaning out.—T. C., Bristol.

[62646.]—**Photographic Chemistry.**—To test for hyposulphites in water, take a portion, and add some sulphuric acid (H_2SO_4), and warm gently. An odour of sulphurous anhydride (SO_2) and a deposit of sulphur indicates an hyposulphite. To another portion add a few drops of ammonio-cupric sulphate (made by adding ammonia to a solution of cupric sulphate till the precipitate dissolves in excess), an instant decolorisation indicates hyposulphite present.—PHOTOCHEMICUS.

[62646.]—**Photographic Chemistry.**—1. Sodic thiosulphate (hypo.) gives with silver nitrate a white precipitate which becomes black on standing or heating, owing to conversion into sulphide.

$$Ag_2S_2O_3 + H_2O = Ag_2S + H_2SO_4.$$

The above precipitate ($Ag_2S_2O_3$) dissolves readily in excess of $Na_2S_2O_3$, hence the silver solution must be fairly strong, and added until a permanent precipitate is formed. 2. Ferric chloride gives a violet-red colouration, which vanishes on standing or heating. 3. If the solution be acidified with sulphuric acid it will decolourise a solution of blue iodide of starch.—SM.

[62646.]—**Photographic Chemistry.**—Perhaps the most convenient test for the general purity of the water employed by "Hypo" would be a dilute solution of permanganate of potash in distilled water. This should be made so weak as to show only a pure rose colour, when viewed by transparency. To an ounce of this solution add an ounce of the suspected water. If it contains sodium hyposulphite, or ammoniacal matter (sewage), it will quickly turn pale yellow. If it does not change colour in 15 minutes, you may infer that the water contains no appreciable amount of "hypo." Be careful that the testing glasses are chemically clean, as the permanganate is wonderfully sensitive to organic matter, and the presence of any trace of this would vitiate the result.—S. BOTTONE.

[62646.]—**Photographic Chemistry.**—The querist may use the following methods to detect hypo. in water:—(1) Take a pinch of starch, and boil it with an ounce of water; when dissolved add five drops tincture of iodine (which will form the blue iodide of starch), and add a few drops of this compound to a little of the water; if hypo. is present it will discharge the blue colour. (2) Make a dilute solution of potassium permanganate (diluted Condy's fluid will do), and colour a small quantity of water a light pink; add a small quantity of the suspected water to this; if the colour is discharged it contains hypo. (3) Mercurous nitrate (in solution) gives a dark brown or black precipitate, with a very slight trace of hypo. (no notice to be taken of a white precipitate). The above are very delicate tests. If a solution of silver nitrate is mixed with HCl we get a precipitate of silver chloride; but, if HCl is mixed with a solution of silver chloride in hypo. there is no precipitate. The reason why ordinary water becomes milky is because the excess of silver nitrate in the paper combines with chlorides, &c., and precipitates; if there is any hypo. present it would probably dissolve the silver chloride as fast as it was formed, and this solution would not precipitate HCl.—PRINCIPIA.

[62652.]—**Antiferment.**—Sozedus is unquestionably the best preservative and antiferment, and very certain in its action. See Sixpenny Sale Column.—SOZEDUS.

[62655.]—**Preventing the Coagulation of Albumen.**—To do this would alter one essential property of albumen, and consequently this problem may be considered impossible of solution. There are somewhat analogous bodies called *peptones*, which are prepared from albumen in the animal economy that do not coagulate by heat.—SOZEDUS.

[62655.]—**Coagulation of Albumen.**—You do not say under what circumstances the solvent of albumen should be harmless. The solutions of albumen in the organic acids are not coagulated by boiling, but a pellicle is formed during evaporation. The addition of some salt—as sodic chloride or sulphate—causes a precipitation of the albumen. Albumen forms definite compounds with metallic oxides. Coagulated albumen is dissolved freely by alkalies. If potassic albuminate be well washed with cold water, it will be soluble in boiling water and boiling alcohol. This aqueous solution is coagulated by acetic, tartaric, or phosphoric acid; but an excess of acid redissolves the precipitate.—SM.

[62656.]—**Photography.**—Should not advise you to use any one fluid developer, as they are uncertain in their results, and do not allow enough latitude. The mercuric chloride intensifier holds good with all plates, but should not be used if the negative is wanted for any length of time. The ferrous-oxalate developer is decidedly better and cleaner than the pyrogallic, but can only be used where nearly correct exposure has been obtained. All dry-plates, to my knowledge, are made with gelatine, except Canon Beechy's collodion emulsion plates, which are now out of date. Alum and citric acid are universally recommended for a clearing solution, but are not needed with ferrous oxalate. In using ferrous oxalate, add about 60 grains of citric acid to the ferrous sulphate solution.—PHOTOCHEMICUS.

[62656.]—**Photography.**—The causes of "Chips'" failures may be many. The following summary of the likely ones may be of service:—1. The developing solution being a *ready made* one, may have become oxidised and lost strength. 2. The pictures may have been *over-exposed*. If the picture shows every detail, but is otherwise very thin, this is surely the case. Chapman's prescription for weak and dense negatives applies to all ordinary makes of gelatino-bromide emulsion plates. There is very little difference between "ordinary," "rapid," and "extra"—the principal one being the price charged. In my hands ferrous oxalate is far superior to any other developer, being much more under control. Alum and citric acid are not much use; better time your exposures correctly and develop cleanly. The two developers—viz., pyro. and ferrous oxalate, can be used with any gelatine plates.—S. BOTTOFE.

[62656.]—**Photography.**—1. The prescriptions you give by Chapman are good for all the sorts of plates in the market. 2. All are gelatino-bromide plates, certainly. 3. Depends on the make of plates, the "instantaneous" of one firm only being as rapid as the "extra rapid" of another firm. If both are by one firm the "extra rapid" would not be so quick as the "instantantaneous." Depends upon taste of individual. Mr. Bottone will tell you that ferrous oxalate is best. I can't help thinking myself that it is a beastly mess. 4. Certainly citric acid and alum is invaluable for removing yellow stains and green fog. 5. I suppose so, but I have not used either make you mention. If you cannot succeed I would recommend "Derwent" or Fry's plates, which are first-class. More information if you care to write to me.—R. A. R. BENNETT, Walton Manor Lodge, Oxford.

[62657.]—**Coil Reel.**—May I take the liberty of answering the last part of this query? The screw must be platinum tipped; if it is not, it will very soon burn to oxide, and then will cease to work. Drill the point of screw about ⅛in. deep; take a piece of platinum wire, heat in spirit lamp, dip in flux (zinc chloride), and touch with solder; touch screw with flux, hold wire in hole till thoroughly joined, cool, cut off wire to right length, and the job is done.—PRINCIPIA.

[62659.]—**Malleable Casting.**—The melting moulding, and casting are conducted in the same manner as common cast iron. For the metal, procure not less than two good sorts of No. 2 pig-iron, and you may add a little good scrap. The secret of this sort of work is the annealing, which is performed thus:—Procure an iron pan adapted to the size and shape of your castings, put a layer of charcoal on the bottom, then some castings, then charcoal, and so on; when nearly full, cover with sand, and an iron lid over all. Put it in an annealing furnace, and fire up slowly. Be careful not to get up the heat too quickly, and when the pan and contents are red-hot through, the heat must be kept constant for five or six hours, then let the fire gradually die out, and not disturb the castings till properly cooled.—ENGINEER, St. Mary Church, Torquay.

[62661.]—**Tin Alloy—Melting Gold.**—I have had the same difficulty many times; I expect you have lead with your gold: one grain of lead to 1oz. of gold is sufficient to make it very brittle. The easiest and quickest way to free the lead is to send through the melting metal a stream of chlorine gas, or expose it to a great heat in a furnace for a long time; I use the former plan. An ordinary oil flask, partly filled with a saturated solution of chloride of potash and spirits of salts, and connecting with it a tube terminating in a clay-pipe stem, through which the gas escapes through the melting metal; the flask may be placed in hot water to further facilitate the formation of the gas. Don't breathe the gas, as it is poisonous.—F. S. REID.

[62663.]—**Clack Box.**—All injectors work by rapid condensation, and, if the water is hot, the condensation is not rapid enough. The pressure is not the same above and below valve, or water would not enter boiler. The difference in pressure is obtained by imparting a great velocity to the water at the point of condensation, and it is this speed which causes it to enter the boiler. There is just the difference of placing a pound weight, say, *on* your toe, and letting the same weight drop—impact.—T. C., Bristol.

THE total quantity of basic iron, Mr. Gilchrist states, made during 1886 in the United Kingdom may be taken at 333,000 tons. As regards spiegeleisen and ferro-manganese, the total production in 1886 appears to have been 193,712 tons, which is an increase of 52,215 tons on the production of 1885.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors

Since our last, "Principia" has replied to 62382.

62233. G.W. Locos, p. 185.
62234. L. and N.W. Goods Engines, 185.
62237. Soft Colours, 185.
62238. Feed of Planer, 185.
62250. Small Accumulator, 185.

62413. Brasses, p. 281.
62432. SS. *Glen Rosa*, of London, 281.
62449. Flour Machinery, p. 281.
62454. Correction of Telescopes, 281.

QUERIES.

[62668.]—**Boring.**—Will some correspondent kindly inform me the best bit, and the best way of boring holes 2½in. in diameter, through hornbeam, without leaving a rough edge underneath? The hornbeam 1¼in. thick. Also the best way of boring a tapered hole 2¾in. at the top., and 2½in. at the bottom in hard wood. Large quantities of above have to be bored, and they will be done by machinery.—ANXIOUS.

[62669.]—**Smelting.**—Will some person acquainted with smelting, please state the malleable-iron process, remelting the same and flux used?—XERXES.

[62670.]—**Organ.**—At the Inventions and Music Exhibition (1885) an organ was exhibited by Messrs. Bishop which could be altered about a semitone in pitch at pleasure by the simple movement of an index placed within reach of the player. Would any kind reader oblige with a description of the mechanism, with sketch, if necessary?—BACH.

[62671.]—**Cleaning Castings.**—Could any reader give me a recipe for cleaning castings in iron and brass? I have tried dilute nitric acid, but it is too expensive, and the fumes are so obnoxious.—H. D. R.

[62672.]—**Dry Cleaning.**—Can any of "Ours" give me information as to the process of dry cleaning and dying, *nettoyage à sec*, so much advertised at present? Is it the subject of a patent, and if so information as to the No. of the specification. It is a process applied to cleaning of garments, lace curtains, &c.—ENQUIRER.

[62673.]—**Jupiter's Satellites.**—On the evening of the 20th there was a very near approach of the first and second satellites of Jupiter, and with a power of 60 they appeared as one object. Can any reader inform me whether one occulted the other, as I was compelled at 11 o'clock to leave off observation?—ARTHUR MEE.

[62674.]—**Mica.**—Can any of "ours" give me the percentage composition of a good sample of colourless, flexible mica?—MONS.

[62675.]—**Emery Wheel.**—Having broken my emery wheel right through in two pieces (the diameter is 8in. and thickness ⅝in.), is there any kind of cement to be had to put it together and stand its work as well as before?—YOUNG TURNER.

[62676.]—**Wire Running.**—Will any electrical reader of "E. M." inform me how a house of about seven or eight rooms should be wired to supply the current for lighting them by incandescent lamps? Supposing the source of electricity to be some little distance from the house, would not the lamps in the rooms nearest to the dynamo be more brilliantly lighted than those further off? And in consequence, would not the first-mentioned lamps have to be considerably over-run in order that the more distant ones may give out their proper light? By what arrangement of leads may this difficulty be overcome? Is it accomplished by using mains of different sizes, and in consequence different resistances? Or by coupling up the lamps in some of the combinations of parallel arc and series systems, or how? Supposing you can afford to lose about five volts in the leads. A diagram would oblige.—PUZZLED.

[62677.]—**Barrel Pump.**—I have a long barrel force pump that goes tremendous hard, wanting two men to work it. Well about 40ft. deep, and delivering about 40ft. from the ground; suction pipe about 2in.; delivery pipe about 1in. How can it be made to go easier? Is delivery pipe too small, or would an air vessel help it anything considerable? Please what is cause of difficulty?—S. H.

[62678.]—**Cracks on Stained and Polished Work.**—I had a ship's model to polish a few weeks ago, the upper part had to be black and the lower part the natural colour of wood (pine). It was made in two pieces, the upper part stained by mixing gas-black amongst the polish, and after putting the pieces together it was all finished with white polish. It looked all right, till a few days after, when the black part commenced to crack and now it is cracked all over; but the lower part shows no sign of cracking. If any of your readers could kindly inform me if it is the fault of the polish or the working of it that has caused it to crack, they will greatly oblige. The polish was made without any benzine.—MILNE.

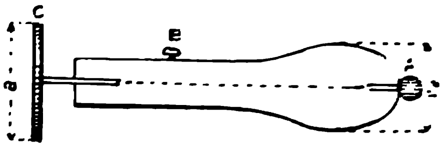
[62679.]—**Weak Ankles.**—I have had the misfortune to have my instep pressed down on account of too much standing; have now had it put in its place by a bone doctor. My difficulty now will be to keep it there, and fortunately, I have arranged for much less standing and walking, so that by strengthening them I may have the pleasure of stronger ankles. Would any reader oblige by stating if it is advisable to assist them by mechanical support (which best—elastic anklet or bandages)? I feel sure, with our multitude of readers, one or two at least will have a really good embrocation for natural weakness not sprain.—HARD STRUGGLER.

[62680.] **Santonine.** How can I dissolve [illegible] [illegible] only.) / Is there any other method but [illegible] ? [illegible] and, the exact quantity of spirit [illegible] [illegible].

[62681.] **Curvature of Lens.** How can I measure, practically, the curvature of a biconvex lens the surfaces of which are portions of two spheres having different radii? Given the lens you have to find its curvature on either side. If a section was on paper it could easily be found, but from the lens itself the curvature has to be measured. SOLAR RADIANCE.

[62682.] **Jew's Pitch.** A plate of glass is coated with asphaltum and developed (after exposure), so that the lines in the cliché are represented by bare glass in the relief. I want to etch away the glass, but I find it impossible owing to the bitumen leaving the glass when the etching fluid is poured on. The etching fluid is composed of a mixture of $CaF_2 + H_2SO_4$. I do not want to etch with the gas as the fluid is more energetic. Even the dilute H_2SO_4 attacks the bitumen. Any advice or reference will greatly oblige. SOLAR RADIANCE.

[62683.] **Clockwork Arrangement.**—Will any kind reader suggest a simple and [illegible] clockwork arrangement to fulfil the following conditions? To be enclosed in a case shaped as under, the object being to revolve the wheel C. The winding up should be at A



and at B there should be a pressure spring actuated from outside, the effect of which should be such that by a soft pressure the wheel C would revolve slowly, and by a firm pressure rapidly. It would be sufficient if the mechanism ran out after two minutes' continuous revolution of wheel C at a speed of, say 100 revolutions per minute, but longer if possible. I believe something taken from a small clock might answer my purpose; but as I am doubtful on this point I should be thankful for a little help from one of "ours."—MALTA.

[62684.]—**Chemistry.**—Is there any benefit to be derived by keeping ammonia sulphide in a green glass bottle? Also what method would the chemical students of the "E. M." recommend me to use to preserve paper labels from the action of acids, &c.?—T. J. T.

[62685.]—**Still.**—Will "B. Sc." or some other correspondent kindly say:—1. May I legally have a still in my possession without interference from the Excise? 2. If I may, what may I distil?—it will hold about a gallon?—LOYAL.

[62686.]—**Heating Bath.**—Will any correspondent give me an easy method of heating water for my bath? The bath is about five feet from, and nearly same level as a good-sized cess pot. I want to know if I can arrange anything to place in pot, that would convey the hot water to bath direct. There is a cold water supply to the pot. —HOT BATH.

[62687.]—**Deafness.**—To "EOS."—You say in "[illegible]" for June 24th that you were cured of deafness in one ear. Would you say what that treatment was or say where to be had?—A SUFFERER.

[62688.]—**Irish Moss.**—Will any of your readers inform me how I can make a complete jelly of Irish moss without spoiling its flavour? Any result I have had is lumpy and watery. I want all the moss properly dissolved and in a stable jelly. I cannot get any information in books.—A. C. D.

[62689.]—**Telescoping of Carriages.**—Can any of your readers inform me where I can see a picture giving a good representation of the telescoping of carriages in a railway collision?—G. W. N.

[62690.]—**Boracic Acid.**—Will Mr. Allen, Mr. S. Bottone, or other of our teachers, kindly say if boracic acid taken internally is harmful to health, in what way does it act upon the system, and what would be the symptoms produced by it? I have heard that it is used for preserving meat, fish, milk and animal fats. Does it effectually preserve them, how is it used, in solution or powder; or is it mixed with any other substance? What would be its effect upon ripe soft fruit, such as strawberries, &c.? Could strawberries and such like fruits be preserved (fresh) by it, or any other substance for eight or nine weeks, not cooked or partially cooked or by syrup? Any information or names of works hereon, would be very interesting to many readers both in England and the Colonies.—T. C. S.

[62691.]—**Compass for Navigation.**—I wish to make a spirit compass, such as are used on small yachts, the card will be 4in. diam., to be made of talc. What is the sort of paint used to paint it with (it has to stand being in spirits of wine without its coming off), and how is it mixed? What ought the size of the air-vessel to be, and how is the floating power of it calculated? Also what size ought the needles to be, and would they do if made of steel hardened and then rubbed with a strong magnet to magnetise them? Any other information on the above subject will be gratefully received.—H. H. D. B.

[62692.] **Springs.**—Can any correspondent who has had experience in the power and use of springs give me any information on the following? I want to make an apparatus about 6in. long by 3in. diameter, and inside to contain a spring that will cause it to revolve rapidly with part friction, for say, half a minute at each winding. What sort of spring would be necessary, and could it be contained in a barrel of that size?—TELEPHONIC.

[62693.] **Duration of Tropical Twilight.**—In reading through Mr. H. H. Johnston's book, "The River Congo," I came across the following brief mention of above (p. 276, second edition, 1884):—"The twilight that succeeds his (the sun's) immolation is some half hour in length." And again in a foot note: "The shortness of equatorial twilights is much exaggerated; night never sets in until half an hour after sunset." The locality where the observation was made is [illegible], on the Upper Congo, [illegible]. Mr. Johnston is a most careful and accurate observer [illegible] the fact of the exaggerated shortness of the twilight [illegible] experience [illegible]. [illegible] would have to be [illegible] minutes for [illegible] between theory and practice?—[illegible].

[62694.]—**Silvering without Battery.**—Can any reader tell me how to use the following recipe which [illegible] without any directions for its use? [illegible] of silver, [illegible] silver [illegible] [illegible], ammonia [illegible] water [illegible] of square copper, and [illegible] of platinum wire.—W. [illegible]

[62695.]—**Keying Eccentric Sheaves on Crank Shaft.**—Will some kind reader inform me the way in which the right angle for keeping the eccentric sheaves on the crank shaft is found, and how the required lap and lead of valve is determined? [illegible] with a [illegible]—[illegible].

[62696.]—**Density of Solutions.**—How can I calculate how much water must be evaporated to raise the density of any solution from its present density to a given higher density, having [illegible] of the strength of that solution? [illegible] much water must be evaporated per gal. to [illegible] sp. gr. [illegible] = [illegible] per cent. sugar [illegible] raise its density to sp. gr. of [illegible] = [illegible] per cent. sugar?—[illegible]

[62697.]—**Alcohol.**—How many pounds of sugar are required to produce the gallon absolute alcohol and how many degrees over proof would absolute alcohol be reckoned?—[illegible]

[62698.]—**Legal.**—I am a bee-keeper and my apiary adjoins [illegible] gardens. [illegible] a swarm lately, and my [illegible] these gardens [illegible] [illegible] where it had gone [illegible]. [illegible] swarm [illegible] and as I would not consent to [illegible] the swarm [illegible] information. Have I any redress?—[illegible].

[62699.]—**Locomotives.**—Can any of "ours" give [illegible] — [illegible] and the number of all engines belonging to the same class?— [illegible].

[62700.]—**Legal—Poor Rate.**—I was summoned [illegible] poor rate [illegible] and payable as stated in advance. About [illegible] after they called on me for payment [illegible] rate [illegible] summoned me without any previous notice. Can that rate-collector legally summons any person he may have a desire to without giving them a proper and fair notice, at any time after the date of rate? And what law is there that the rate should be paid in advance at all? [illegible] it seems a one-sided law, and totally different to anything connected with any other business. I should like to know the exact legal points on it, as I don't mind any expense to have justice.—F. T. [illegible]

[62701.]—**Canoeing from Oxford.**—Will any of "ours" kindly give information and cost of canoe and requisites for a trip from Oxford to Teddington, how to do it cheaply, and obtain the greatest amount of pleasure in the journey at the minimum amount of expense? Would it be better to take one's own canoe [illegible] miles to Oxford or hire one there? What stores, &c., and the best books on [illegible] description of the places, some of which are some distance from the river, but a book of the river one can work [illegible] from? I have one of the so-called "Guides to the Thames," but it is not what one wants on a trip of the kind I purpose taking.—YAK.

[62702.]—**Battery.**—To MR. BOTTONE.—I have a ten-cell Bunsen battery which I charge with chromic acid, and dilute sulphuric acid. How many of Swinburne's [illegible] volt, [illegible] incandescent lamps would it supply in parallel? —T. G. S.

[62703.]—**Dynamo.**—Will Mr. Bottone kindly give dimensions of [illegible] dynamo? Also lengths of wire required for same. Also what power will be required to drive.—T. G. S.

[62704.]—**Tour in Norway.**—Would Col. J. B. Campbell kindly state the name of a country place or places in Norway where one could live at the cheap rate mentioned in last week's reply, and at the same time have a few subjects for photography within easy reach? I intend taking a camera, and will land first at Bergen. Perhaps it would be better to make Bergen one's head-quarters and take trips from there; but any hints will be highly esteemed on a ten days' photographic tour.—S. [illegible]

[62705.]—**Drilling Bicycle Hubs.**—I am very much pleased with the contrivance of C. [illegible] for drilling the hubs of bicycles, and should for one be very much obliged to him or any other of your numerous readers, who I am sure know how to make cycles of various descriptions, if they would give us a few lessons through the "E. M." about the construction of such machines. A few articles on subjects of this kind would do more to advance the sale of the publication than anything else that I can think of.—[illegible].

[62706.]—**Stains in Plane Planks.**—I have a quantity of plane-tree wood in planks, cut some time ago, and then very white in colour, but now very much discoloured with dark patches and streaks. Can any contributor tell me how to remove these unsightly stains? I have heard that there is some kind of acid for this purpose.—G. T. BARNES.

[62707.]—**Dumb-bells.**—Can any reader tell me about what weight I should choose? I am 21 years of age, weight [illegible] stones, height 5ft. [illegible]in., occupation sedentary. I fancy there was a small pamphlet published a few years ago, giving advice and several interesting feats with dumb-bells. Can anyone give me title? Any particulars on this subject will favour.—L. [illegible] CLERK.

[62708.]—**Tokens, &c.**—1. What are these issued for? I have one dated 18[illegible], having "Bank of Upper Canada," and St. George and Dragon on one side, and "Bank Token—one penny" and a design on the reverse. 2. I have also a piece of copper money with "esse quam videri" on one side accompanied by a lion, and "Hull halfpenny, 18[illegible]—payable by I. K. Picard, Lead Works, Hull," on the reverse. 3. Is Maundy money considered legal tender? 4. What is the significance of the "H" which appears on many pennies and halfpennies? Any information will much oblige.—[illegible].

[62709.]—**Hot-Air Engine.**—Will J. Seal or others kindly give dimensions for a hot-air engine on his model, as recently illustrated, for a full one horse-power, both [illegible] diameter and length of stroke of working cylinder and [illegible]. How should the displacer in a large engine be made, of what material, hollow or filled, and if filled with what material?—MOTOR.

[62710.]—**Electric Communication.**—To "SIGMA," S. BOTTONE, AND OTHERS.—Two houses, [illegible] yards apart are required to be connected by electric bells and signals. What sized wire (would galvanised iron wire do), and what battery power is necessary?—ELECTRICUS.

[62711.]—**Telephone Circuit.**—Will some reader kindly say whether a double line wire is necessary to effect telephonic communication between a distance of 100 yards, or would the earth form the return circuit?—EOLUS.

[62712.]—**The Lake District.**—Will "Eos" or some other correspondent give me particulars of English Lake District as a place of residence, especially as regards climate and healthiness?—FYLDE.

[62713.]—**Reducing Cyanide of Gold.**—I have a gold plating bath which has got contaminated with copper. Will Mr. Bottone or Mr. A. H. Allen tell me if I can recover the gold by the following plan? Precipitate the copper, &c., by a stream of hydric sulphide, filter and precipitate sulphide of gold with sulphuric or hydrochloric acid. Will it be necessary to reduce the sulphide of gold by heat before dissolving in aqua regia, or must I add it to the sulphide to get a bichloride of gold? —TAU THETA.

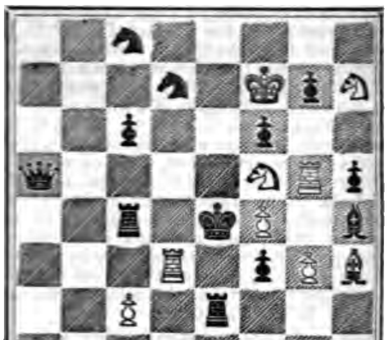
[62714.]—**Electro-Metallurgy.**—I shall be glad if some practical electro-metallurgist will tell me the weight of silver per square inch usually deposited on the best quality plated spoons and forks. Napier in his "Manual" says "[illegible] to square foot = 5gr. to square inch gives a good plate," and I wish to know if this is equal to the best quality plate in the trade. I should also like to know the weight of gold to the square inch, to give a serviceable plating to watch cases, chains, finger rings, &c.—TAU THETA.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM ML.—BY A. BOLUS.

Black.



White. [10 + 11

White to play and mate in three moves.

SOLUTION TO 1,047.

White.	*Black.*
1. Kt-K 4.	1. P-Q 6 (a).
2. Kt takes B (ch).	2. K moves.
3. Kt mates.	
	(a) 1. K takes Kt (b).
2. Q-K B 5 (ch) &c.	
	(b) 1. B or B-P moves.
2. Kt-B 5 &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,048 by A. Dean, G. A. A. Walker, J. J. Spence, T. H. Billington and Black Pawn; to 1,047 by T. H. Billington and G. A. A. Walker.

PROBLEM (1,047), having been published before, will not be included in the competition.

HENSING.—You will see 1,047 is sound enough.

A. E. MACKETT.—If in 1,048 1. $\frac{\text{Kt-R 7}}{\text{P-Q 6}}$ 2. $\frac{\text{Kt-B 6}}{\text{B takes Kt}}$

M. FLORAN DE VILLEPIGNE has devised, in Paris, an instrument, the autographometer, which records automatically the topography and difference of level of all places over which it passes. It is carried about on a light vehicle, and those who wish to use it have nothing to do but to haul it, or have it hauled, over the ground of which they desire to have a plan.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,025.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: Nos. 1,003, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 29, and unacknowledged elsewhere:—

B. AND F.—Col. O'Hara.—J. and W. Archbutt.—Julius Sax.—Blakey, Emmott and Co.—T. Casson.—G. Calver.—W. B.—Cooper and Morris.—G. Birch and Co.—Rev. W. M. White.—J. Francis.—F. Childers.—W. Rogers.—C. Simpson.—M. Glover and Co.—G. Plant and Son.—Coney.—Lex.—Oil Rag.—W. G. W.—Nero.—T. B.—J. S.—E. Gobert.—I. C. T.—C. A. Beney.—E. M. Richards.—R. E., Belfast.—Arthur Mee.—G. S. M.—S. Bottone.

J. A. JEFFREY. (The A. B. C. manure was produced from sewage by means of alum, blood, and clay. Whether it is so produced nowadays we do not know, nor who sells it. The query itself is against the rules, and should be inserted in the "Wanted" column.)—HARRY FRIVOLI. (All the details necessary to determine what can be done by any battery arrangement can be found in our back volumes. To those conversant with the subject, it is well known that electric light cannot be obtained as cheaply as gas-light, and as to the batteries the only chance is that some one may discover a combination in which the battery products are worth more than the original cost of the materials, and so the current is obtained for nothing. How long such a condition of things could last is a material question; but at present you may be sure that no such battery combination has been discovered. Many people have seen the battery referred to, and it will be quite time enough to enter into details when the promises have become performances. Even in recent numbers some of our correspondents have endeavoured to make that fact plain.)—ROCKET. (You will find a good deal of useful technical information in back volumes as to the making of fireworks; but if you would prefer a book, procure Kentish's "Pyrotechnist's Treasury," Chatto and Windus.)—O. G. BARRINGTON JONES. (You are quite correct in your description; but unless you possess the determination to succeed, and will not be disappointed by a good many failures, we would advise you not to attempt to cut and polish Iceland spar by way of economising. Even the most skilled workers occasionally make what we may term "failures," and no novice can hope to succeed. Still, if you are determined to try, write again, and we will see what can be done to help you. If you want only a prism, better purchase one from those who have made it a business to construct them.)—ELECTRA, Newport. (No sketch needed. The description has been given long ago, though in this case not many times, for the arrangement is so simple. The current merely passes through the magnet as often as the circuit is made at the key, and so the armature being drawn to the poles, the hammer strikes the bell.)—CLEANER. (The company may have some rule to that effect; but we should think the locomotive superintendent would not study about mere age if a "cleaner" was fit for promotion, and he wanted a "fireman." You can easily ascertain whether there is such a rule by asking any of the drivers, or by inquiry at one of the yards.)—REX. (If received, some notice was taken of it. Any druggist will make you up a hair-dye, as jet black as it is possible to make it; but you must remember that with any dye the application must be often repeated. There are some good recipes in Nos. 394, 398.)—A. E. B. (The answer has been frequently given—the Leclanché.)—AN AMATEUR. (See the indices of back volumes or any textbook. The Post-office form of Daniell was described so recently as p. 273. As to "better results," you must explain what it is you want to do before that question can be answered.)—W., Photographic. (If you cannot refer to back volumes, why do you not procure one of the many excellent guide-books to the art which are published nowadays? The best burnisher is probably the roller press; but a higher degree of polish—an objectionable polish, in fact—is produced by the common burnisher which consists of a piece of iron with a smooth steel edge mounted in a frame carrying a roller: the iron is heated by a gas-jet (Bunsen burner) and the prints are drawn over the steel edge by turning the roller. If not carefully done they are liable to be torn. Before burnishing or rolling the prints must be rubbed over with a solution of Castile soap, one grain to an ounce of methylated spirit. When dry they are ready for the burnishing or rolling process. The simplest device you can have is a steel roller and a steel plate; heat the latter, place the print on it, and roll until you get the desired degree of polish.)—U. DEALER. (We believe we answered you last week. You must keep up the temperature by means of a lamp or boiling water. There is a good form of incubator in No. 1009, p. 471, and several other forms in back volumes.)—W. F. C. W. (If you will kindly look on p. 135 of this volume—the number for April 8—you will find a table which answers your question so far as it can be answered in a short space. For further information consult the tables in Mr. Sprague's work. The size of the cell has nothing to do with the question of the number of volts. Is your composition cheaper than zinc, or do you get the current for nothing? Bichromate or chromic acid cells are about the only simple arrangements that give two volts; but Grove's gas battery and the lead peroxide will, we believe, give a trifle more.)—CARINO. (If the dog shows no symptoms of rabies there is no ground for alarm.)—SPINE. (Only a medical man can diagnose the case, and even he would require to see the patient. It may be, and most likely is, rheumatism.)—IGNORANT. (Perhaps the replies to the query referred to may suit you; but there are recipes in back volumes, and many little handbooks of the art.)—STICKY. (The cement is usually a mixture of guttapercha and pitch. If too brittle, add a little guttapercha.)—DONCASTER. (Where do you find any reference to it? The address must be advertised for.)—H. S. (You can purchase transparent lacquer at any of the shops in Clerkenwell where watchmakers' materials are sold.)—FIGURES. (No room for such questions just at present. You will find similar examples in back volumes, and any good arithmetic gives the rules.)—CAPUT. (No; those of Asam are even salubrious. See Nos. 940, 955, for much information about Indian tea plantations. 2. It is none the worse for being so old; but the later editions contain much more. 3. It is simply dressed with a drying oil.)—R. M. (For directions for making a bellows camera see Nos. 953, p. 380, or No. 894, p. 224.)—C. M. (You may possibly obtain it now from some of the large dealers in chemical reagents; but there is no great demand for it, and we believe it is made only in Leipsic.)—GRATEFUL. (There is a good deal about eczema and its treatment in Vol. XXXVII. pp 114, 135, 178, 201, 223. See also the index of Vol. XXXIV. It is most important to discover the cause; then the treatment may be successful.)—VEXT. (Better let them sue you and defend the action. Not that we expect you have much chance of escaping payment, unless you can really satisfy the judge the goods are rubbish.)—R. SMITH. (No. It is simply good as evidence of an intention to assign the patent; but there should be a proper assignment drawn up by a solicitor.)

HARNESS' ELECTROPATHIC BELT should be worn by all WEAK MEN AND WOMEN. It restores health, strength, and energy to the whole body, and promptly relieves and cures all Nervous and Rheumatic Affections, Liver and Kidney Diseases, Sleeplessness, &c. Thousands of testimonials received. Pamphlet and advice free of charge. Harness' World-famed Electropathic Belt may be obtained (post free) by remitting Cheque or P.O. for 21s., to Mr. C. B. HARNESS, Consulting Electrician, THE MEDICAL BATTERY COMPANY (LIMITED), 52, OXFORD STREET, LONDON, W. (corner of Rathbone-place).

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For every succeeding Eight Words	0	3

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⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

Advertisements must reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

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PAYABLE IN ADVANCE.

6s. 6d. for Six Months and 11s. for Twelve Months, Post Free to any part of the United Kingdom. For the United States, 13s., or 3 dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-office Order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 4d. each to cover extra postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. IV., VII., XXVI., XXVIII., XXX., XXXII., XXXIII. XXXIV., XXXV., XXXVI., XXXVII., XXXVIII., XXXIX., XL., XLI., XLII., XLIII., and XLIV., bound in cloth, 7s. each Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.).

Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

USEFUL AND SCIENTIFIC NOTES.

A New and Impervious Dressing.—Photoxylin, a substance in use amongst photographers, was recommended some time ago by Dr. Krysinski as a suitable material for mounting microscopic specimens, and more recently still it has been utilised by Prof. Wahl, of St. Petersburg, as a substitute for collodion in surgical practice. A 5 per cent. solution in equal parts of alcohol and ether he finds preferable to collodion, as it adheres more firmly to the skin, not being so easily rubbed off in washing. It is absolutely impervious to liquids, and exerts a perfectly even compression on the tissues. In out-patient practice Prof. Wahl finds that, after small operations such as the extirpation of glands, the application of photoxylin solution enables him to dispense entirely with voluminous antiseptic dressings; also in plastic operations on the face, and in operations in the neighbourhood of the male congenital organs, such as those for the radical cure of hernia and castration, where it is very difficult to prevent the urine soaking through antiseptic dressings. Prof. Wahl, after carefully arresting all hæmorrhage, closes the wound with sutures and gelatine plaster, and then covers the whole with a thin layer of wool soaked in a solution of photoxylin. This, it is stated, will remain eight or ten days, entirely resisting all the effects of moisture. Even in laparotomy, extensive dressings may, he believes, be dispensed with by painting a solution of photoxylin over the wound with a brush, or by the application of a layer of cotton wool soaked in the same liquid. Photoxylin appears to be unknown in this country. It was introduced by Messrs. Mann, of St. Petersburg.—*Lancet.*

Massage in Fractures.—Dr. Georges Berne recently made an interesting communication to the Société Médicale de l'Elysée on the treatment of certain fractures by massage. After showing the importance of a good venous and lymphatic circulation in fractured limbs, he insisted upon the necessity of keeping the joints in the neighbourhood movable and supple. It is particularly in fractures of the radius and fibula that massage is useful, the inferior epiphyses being supported, as it were, by natural splints in the shape of the contiguous bones. Where there is not displacement, extensive centripetal *effleurage*, commences early in the treatment, will promote the absorption of the blood extravasated around the fracture. Von Mosengeil has shown that massage displaced effusions through the lymphatic network of the cellular tissue, and the same thing occurs when centripetal pressure is applied above the seat of fracture. The rapid retraction of the tendinous sheaths of the fingers when they are immobilised is a matter of common experience. Dr. Berne maintains that this accident, almost inevitable with the usual treatment, may be obviated by massage. Dr. Berne is also an advocate for massage in fractures about the elbow and patella, but he urges the necessity of caution whenever there is displacement or wound of the integument. In all cases, however, he maintains that manipulations should be performed by an expert scientific masseur—never by the so-called medical rubber.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Pills.—Nervous Debility.—These Pills are the best regulators and strengtheners of the nerves, and the safest general purifiers. Holloway's Pills are particularly recommended to persons of studious and sedentary habits, who gradually sink into a nervous and debilitated state unless some such restorative be occasionally taken.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Wanted, a **Stopped Diapason, Kerolophon, or other 8ft.** stop, for light wind. Will give useful exchange.—A. T. INSKIP, Shefford, Beds.

112 **Circular Cutters** and other Tools, cost 4d. to 6d. each, fitted with spindles, suit a lathe; 3½ Leg Vice and Sausage Machine.—Address as below.

Exchange for **Stocks and Dies**, Whitworth thread, over ½, or small Drilling Machine, or offers. Stamp, particulars of above.—SEDGLEY, 22, Ryding-square, West Bromwich.

Camera, ½-plate, mahogany body, with achromatic lens, dark slide, 2 printing frames, 3 Dishes, and "Marion's Guide to Photography." Will exchange for Musical Box or offers.—J. ASH, 1, Park-street South, Wolverhampton.

Will exchange a good **Monocular Microscope** for good Portrait Lens.—J., Lower Eaton, Hereford.

Boston **Lever Watch**, good timekeeper. Exchange Medical Coil Machine, or small Telescope.—W. J., 34, High-street, Aberdare.

Complete set of **Double Engine Castings**, 2H.P. Cylinders bored and turned, valves fitted. Stamp.—E. A., 2, Alexander-road, Knaphill, Woking.

Model of **Railway Milk Churn**, strong tin, with brass mounting, suitable for milk seller's window or ice-cream shop. Exchange.—W. BUTTERWORTH, Tutbury, Staffordshire.

Wanted, Stocks, Dies, Pipe Tongs, or Fitter's Tools. Exchange 2 Vols. "Ward and Lock's Industrial Self-Instructor," publisher's bindings, also "Cassell's Encyclopedic Dictionary," to date, or offers.—G., 41, John-street, Luton.

Wanted to exchange, a 5in. **Lathe Head**, by Worssam, of Chelsea, and an Electro-Motor for sewing machine, and a Rhumkork's Coil (4in.), for a good strong 5in back-geared Lathe Head. Must be in perfect working order.—T. C. S., 85, Freshfield-road, Brighton.

Lathe wanted, about 4½in. centre, part money and part exchange.—Apply, W. ASHDOWN, Junior, High-street, Crayford, Kent.

Medical Electricity.—Griggs' Patent Conical Electro-Magnetic Machine, cost 10 guineas; Halse's 12-cell Silver and Zinc Battery and Coil, in exchange, Standard Electrical Works, or Electro Deposition Apparatus.—8, King-street, Truro.

Dynamo, laminated armature, 4½ by 5½, splendidly made machine, good as new. Exchange. Photo.—E. THORNTON, Handpool-road, Barrow-in-Furness.

Will exchange my **Electro-Plating Dynamo**, 12in. H Armature, made by Opperman Bros., for second-hand Jeweller's Flattening Mills, with multiplying gear.—Below.

Pair of 13in. **Tailor's Shears**, new. Will exchange for Serge, Scotch, or West of England Cloth.—CHAS. HOOPER, jun., Salisbury-street, Mere, Wilts.

Castings for very powerful Launch Engine, 5in. bore 6in. stroke. What offers? Particulars and sketch, stamp for reply.—BELL, 11, Tilery-road, Stockton.

Wanted, Shaping Machine or a Milling Machine for power. Exchange 54in. Coventry Machinists' Special Club Bicycle, cost £18, part nickel-plated, very little used.—T. E. BLUNDELL, 103, Great George-street, Liverpool.

Small **Induction Coil**, with condenser; also small Motor and 4-cell Bichromate Battery, in stained box, with 5 c.p. lamp.—J. BALDWIN, Broadway, Sutton, Surrey.

Clarionette, B flat, 10 keys. Exchange for set of 8ft. Harmonium Reeds, or offers.—H. DAVIESON, Alexandra-road, Tonbridge.

Dulcimer, fine tone, by Walker. Exchange for anything useful; Bunsen Battery or Nickel-plating requisites preferred.—29, Traffic-street, Derby.

Best **Cast Steel**, short bars, 1 to 5ft., ⅜ to 1¼; octagon, suitable for chisels. Offers per cwt. requested.—GILBERT, Oxford-road, Sheffield.

"**National Encyclopaedia**," 7 volumes, new, cost 84s. Good Portrait Camera Wanted, or offers.—J. NEWMAN, 14, Boarded-lane, Reading.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Patent Heat Conductors, for cooking, save one-third time and firing, and one pound of meat in every ten pounds cooked, retaining all nourishment.

Roasters and Bakers, 2s. 6d.; Boilers, 2s. Of all ironmongers. Pamphlet free.—TALLACK, 28, Hatton-garden London.

Carbon Plates, best quality, cut and moulded, plain and capped; quality cannot be surpassed.—GEO. G. BLACKWELL.

Pebble Carbon.—Graphite for Leclanche cells, splendid conductor; price very low.—GEO. G. BLACKWELL.

Manganese Oxide specially prepared for Leclanché, batteries; high strength and purity, greater E.M.F., constant action; been in use 15 years with immense satisfaction; 7, 14, and 28lb. packets. Prices on application.—GEO. G. BLACKWELL, 26 Chapel-street, Liverpool.

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New Illustrated Price List of **Screws, Bolts, and** NUTS for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Wheel-Cutting to 12 inches diameter in brass only.—CLEGG, 15, Belinda-street, Hunslet, Leeds.

Planing to 12in. by 12in. by 8in. Boring, Turning Screw-cutting, Slide-rests, &c.—CLEGG, as above.

Mica or Talc.—RICHARD BAKER and CO., 9, Mincing-lane, London.

Electric Depot, 10, Deansgate, Manchester.—Handiest shop in the trade. Largest stock. Greatest variety. Lowest prices.

6in. Tulley **Refracting Telescope**, equatorially mounted, and nearly new Observatory for same, with revolving dome, cost over £150; price now asked £75; or will accept in exchange a good Horse and Trap equal to that amount.—F. S. A REID, 23, Ludgate-hill, E.C.

Steam **Boilers** of all kinds, one horse-power and upwards.—GRANTHAM CRANK and IRON COMPANY (Limited), Grantham.

Watchmaker's Oil, original, true, non-congealable, 1s., free. Avoid imitations.—GODFREY and COOKE, 30, Conduit-street, W.

DANCER'S Tourists' **Opera and Field Glasses** New series, illustrations one stamp.—11, Greenhill-street, Greenheys, Manchester.

The Piles.—Dancer's Tubes afford relief. Directions in case, free 9 stamps.—11, Greenhill-street, Manchester.

Woollen Cloths for men's and boys' suits, direct from the manufacturer, thus saving intermediate profits.

Woollen Cloths.—Patterns of new season's goods, fancy coatings, trouserings, hair lines, &c., post free on application.

Woollen Cloths—Any length cut. Write for patterns to CHARLES ARROW, Woollen Manufacturer, Piece Hall, Halifax.

Simple Rules for Transmission of Power by belts, ropes, shafts, and wheel gearing, are contained in illustrated price list, post free, on receipt of one stamp.—BAGSHAW and SONS, Engineers, Batley, Yorkshire.

"**Beginner's Guide to Soldering**," containing simple, practical directions for soft soldering, hard soldering, cold soldering, and

Chemical Soldering, with twenty receipts for making solders. Post free, 1s. 1d.—HERBERT JONES, Broadfield, Wallasey, Cheshire.

Wall's Patent **Variograph**, for vitrified ceramic photographs, for plain and coloured photographs. Variograph Solution, Variograph Plates, Variograph Paper, only obtained from the Inventor and Patentee, R. T. WALL, Acacia-villa, Longfleet, Poole.

"**Beginner's Guide to Photography**," one shilling. Wholesale of the publishers, LEJEUNE and PERKEN Hatton-garden, London.

"**Beginner's Guide to Photography**," one shilling. Free from abstruse technicalities. Retail of Opticians and Booksellers.

Lathes, Files, Saws, Steel, cheap, good. List 2 stamps. Cash or hire.—ROBINSON, Catherine-street, Sheffield.

Chromic Acid, in 1 and 2lb. patent airtight canisters, 1s. 1d. and 1s. 10½d., post free.—H. AUSTIN.

Chromic Acid. Insulated Wires, Jars, Porous Cells Carbon Plates, Zinc Rods, &c. List, one stamp.

Use Chromic Acid for primary batteries, powerful, clean, and fumeless.—H. AUSTIN, Amberley-road, Armley, Leeds.

Lathe Castings, &c.—See T. Taylor's advertisement in ENGLISH MECHANIC every other week. Established 1847.

For improved **Leclanche Batteries**, Bells, Wires, and Fittings, best make, apply, FOWLER, LANCASTER, and CO., Birmingham.

Fowler, Lancaster, and Co., Birmingham, manufacture all Electric Apparatus. Best workmanship only. Lists on receipt of postage.

Launch Engine Castings, Forgings, Working Drawings, various sizes, illustrated list, 2d.—ENGINE WORKS, Tintern-street, Sunderland.

Gas Engine Castings.—"Compression principle," latest improvements. Photo and particulars, 1s.—9, Raby-street, Millfield, Co. Durham.

Mesmerism.—"This book is a very good one; anyone can learn the art from it."—*Weekly Budget.* 2s. 6d.—W. THOMAS, 22, Clarendon-road, Anfield, Liverpool.

Dynamo Building for Amateurs or **Engineers.**—Illustrated Pamphlet, 1s., post free, from ALFRED CROFTS, Dover.

Liverpool Astronomical Society.—Now ready, Vol. V. of "Journal," 8vo., 232pp., with index, and 43 lithographic illustrations on toned paper, cloth lettered, 4s. 6d. A sample of the Journal, post free, 6d.—Apply to W. H. DAVIES, Secretary, Irvine-street, Liverpool.

Trouser Lengths, 5s. Cheap Cloth for Ladies' dresses, jackets, boys. Patterns free.—HEWITT, Winfield Mount, Leeds.

Second-hand **Lathes**, Drills, Planers, &c. Send 2 stamps for list.—BRITANNIA CO., Colchester.

Notice.—Our new address is—100, Houndsditch, London. All letters to BRITANNIA WORKS, Colchester.

We are **Bona fide Makers** of upwards of 250 varieties of Engineer's Tools, and constantly adding.

New Inventions or Models of Patents exhibited. Patents disposed of.—BRITANNIA CO.

Prize Medals and repeated orders from the British and other Governments attest the standard quality of our tools.—BRITANNIA CO., Colchester.

Horizontal Engine (brass), 1¼in. bore, 2in. stroke, copper boiler, complete.—B. PHELAN, 147, Brook-hill, Sheffield.

For Sale, Holmes Burke's **Battery**, 27 cells, with new zinc plates and porous pots, for arc or incandescent lamps.—Apply, R. RIMELL, 11, Clapton-pavement, Clapton, E.

Bell, No. 2 Leclanche Cell, Push, 24 yards wire, 7s.—THORPE, 59, Theobald's-road.

Electro-Plating and Gilding successfully Taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Nickel-Plating.—Batteries, Nickel Salts, and Anodes. Every requisite.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Calico Mops, Scratch Brushes, Potash Brushes, Polishing Sand, Lime, and Rouge, Compositions for Finishing.—Address, HENRIC.

Small **Printing Plant**, nearly new, with every requisite, would suit young beginner or private firm, price £45. Genuine bargain.—MITCHELL, Printer, Kent-street, Leicester.

Grand Result.—Inventions Exhibition.—English Cremona Violin. Warranted equal Stradivari. Inspection by appointment.—WOOD, Blindley Heath, Redhill.

Two syphonoid unpolarisable **Primary Batteries**, each of 4 cells, with plates, 9 by 5 inches, risen and lowered by windlass.—WARREN ROUSSEAU, Clarendon-road, Walthamstow.

Re seat your Chairs with the new Perforated Bent Wood Seats, post free 9d. Cut paper pattern size. Everyone is buying them.—SHINNER, Edgware-road, London. Wholesale supplied.

Two small **Lathes** for sale, suit dentist, clock, or scientific instrument maker, £1 17s. 6d. and £3. Photo, 3d.—M., 58, Dean-street, Soho, London.

Leclanche Batteries, constant and strong, from 2s. each. Separate parts supplied. Prices on application.—CARTER.

Electric Bell Sets, from 8s. complete, can be fixed by anyone.—WALTER CARTER, 186, Camberwell-road, London.

Sozedus.—A new organic chemical. The best preservative and anti-ferment. Sample and particulars, 3d. stamps.—The SOZEDUS CO., Birkbeck-road, Harrow-green, E.

Electro Motors for Paddle or Screw Boats.

The **Medical and Blasting Dynamo**, in stained case, 35s.; in polished walnut case, £2.

The **Medical Dynamo** will light two 3c.p. lamps, or from lathe two 5c.p. lamps.

Blasting Dynamos. Special designs. These are far more powerful than magneto exploders.

Electro Motors, Hand and Power Dynamos of the latest designs, short thick magnets, silk wire throughout.

Galvanometers and Electrical Testing Apparatus.—G. BOWRON, 97, Crawford-street, W.

Steel Name Stamps, 3d. per letter. Figures, set, 2s. 4d. Letters, 6s. 4d.—E. F. BALDWIN, Robinswood-hill, Gloucester.

Cheapest and best long-focus portable **Cameras** made, all movements and improvements, ½-plate, 61s.—W. SMITH, 11, Broad-street Corner, Birmingham.

Castings.—New Designs and Price List of Launch, Horizontal, and Vertical Engine Castings. Drilling Machine, Lathe, Governor, and Pump Castings, Screw Taps, Valves, Lubricators, 1 stamp.—TOMLIN, Engineer, Highfield-terrace, Barnsley, Yorkshire.

French Polishing, Staining, Painting, and Varnishing.—125 Trade Recipes, with full instructions and details, post free, 1s.—I. TOMLIN, 28, Highfield-terrace, Barnsley, Yorkshire.

Small **Electric Incandescent Lamps**, ¼in. diameter, post free, 7d.—W. HABGOOD, Hazlebrook, Buccleuch-road, West Dulwich, S.E.

Galvanometer, sensitive to delicate currents—vide ENGLISH MECHANIC, June 17th, post free, 2s. 6d.—Address above.

Piles cured first application.—Palmer's Indian Ointment. 13½d. Fifty years' celebrity. Acknowledged infallible boon to sufferers.

Accompanies Palmer's **Indian Ointment**, internal remedies and instructions (gratis), guaranteeing health.—Chapel-terrace, West Auckland, Durham.

Palmer's Astonishing Cures!—Indigestion, liver complaints.—Digestive Powders, 13½d. Liver Pills, 13½d. Establishing permanent health.—Above.

Brass **Model Engine Castings**, rough and finished, best quality; list, stamp.—WOOD, Dalley-street, Broughton, Manchester.

Gasoline—the finest—for Gas-making, 1s. 9d. per gallon, cheaper by barrel. Guaranteed.

Finest **French Polish and Varnish** from 3s. 6d. Lubricating Oil, from 1s. per gallon.

Virgin Cork, 12s. 6d. per cwt. Crystal Oil, from 5½d. per gallon.

We are now Contracting to Supply **Burning Oil** for winter months. Particulars from—H. JONES and Co., Viaduct-street, E.

Dynamos for Lighting—Experimental Dynamos—Hand Dynamos, Plating Dynamos, new designs, Electro Motors, &c.—F. S. WILLIAMS.

Jubilee Dynamos—several at reduced prices; only used a few times for Jubilee.—F. S. WILLIAMS.

Electric Light Installations undertaken; every description of electrical apparatus. Trade supplied. List, 2 stamps.—F. S. WILLIAMS.

Notice.—In consequence of **Fire** at our London agent's, all orders, &c., to be sent direct to—F. S. WILLIAMS.

Insulated Wires and **Cables** of every description.—F. S. WILLIAMS, Chauncy-street, Edmonton; and at Tottenham.

Cable.—Quantity of good second-hand Electric Light Cable, almost all sizes, half price.—GILLETT.

Induction Coils—new, misfits, 2s. 6d. each; postage 6d.; very powerful.—GILLETT.

Lamps.—Quantity of Swan Incandescent Lamps, 5 and 10 candle power, 2s. 10d. each.—GILLETT.

Large Induction Coil, suitable for Rheumatism or other purposes, 10s. 6d., cost £2.—GILLETT, 36, Red Lion-square, W.C.

Small **Astronomical Telescope**, with equatorial mounting and accessories, in perfect condition.—Apply by letter to ASTRO., care of J. Lee, 44, Liverpool-street, London, E.C.

Six new 1-keyed B flat **Flutes**, 10s.; 30 new [illegible] Pots, 5s. 12 Cup Bells (Bell Metal), 5s., or offers in Castings.—E. STONER, 10, Roman-road, Bow, E.

Will sell my Taylor's Lockstitch **Sewing Machine** in good working order, on ornamental stand, only 25s.—CHAS. HOOPER, jun., Salisbury-street, Mere, Wilts.

French Polish.—Recipes for making all qualities proved to be the best for working, durability, and gloss, by 9 years' experience, 1s.—H. DAVIESON, Alexandra-road, Tonbridge.

One-horse **Table Engine**, new, very cheap. [illegible] Smith's Fan, Castings.—LEA, King-street, Melksham.

Varnishes.—Simple methods for making excellent cheap varnishes. 4 recipes, with instructions, 1s.—Below.

Sealing Waxes.—Six assorted recipes, with instructions, 9d. List of others.—G. WEST, 9, Chances-row, High-road, Tottenham.

Calver's **Mirror and Flat**, 6½in., home mounted.—A. BEST, 2, Comboss-road, White Post-lane, Hackney-wick.

Shippey Brothers.—The Universal Electric Light Agency, 13 and 14, King-street, Cheapside, London. Lists, 3 stamps.

Shippey Brothers supply Engines, Dynamos, Batteries, Arc Lamps, Fittings, Shades, Carbons, Cables, Wire, Switches, and everything Electrical.

Electric Light Installations carried out in any part of the world, by water, gas, or steam-power.

Shippey's double surface "**Hydro-Carbon** BATTERY PLATES," the best plate yet introduced for Battery Lighting.

Domestic Electric Lighting.—Complete sets of the Volta Pavia Battery supplied by us for lighting 3 to 10 lamps for 300 hours with one charge.

Shippey's Patent Battery Lamps are supplied by us in 4, 5, 6, 8, 10, and 12 Volts. Sample by post, 2s.; [illegible] dozen.

N.B.—These **Lamps**, being of very low resistance require 50 per cent. less outlay for plant to light them.

Dynamo Lamps in all voltages and candle-power. Most economical lamp in the market. Sample, 4s., [illegible] dozen.

Coloured Incandescent Lamps for Jubilee Illuminations, all voltages and colours, 4s. each.

Battery Switches, new patterns, 2-light, 1s. 6d.; 4-light, 2s. 6d.; 6-light, 5s.

Eclipse Bell Sets, 6s. 6d., 7s. 6d., 8s. 6d., 10s. 6d., with wire, push, and battery, complete.

Shippey Brothers require Special Agents for all districts not represented. Liberal terms to practical men of business.

Emperor Dry Plates.—Half-gross ¼, 4s. 6d.; ½, 7s. 6d., any developer.—ROGERS, 25, [illegible]

Blacksmith's **Drilling Machine**, new [illegible]
drills 1¼ inch.—BEECHING and Co., [illegible]

Copper Boiler, 36in. by 14in.
stand, all fittings, cheap.—CLIPSON, [illegible]

Bench Lathe, 2½ centres,
motion, 35s.—BROMLEY, Engineer, [illegible]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JULY 8, 1887.

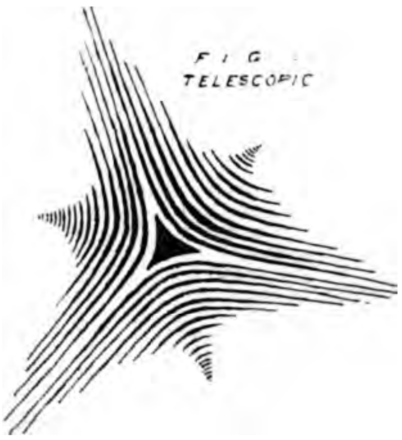
MICROSCOPICAL ADVANCES.—XX.

By Dr. ROYSTON-PIGOTT, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians; Fell. Cambridge Phil. Society; formerly Fellow of St. Peter's College, Cambridge.

Diffraction, Ancient and Modern.

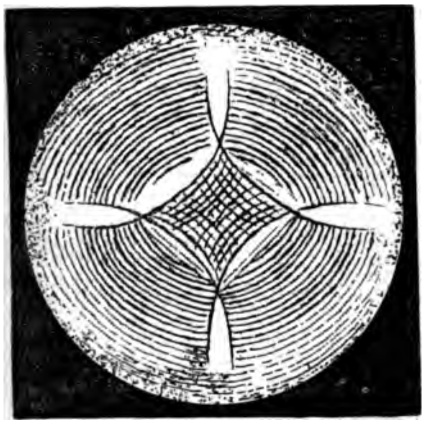
NOTWITHSTANDING the close relationship between microscopic and telescopic solar diffractions, no drawings of the former have been published.[*] Yet these phenomena beautifully illustrate each other. There is no more important subject, when appreciated, in the whole realm of optical science than what we have now on hand. Its principles embrace the behaviour of every beam of light which glances off any body intercepting its course. To give a few more instances of optical similarity, take Sir John Herschel's diagram (telescopic), entirely composed of hyperbolic curves. The diffractions are caused by a small triangular aperture placed before the telescopic object-glass directed to a distant luminous point as a real or artificial star.

F I G
TELESCOPIC



MICROSCOPIC.

F I G 2

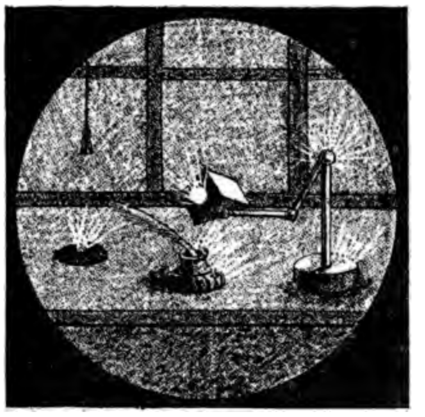


Grimaldi, who began his researches about 1620, does not state the distance of the aperture from the diffracting body or from the shadows and bands thrown upon a screen. Two hundred years afterwards, Fresnel [illegible] exact results. The distances (in a [illegible] of the luminous aperture from th[illegible] body (a wire) were most carefully ascertained. He got the finest and clearest bands, when the wire was as small as one-tenth of a millimetre[*]—i.e., 1-240th of an inch in thickness, placed about 20ft. away from the luminous aperture and 3ft. from the micrometers. Finding the motion of the sun rapidly destroyed the scene, he inserted in this minute hole a drop of honey, which answered admirably; better, by using a very small lens of great convexity, shading the ray with ruby-coloured glass of great rarity, lent by M. Arago. With this, Fresnel obtained extraordinary exact micrometric measures for the red and orange rays, all others being extinguished. He thus produced a pure homogeneous ray. The "micrometer wires" were made of silk thread."[†]

It is now proposed to describe the heliostats which I have found most convenient for divulging diffraction beauties, quite hidden unless very high microscopic power be employed.

Heliostat[‡], after Dr. Royston-Pigott (Proceedings Royal Society 1873).

I have always found (like Schwabe with his sunspots) the mornings in early May, when the night has cooled the earth, radiation to be the least. Otherwise the spectra are invisible, which require exceedingly still air. A long room is, however, far preferable.[§]

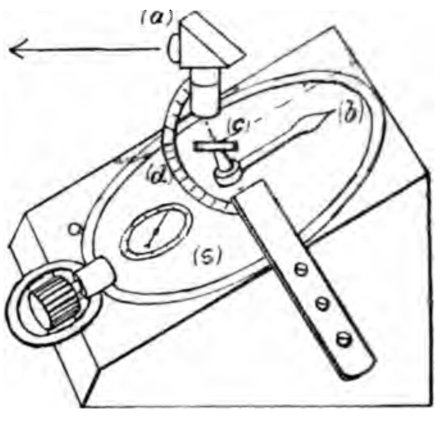


A New Sidereal Heliostat.—A small reflecting disc is mounted on the minute hand of a sidereal watch, *fixed equatorially* on a wooden base to the latitude and meridian of the place of observation. The disc should be about ½in. above the dial, to admit winter solar rays. Two inches above this is fixed a small right-angled Amici prism, allowing rotation.

The solar beam is then reflected by the disc, and enters the prism; when by internal reflection it is transmitted to the microscope in the desired direction. An Amici prism is the best possible form, as it gives a steady achromatic solar image (see Fig. 3).

For the thorough enjoyment of the brilliant glories of solar diffractions as revealed by the heliostat and the microscope, telescopic spectra should first of all be thoroughly mastered, for which a small glass of inferior quality will suffice.[||] These heliostats demand no darkened room and shutter hole; but serene skies, free from thin clouds, are indispensable. A cap reducing the aperture by a rim is the most convenient for firmly holding circular gratings, perforated zinc of various patterns, triangles, squares, or annuli, the cap being dropped over the circular plates. A good many were fitted.

FIG. 3.



As the skies seem to have forgotten "ye Merrie Month of May," a Swan incandescent lamp has been installed which answers passing well (May, 1887).

After the observer is educated in these details by the telescopic diffraction phenomena, he should commence with the microscopic solar wonders, where almost an unlimited field of new orders of colour, form, and significance await his admiring contemplation.

The excessive splendour of a miniature sun depicted in the focal plane of a powerful microscope (even under 1,000 diameters), arrayed with the most astounding prismatic rings, ellipses, parabolas, and hyperbolas—I say this excessive effulgence demands the greatest caution in subduing the intensity of the light.[*]

Instead of an Amici prism a small positive diagonal eyepiece of ½in. focus, furnished with a metallic flat reflector, may be substituted for the small Amici prism (*a*). The "minute" hand (*b*) carries the plane reflector (*c*), and an arm (*d*) firmly maintains (*c*)[†] in its place, which revolves in sidereal time; (*s*) is the sidereal watch.

(*To be continued.*)

THE THEORY OF MACHINES.—XII.

By FRANCIS CAMPIN, C.E.

Shaft-Bearings.

IN order that shafting may run smoothly, and without avoidable friction and wear, it is necessary that it shall be laid truly in line, especial care being taken that the bearings are properly adjusted, so that the shafting runs truly within them, as a very slight cant in a bearing will cause considerable damage and inconvenience.

The distance apart at which the bearings should be placed will depend in a great measure upon the diameter of the shafting: they should in all cases be sufficiently close to prevent the intervening shafting from appreciably sagging or deflecting, for should this occur it will be materially increased by centrifugal force when the machinery is running, and the result will be to wear the ends of the bearings into a bell mouthed form, and thus reduce the original bearing surface.

---

[*] With the exception of thes[illegible] to the Royal Society, No. 166, ' [illegible] cular Solar Spectra" (33 figu[illegible]

[*] A metre is 3·3ft.

[†] "The value of (*d*), the length of a single undulation, corresponds to the common limit of the red and orange rays, and deduced from the observation of Sir Isaac Newton on coloured rings of 0·000000623 of a mètre (Fresnel), which equals 245 ten-millionths (Fresnel) (or 0·0000245 of an inch)."

[‡] This heliostat was leant to the late Mr. Wray about twelve years ago for testing his telescopes. He reported that "the severity of the test was past all doubt." I have used it at various distances varying from 40 to 100 yards. [illegible] researches from 100 to 200in. were [illegible] mercurial bulb commonly used is too [illegible] the spectra.

[§] [illegible] abolic curves of his celebrated [illegible] (like a lane) free from city [illegible] inds. Dr. Draper did the same.

[||] [illegible] Huyghenian eyepiece of

[*] The following details may assist the experimenter:—Diameter of solar image at prism (3 sine 30′), theoretical = 0·026, diameter of miniature sun formed by ½ objective on the stage of the microscope 200in. distant from the luminous prism, reduced = 0·000016 really 1,600 times or $\frac{16}{1,000,000}$, observed diameter of solar miniature on the stage and in the field of the micrometer. Exclusive of the jet black diffraction ring = 0·000061″; estimated breadth of first black ring = 0·00002″; therefore the spurious disc of the sun in the miniature is nearly four times too large—viz., 0·000016 : 0·000061 :: 4 : 1 nearly.

[†] The little mirror C′ swings on two pivots to adjust it to the sun's declination.

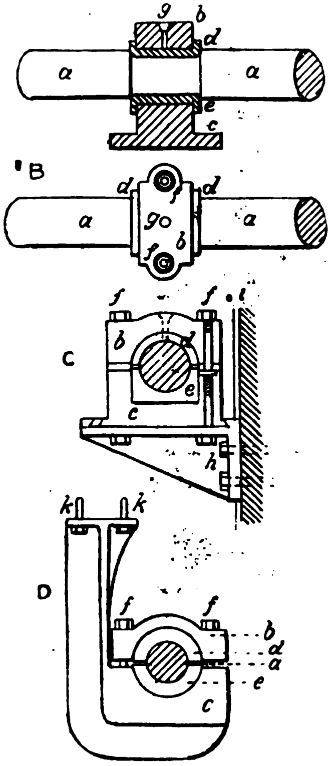
A bearing must in every case be placed as close as possible to every pulley, spur-wheel, or clutch on a piece of shafting: it is not so absolutely necessary at the couplings, if permanent; but it is desirable to also have them there—this is to avoid transverse strain.

Theoretically speaking, increasing the number of bearings does not increase the total friction; but practically it may, for should the bearings be screwed down even a fraction tighter than is necessary for exact contact with the journals (parts within the bearings of the shaft), friction over and above that due to the weight and load of the shaft will be brought into action.

The general and fundamental form of bearing is shown at A, B, and C (Fig. 51).

A shows the bearing in longitudinal section, B the same in plan, and C the same in front elevation; the letters refer to the same parts in all three sketches. *a a* is the shaft slightly reduced in diameter to form the journal resting in the bearing; *c* is the base piece, called the plummer block, and *b* is the cap; *d* and *e* are brass or gun-metal bearings in which the journal immediately rests; at *g* is a hole perforated through the cap and top bearing to allow of the necessary lubrication. There is cut in the top bearing a small, longitudinal groove to allow the oil to spread along the whole length of the journal and lubricate it uniformly.

FIG. 51



h is a bracket fixed against a wall, *i i*, to carry the bearing, shafting usually being run along the walls of the building.

At *C* the right-hand side of the cap and plummer block is shown in part section to exhibit the shape of one of the double stud bolts, *f*. It will be observed that the central part carries a conical collar below which is a screw thread corresponding to an internal screw thread in the plummer block *c*. This stud bolt is further screwed at each extremity for the reception of a nut. The studs are first screwed into the plummer block until the conical collars jam them tight; the plummer block is then placed on the bracket *h*, and secured by the lower nuts as shown, and in some cases also by snugs cast on the top of the bracket. The lower brass *e* being fitted in, the shaft is placed in position, the top brass *d* adjusted upon it, *and secured by the cap b*, which is fastened *down by the top nuts on the stud bolts f.*

Where there is plenty of room the stud bolts may be single, holding only the cap, there being lugs cast on the ends of the plummer block by which it may be bolted to the bracket *h*, or other bed upon which it is destined to rest. Care must be taken to obtain as solid a foundation as possible for these bearings, in order to reduce the vibration to a minimum.

When the shafting cannot be run near a wall, and there are no columns to which to attach brackets to carry the bearings, recourse must be had to hangers, of which one is shown at D, Fig. 51.

a is the shaft, *c* the plummer block, cast in one piece with the hanger, *b* the cap secured to the plummer block by single stud bolts *f*. *d* and *e* are the top and bottom brasses fitted as in the previous example. The hanger is secured to the joist of an upper floor, or to a roof timber, by means of the bolts *k k*.

This arrangement is very objectionable, and only to be tolerated when unavoidable, as even when the joist to which the hanger is fixed is of iron the vibration of the floor, especially if it supports machinery, will be communicated through it to the lower shafting, causing a tremor and chatter, which must interfere with the steadiness of working and increase the wear of the bearings.

In order to keep the shaft journals properly lubricated, a mechanical lubricator should be attached to the aperture *g*, to insure that the oil be supplied *continuously* and uniformly, for by lubricating at intervals, which, when left to manual labour, is sure to be irregular and uncertain, can never be attended with satisfactory working.

There are a great number of self-acting lubricators in the market of simple description, and as they are largely advertised, it is not necessary to describe them here, beyond saying that they consist mainly of an oil reservoir protected from dust, and either supply a small continuous flow of oil to the bearing, or else supply a small quantity at every revolution of the shaft. A great many experiments have been made both formerly and in recent times with a view to determine the relative merits of various unguents for reducing the friction of machinery, and of late years strenuous efforts have been made to introduce mineral oils for that purpose, but we are inclined to think with comparatively little success.

Although there has been much discussion and many experiments as to the efficiency of different metals for bearing surfaces, some of the results are so contradictory that it would appear, after all, that the co-efficient of friction depends more upon the nature of the unguent used, and the regularity of its application, than upon the composition of the metals it is supposed to separate.

If two greasy surfaces rub together, both being perfectly smooth, the surfaces in contact should be surfaces of grease, not metal, and then we have a common co-efficient for all the metals, which may be taken as 0·08 throughout.

The chief trouble with bearings is found in their tendency to become heated, and their proportions should therefore be determined with a view to keep this down to a minimum.

The work done in overcoming friction is converted into heat, which heat is of necessity absorbed by the shaft and the bearings, and it must be got rid of by radiation or conduction, and for this purpose it should be developed on as large a surface as possible.

The quantity of heat corresponding to any given quantity of mechanical work is an easily measurable amount, for it has been experimentally shown by Dr. Joule that the quantity of heat required to raise the temperature of 1lb. of water 1° Fahr. corresponds to 772 foot-pounds, and this having been variously corroborated by other physicists, has been universally accepted as the mechanical equivalent of heat. One of the most striking corroborations is that derived from the comparison between the theoretical and actual velocities of sound in air; but for full particulars on this subject the student is referred to special treatises on heat such as Dr. Tyndall's and the late Professor Clerk-Maxwell's.

We have, however, another physical property to consider, that of "specific" heat. This refers to the capacity of bodies for heat, and by "capacity" is meant the quantity of heat absorbed to produce a given rise of sensible temperature. Heat being a mode of motion, quantity seems a rather inapt term; but in lieu of a better it must serve.

The quantity of heat that will raise one pound of water one degree will raise eight pounds of iron (about) one degree; hence, we say that the specific heat of iron is 0·125, and the mechanical equivalent to the heat requisite to raise one pound of iron one degree Fahrenheit will be 96ft.-lb.

From these data, then, if the conditions of working are known, the quantity of heat generated in any given bearing may be accurately estimated.

Let p = the resultant pressure on the journal of a revolving shaft acting radially; c = co-efficient of friction, d = diameter of shaft journal in inches, n = number of revolutions per minute, Q = number of pounds of iron raised one degree Fahrenheit per minute; then,

$$Q = p \times c \times n \times \frac{3{\cdot}1416 . d}{\times\ 96} = \frac{p . C . n . d}{367} \text{(nearly)}.$$

For lubricated bearings $c = 0{\cdot}08$, let $n = 60$ revolutions per minute, p = 6,000lb., and d = 3in., then,

$$Q = \frac{6000 \times 0{\cdot}08 \times 60 \times 3}{378} = 229\text{lb. (nearly)}.$$

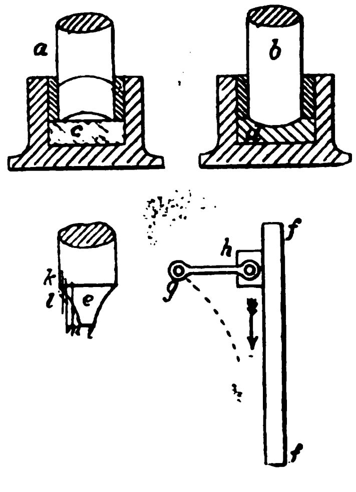
If the journal has a length of one and a half diameters, the weight of that part of the shaft will be—at 23·75lb. per foot—23·75 × 4·5 ÷ 12 = 8·91lb.; and assuming that as much heat is taken up by the bearings as by the shaft itself, there would be sufficient friction to raise its temperature by nearly 13 degrees per minute, and this must chiefly be dispersed by radiation from the cap of the bearing and the shaft close to the bearings.

The higher the velocity of the shafting and the greater its diameter, the greater will be the amount of work expended on friction, and the greater, therefore, the heat generated; the diameter, therefore, should be kept as small as is consistent with the requisite strength, and any increase of surface in the bearings provided by making them of greater length, which will not increase the work of friction, as that depends simply upon the gross load on the bearing, the diameter of the journal, and the velocity of rotation of the shaft.

A very general proportion for journals running under moderate loads is one and a half diameters; but for exceedingly high velocities of 1,500 or 2,000 revolutions per minute, such as occur in fan shafts, a length of six to eight diameters is sometimes used.

Vertical shafts, such as are required for turbine water-wheels, mill-stones, &c., must be supported at the bottom upon a step. Three step bearings are shown in Fig. 52.

FIG. 52



In the first, the vertical shaft *a*, of which the lower part is shown in vertical section, has at the bottom a concavity which fits upon the spherical boss upon the foot step *c*; *b*, on the contrary, has at its lower end a convex bearing fitting into a concavity in the block *d*. Of these two the former has the advantage that the supporting piece, being convex upwards, there will be no tendency for dust or dirt of any sort to work into it, though it is not so convenient for the purposes of lubrication as the second.

Where, however, the shaft end is under water this does not signify, and then it is advisable to make the bearing of hard wood.

In order to prevent lateral motion of the foot of the shaft, it is surrounded by a socket lined with a brass bush, as shown in the figure.

One great disadvantage in end bearings of this description is the unequal wear arising from the friction which gradually destroys the uniform contact of the rubbing surfaces, for it must evidently be greatest at the periphery, from which it diminished until at the centre of the shaft it disappears.

In order to remedy this defect, the end of the shaft may be made of the form shown at *e*, with, of course, a corresponding foot-step to fit it. The contour of this curve is such that the wear of material on the bearing surfaces, *measured parallel to the axis of the shaft*, will be the same at every point.

The reason of this may be explained as follows:—The pressure upon the bearing surfaces will at any point act in a direction at right angles to a tangent to the curve at such point, and in this direction the wear resulting from friction at that point will occur, and it will be proportional to the diameter of the bearing at that point. As the end of the shaft wears, so will it descend deeper into its bearing in a direction parallel to its axis.

By drawing a line *l m* of the same contour as *k i*, and (measured upon the lines parallel to the axis of the shaft) at the same distance from it at every point, we inclose a space that may represent the part worn away by friction. Now, it will be observed that at *m i* the *normal* distance between the two curves is much less than at *k l*, the intermediate distances varying from one to the other. In order that the distances measured parallel to the axis of the shaft may be equal, the normal distances between the curves must vary as the diameters of the end of the shaft.

A simple method of describing this curve is illustrated at *h f g*. *f f* is a straight edge secured upon a piece of card, paper, or perfectly smooth board; *h* is a block, which can be freely slid against its edge—this block carries a light arm, *h g*, which moves with perfect freedom upon a pin in the block *h*. At the end *g* is fixed a blacklead pencil, finely-pointed, and with its point resting upon the paper or board beneath the straight edge.

Now, by carefully drawing the block *h* down the straight edge *f f*, in the direction of the arrow, having started with the arm at right angles to *f f*, the pencil at *g* will trace out the required curve, to which a template may be cut as a guide and a gauge in turning the end of the shaft to the required form.

The friction on an end-bearing may be simply ascertained from the following formula:—Let d = the *mean* diameter of the bearing part of the shaft in inches; P = the total load upon the bearing in pounds; n = the number of revolutions per minute; W = work expended in friction per minute in foot-pounds; then

$$W = \frac{3{\cdot}1416 \,.\, d \times P \times n}{12}$$

(*To be continued.*)

ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS.—XIV.*

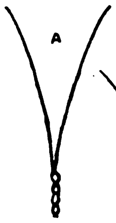
By S. R. BOTTONE.

The Thermopile.

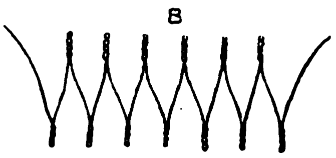
§ 54. THIS instrument depends in its action on the fact that when the point of junction between two pieces of metal is heated, or cooled, a current of electricity is set up. It is not necessary to this effect that the metals should be of different nature; but they must be in different molecular states, so that they oppose different resistance to the passage of heat and electricity. As, however, the greater the difference in these respects the greater the force called into play, it is usual to employ dissimilar metals, or metallic alloys, &c., in which these differences are highly accentuated.

§ 55. A very convenient form of thermopile for the amateur, and one which, with a little care in the management of the heat, gives a very constant current, adapted to delicate and long-continued experiments, such as grading delicate galvanometers, &c., may be constructed as follows: Cut 25 or 30 pieces of No. 16 German silver wire into 6in. lengths; do likewise with a similar number of pieces of No. 16 copper wire. With a pair of pliers twist tightly about 1in. of the extremity of one copper wire to the extremity of one German silver wire, so as to join them firmly together, as shown at Fig. A. In a similar manner join the remaining pairs of copper and German silver wires; clean the junctions with a bit of sandpaper, and solder the junctions with as little hard solder as you possibly can. Now twist and solder the opposite extremities of the joined wires, each German silver to the copper of the next pair (not its own), leaving the first copper and last German silver as terminals (see Fig. B). Now procure two wooden cornice-pole rings, about 3½in. in diameter (such as are used to suspend curtains from the pole), and with a coarse rasp file one surface of each ring *flat*, so that if laid upon one another, after filing down, they form one thick ring, as shown at Fig. C. To the lower ring, at equidistant points, should be affixed three wooden rods about 6in long, spreading out somewhat, so as to admit of the insertion of a spirit lamp between them. For the sake of stability, these three rods, which form the feet on which the thermopile rests, may be inserted into a heavy wooden or leaden base, as shown at D in the Fig. The next step is to place the joined wires in a radiating fashion on the ring, and clamp them in their place by covering them with the upper ring, which must be screwed tightly down to the lower one, care being taken that the screws do not touch the wires, and also that the wires do not touch each other, except at the soldered junction. The inner circle of junctions must not touch, but must stand at equal distances all round the centre of the circle described by the ring, leaving a space of about ¼in., in which the flame of the spirit lamp can burn and heat these junctions simultaneously. The two unsoldered ends (of copper and German silver wires) are then to be attached to binding screws, which serve as the poles or terminals of the thermopile. Fig. E illustrates the appearance of the finished instrument. On placing a lighted spirit lamp on the base, so that the flame plays against the junctions pointing to the centre, a current will be found to flow from the two terminals. The electromotive force of these little instruments is about one-twelfth of a volt for each pair of wires, so that a dozen pairs of wires gives very nearly one volt. On the short circuit *each pair* is capable of giving about one-third of an ampère. Coupled up in series (as shown), this remains, of course, the same. To increase the current, the elements must be made larger, or, what amounts to the same thing, coupled up in parallel instead of in series. For the benefit of those amateurs who may be desirous of attempting something on a larger scale, I subjoin the following account of a thermopile which I made on the plan of Clamond's pile, with some slight modifications: 288 strips of tinned iron, 1in. wide by 5in. long, were cut out. A mould of plaster-of-Paris was prepared, in which could be cast oblong squares, 2½in. long by 1in. in square section. At end of the two extremities of the mould were placed, standing upright, a tinned iron strip. The mould was then filled with a molten alloy, consisting of two parts of antimony, melted with one part of zinc (as this alloy expands considerably on cooling, it must be withdrawn from the mould as soon as set). By this means were obtained 144 castings, having a tinned iron lug at each end, looking something like a letter E without the central stroke. An iron ring, about 1in. wide, ¼in. thick, and 1ft. in internal diam., was supported on four stout iron rods, screwed to it, at a distance of about 10in. from the ground. On this ring was placed a coating of good Portland cement, about ½in. thick. The castings, with their lugs previously bent, as shown at Fig. F, and having a thin piece of mica (talc) inserted between the inner strips and the alloy, to prevent contact, were then arranged in a circle on the iron ring, each one being separated from its neighbour by a thin piece of mica, and the whole held together by means of a little

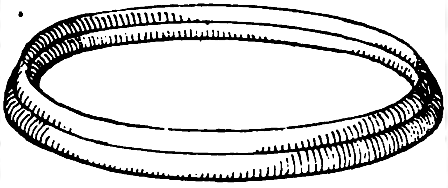
A



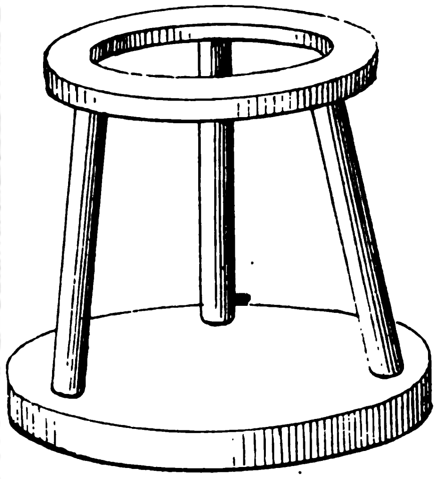
B

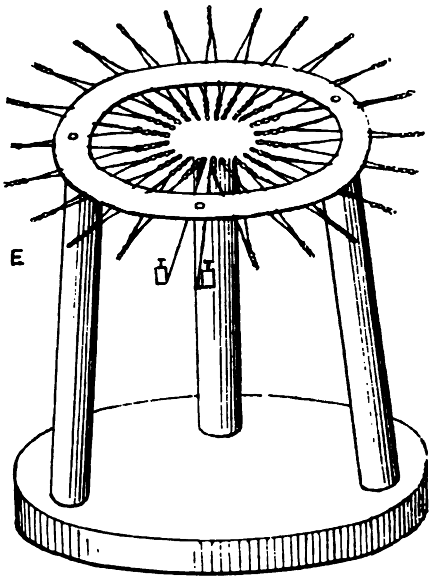


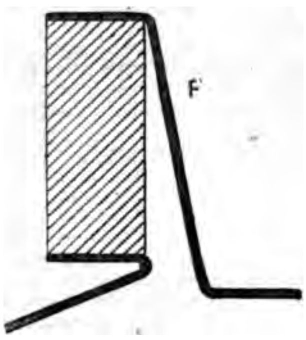
C



D







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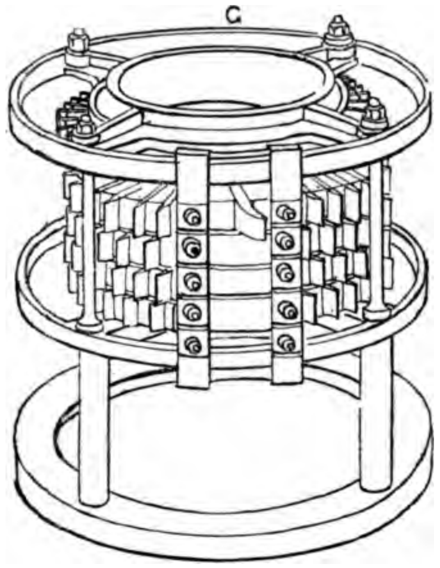
Portland cement put in between as each casting was placed in position. Several such layers of circles of castings were thus arranged, care being taken that the faces of the castings projected about ⅛in. inward beyond the iron ring. When the entire series of castings had been thus arranged in circles, and set in cement, a final layer of cement, about ¼in. thick, was spread over the upper layer, care being taken in each layer to leave quite 1in. of the castings projecting outwardly, free from cement. A second iron ring, precisely similar to the first, was now laid over the top, and when the cement had set, clamped to the lower one by means of three long screw clamps. The iron strip attached to the inner end of one casting was then soldered to the iron strip attached to the outer end of its neighbour (previously cut to the required length), and so on all round each circle, except at one point of each circle only, where, of course, the projecting strips were left free, to be afterwards attached to binding screws as terminals. Each circle had its own pair of terminals, and these could be coupled up to the neighbouring circles, either in parallel or in series, as the case might demand. I have used this pile with a large paraffin burner having an iron chimney nearly touching the interior ends of elements. I have also tried it with a charcoal brazier (with a similar iron chimney) with gas, and with a small coke stove. For steady currents of low E.M.F., but considerable quantity, the 6in. paraffin burner answered admirably.

G



The following table will give a fair idea of the force developed with the said paraffin burner, the elements being in all these cases couple up for tension—i.e., in series :—

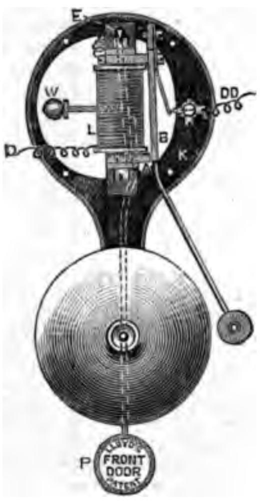
No. of Elements.		E.M.F.		Ampères on a short circuit.
36	......	2	......	0·6
72	......	4	......	0·6
108	......	6	......	0·6
144	......	8	......	0·6

Fig. G is reproduced from a photograph of the identical thermopile (of four circles of 36 elements) with which the above trials were made. By using more powerful sources of heat (up to a certain point) correspondingly more powerful effects were obtained.

THE "BOSS" ELECTRIC INDICATING BELL.

THE present system of domestic signalling has many imperfections. A novelty has just been brought before our notice which appears to be a step in the direction of improving the means of communication either in large public buildings or private houses. It is simple in action, cheap, and efficient, and the absence of all danger of oxidisation of contacts, owing to the low-tension current employed in working, it is an advantage.

A special feature in this bell is the pendulum, *on which* the name of the room, &c., appears in luminous paint. Upon the push being touched, the pendulum swings from 1 to 30 minutes, according to the regulator. The magnet attracts at the same time the armatures of the bell and pendulum, thus utilising all the magnetism produced. Having but one coil its cheapness of construction is evident. It requires only a couple of Leclanché cells to work 30 to 50 bells.



CLAMOND'S IMPROVEMENTS IN THE TRANSFORMATION OF HEAT INTO ELECTRICITY.

SOME years ago great expectations were aroused by the thermopile devised by M. Clamond, but so far nothing of any commercial utility has been devised in connection with thermo-electricity, although several inventions of the kind appear to indicate the way in which to look for a successful application of the heat to be obtained from ordinary fuel in the generation of electricity in the most direct manner. M. C. Clamond, of the Boulevard de Strasbourg, Paris, has recently taken out letters patent in this country for an invention relating to the transformation into electricity of a portion of the heat evolved from any source, and more particularly from the combustion of fuel in a fireplace. Although the apparatus to which this invention relates may be considered as relating to thermo-electricity, yet it is based upon new laws and facts discovered by him, which he explains in order that the fundamental principles of the invention may be readily understood. Assuming a series of bodies A G, Fig. 1, endowed with energetic thermo-electrical powers to be placed in a row, every alternate body A of the row being positive, such as is an alloy of antimony and zinc, while the other bodies G are negative, such as galena or sulphide of lead, and assuming that between each positive and negative body is placed a block of metal C C, F F, having sufficient conducting powers of heat and electricity, such as copper, silver, nickel, iron, &c., which blocks are termed "inter-contacts;" and assuming further that while one set of alternate blocks C C is heated, the other set F F is cooled, the development of the electromotive forces will be subject to the following law which he has discovered; they are—viz., a function of the difference of temperature between the two series of inter-contacts, and are independent of the temperature of the thermo-electric bodies, or of any parts of these. The following may serve as an example of the experiments from which M. Clamond deduced this law: Two parallel bars, one consisting of an alloy of antimony and zinc, A Z Fig. 2, and the other of galena G A, have at one end N, each an inter-contact F, which are separated from each other by a non-conductor I, while at the other end M they have a single inter-contact C common to both. On heating the last named inter-contact C and cooling those first named F, and connecting these by wires to a galvanometer *y*, the ordinary current of a thermo-electric couple will be observed to flow from the antimony-zinc bar A Z through the one inter-contact F and wire connection to the other inter-contact F and galena bar G A, and thence through the inter-contact C of the other end back to the antimony-zinc bar.

If now, as in Fig. 3, the heated inner contact C be placed against the cooled ends N of the bars, and the cooled inter-contacts F against the heated ends M the same electromotive force and the same current will be obtained as before, but circulating in the contrary direction from the cold to the hot in A Z, and from the hot to the cold in G A, yet always going from the hot inter-contact to the cold inter-contact in the antimony-zinc bar A Z, and from the cold inter-contact to the hot inter-contact in the galena bar G A. If again the whole or parts of the bars be heated to any desired degree, and these be touched at any point by the inter-contacts C and F, the same result will always be obtained, which proves that the difference of temperature between the inter-contacts C and F alone determines the electromotive force and the direction of current produced.

M. Clamond has determined the theory of these phenomena, which consists in that the seat of the transformation of the heat into electricity does not lie in the mass of the thermo-electric bodies, nor even in the material element constituting the surfaces of the contacts, but in the very small spaces actually existing between them at their points of contact, which therefore constitute the theoretical inter-contacts, so that the transformation takes place and the current is produced simultaneously and instantaneously, before the thermic circulation has had time to establish itself between the contacts and inter-contacts and the thermo-electric bodies. It is to be understood that it is advantageous that the metal of the inter-contacts should be a good conductor of heat, so that it may readily convey the caloric to the theoretical inter-contact. This law has for its first practical result, to dispense with the necessity of maintaining the two ends of a thermo-electric body at different temperatures, as has been done up to the present time, and consequently to allow of the substitution for the long bars, simple thin plates, which are lighter, less expensive, and much less resisting to the passage of electric currents—it being sufficient to maintain the inter-contacts at different temperatures. At the same time, as the plates do not require to participate in the temperatures of the inter-contacts, they are not subject to the deterioration that results when they are exposed to high temperatures. This discovery in the transformation of heat into electricity also permits of the determination of the conditions of maximum of useful effect of this transformation, which are as follows:—Taking two series of homogeneous actively thermo-electric bodies, the maximum yield of transformation of heat into electricity will be the better attained if the relative resistances to heat of the elements of the complete circuit are so arranged that a greater portion of the decrease of thermic potential (fall of temperature) is effected between the surfaces of contact of the inter-contacts and those of the active bodies.

The following is the principle of the construction which M. Clamond has been led to adopt: Assuming that a flat plate of thermo-electric material A B, Fig. 4, of considerable area as compared with its thickness, has its surfaces divided into a number of small squares *m*, *n* and that against the centre of each such square a pointed metallic conductor C F be made to bear, there being a pair opposite each other on each side of the plate as shown, and assuming that the conductors on the one side are heated while those on the other side are cooled, then the two portions of the thermic resistance at the points of contact will be very considerable as compared with the opposite thermic resistance offered by the active body; thus only a small quantity of heat will pass at each pair of conductors, but making by the collective action of a large number of such pairs a large quantity, and this transmitted heat will be utilised to the greatest advantage. Practically, the points of the conductors, which should not be too fine, should pass to a certain extent into the active body, the important point being that the section of contact of the conductor with the plate be restricted as much as possible. In practice the points of the conductors would be made to

FIG.1

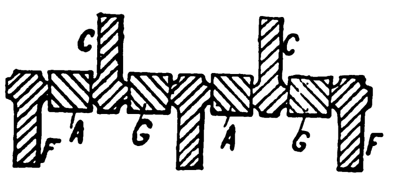


FIG.4

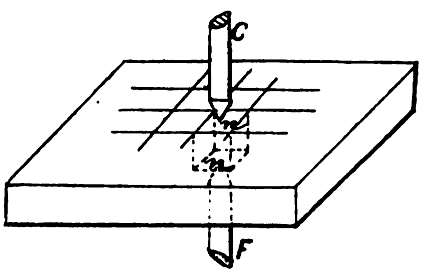


FIG.2

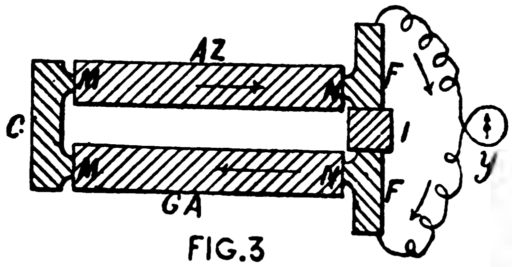


FIG.3

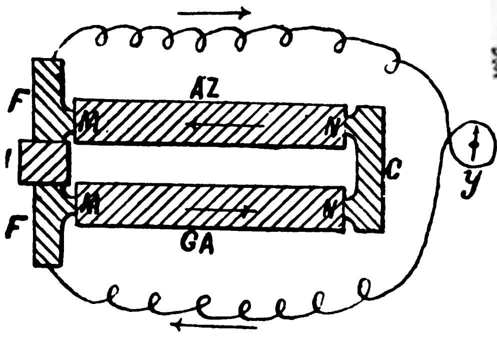


FIG.6

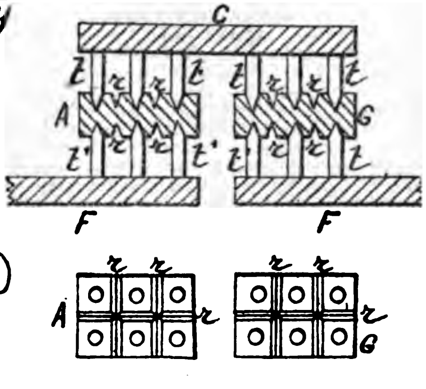
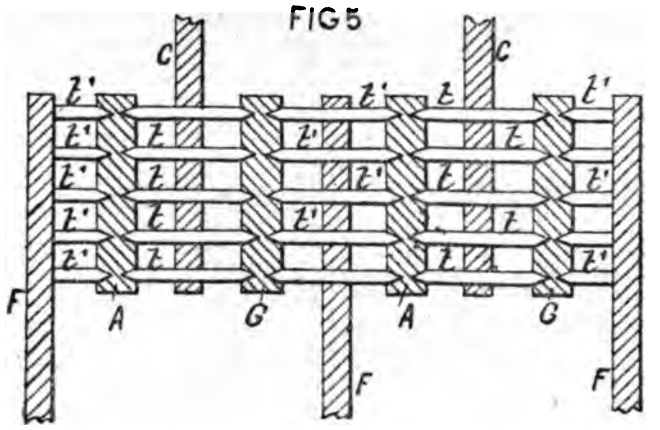


FIG5



approach within a short distance of each other in the plate. The points of the conductors may be made with circular or longitudinal grooves for increasing the surface of contact. The acuteness of the points of the conductors is favourable for the electric circulation, as it tends to diminish the electrical resistance on the passing of the current from the contact rod to the generally less perfect conducting material of the thermo-electric substance, through the infinitesimal arc that separates them. The contacts may, however, be spherical, plane, cylindrical, &c., so long as they are of restricted extent. Thus, in constructing a thermo-electric element according to this method, various arrangements may be adopted, in all of which, however, the inter-contact bodies are formed with a number of pointed projections that are in contact with the positive and negative thermo-electric bodies, the heated inter-contacts being in contact with one side, and the cooled ones with the other side of the said bodies.

Figs. 5 and 6 show a complete thermo-electric element constructed according to the above-described principles. The two arrangements only differ in the relative positions occupied by the several parts. In both cases A and G are the thermo-electric plates, the one being positive and the other negative, C and F are metal plates or blades to which are soldered stems $t\,t^1$, the ends of which enter into the plates A and G. The plates C and F, together with the stems $t\,t^1$, constitute the inter-contacts, the plate C receiving heat from any suitable source, while F is cold, the difference between their temperatures determining the electro-motive force of the couple. As it is essential that the heat should pass entirely through the stems $t\,t^1$, and heat transmitted by radiation from C to A and G and from the plates A and G to F being lost for the transformation, the spaces between these parts round the stems t are filled with a bad conductor of heat, such as asbestos paper, glass powder, &c., which prevents such transmission by radiation. For preventing as much as possible the fracture of the thermo-electric plates A and G owing to unequal expansion and contraction, it is preferred to make grooves $r\,r$ in them between the contiguous points of the inter-contacts, thus dividing the plates into squares as shown at Fig. 6. With this arrangement any fracture will take place at the grooved part, and will consequently not affect the action of the apparatus. In place of using continuous plates for the thermo-electric bodies, these may consist of a series of cubes or cylinders, each of which has a pair of inter-contacts; or when only a weak current is required a single such cube or cylinder may be employed. The inter-contact rods $t\,t$, which are generally made of copper or other metal, may be coated with a double layer of electro-plating; the first coating, which is of nickel, protects the rods against the corrosive action of the active bodies, and the second coating, which is of silver, improves the contacts and prevents oxidation at elevated temperatures.

Instead of pointed rods may be used toothed plates for the inter-contacts, the teeth taking the place of the points of the rods; or in place of serrations, the blades may have a continuous sharp contact edge.

Compound elements may be formed for increasing the effect produced by the simple elements above described, by combining together a number of the thermo-electric bodies in two groups—one consisting of positive, and the other of negative bodies, the plates or bodies of each group being connected together by inter-contact rods, the inter-contacts C at the one end of the two groups being formed into one. With such an arrangement the advantage is gained of having a greatly increased resistance to the passage of heat, without a corresponding increase of resistance to the electric current, the former increasing about as the square of the number of plates, while the latter only increases directly as the number.

The electrical constants of the simple element being E and R, those of the multiple element will be about E and n R. Now the maximum quantities of heat that each of these couples can give off in an external conducting circuit being given by the formulæ: simple element $\frac{J\,E^2}{4\,R}$ multiple element $\frac{J\,E^2}{4\,n\,R}$ (J being the coefficient of Joule) the total quantities of heat consumed by the couples will be: For the simple element $q + \frac{J\,E^2}{4\,R}$; for the multiple element $\frac{q}{n^2} + \frac{J\,E^2}{4\,n\,R}$; the ratios between the quantities of heat taken up and consumed will be: For the simple element: $r = \frac{J\,E^2}{4\,R\,q + J\,E^2}$; for the multiple element $r\,n = \frac{J\,E^2}{\frac{4\,R\,q}{n} + J\,E^2}$; it will be seen, therefore, that the useful effect increases with n; that is to say, with the number of plates of the multiple element, and that it tends towards unity when the number of plates is indefinitely increased. This arrangement also permits of the use, in forming the element, of several different active bodies having thermo-electric action of the same sign, those plates which are most heated being formed of substances of higher melting point than the others. Although in forming these elements M. Clamond prefers to use energetic bodies, such as the alloy antimony and zinc (about 2 of antimony to 1 of zinc) for the positive element, and galena or sulphide of lead for the negative one, yet bodies may also be employed that are less far removed from one another on the thermo-electric scale, and even simple metals, such as antimony, iron, nickel, &c., may be used. In this case the forms of the bodies may be somewhat modified to facilitate manufacture, and also on account of their greater conductivity.

M. Clamond shows in the specification of his invention (No. 6869, 1886), a variety of methods of utilising the principle, and especially an arrangement for use with gas, petroleum, or other convenient or cheap source of heat; but as the actual arrangements adopted in practice will depend largely on the facilities presented for manufacture we need not occupy space by describing those set out in the specification.

THE ECONOMICAL BATTERIES.

IN spite of all that has been recently put forward in our columns, we are apparently no nearer to that economical primary battery than we were when we described (p. 269, Vol. XXXIX.) a visit paid to the "domestic primary battery"—a modification of the Lalande-Chaperon element which did promise to supply current cheaply if only a market could be found for the products of the cell. At present that market has not been found; but other inventors are following on the same lines, for we find that Mr. W. S. Squire has obtained a patent (No. 4,522, 1886) for a process for utilising the spent liquid from certain voltaic batteries. In certain voltaic batteries, in which solution of caustic potash or soda is used as exciting liquid and zinc as one of the elements, the spent liquid consists chiefly of a combination of potash or soda and oxide of zinc, forming what may be termed zincate of potash or soda. Mr. Squire's invention relates to a process for treating this liquid so as to restore the potash or soda in condition for subsequent use, and for obtaining zinc compounds that can be applied in the arts or manufactures. For that purpose he effects a reaction by means of sulphuretted hydrogen, so as to obtain impure zinc sulphide as a precipitate, and solution of caustic potash or soda as supernatant liquid. This reaction may be effected directly by passing the sulphuretted hydrogen through the spent liquid of the battery, preferably keeping the liquid in agitation so as to break the thin shells of zinc sulphide which tend to form around the bubbles of sulphuretted hydrogen. Or the reaction may be effected indirectly by passing sulphuretted hydrogen through a solution of caustic potash or soda, thereby transforming it into potassium or sodium sulphide, and then mixing that solution with the spent liquid of the battery, causing precipitation of impure zinc sulphide. In either case, the liquid, separated by decanting and filtering, is solution of caustic potash or soda ready for subsequent use, and the precipitate, impure zinc sulphide, is dissolved in hydrochloric acid or sulphuric acid, whereby sulphuretted hydrogen is evolved, which is at once applied as above described to the treatment of spent liquid, or is stored for subsequent use in this way. When hydrochloric acid is used as the solvent of the zinc sulphide, the liquid produced is zinc chloride that can be purified and used for disinfecting or other purposes. When sulphuric acid is employed as the solvent, the liquid produced is solution of zinc sulphate, which may also be purified and used for various purposes. The patentee finds it advantageous, however, to produce from the purified chloride or sulphate of zinc a useful pigment by adding to it barium sulphide. When the chloride is thus treated, zinc sulphide is precipitated; when the sulphate is thus treated, a mixed precipitate of zinc sulphide and barium sulphate is produced.

SOME CIRCULAR SAW KINKS.*

TO cut two pieces of stock on a circular saw, and to have both pieces of the same length, is a comparatively easy matter, but it is not every man who knows how to do it. When gauges are made and set is a method not taken into consideration. The first piece is to be measured by rule or square, marked and cut off. The second piece or strip is then placed in position to be cut, and the carriage moved forward until the saw almost, but not quite, touches the strip. The cut piece is now to be placed beside the uncut one, the ends farthest from the saw being adjusted by the forefinger, until they are both in the same plane, that is, until they are both just "even" with each other. The nicety of an adjustment made in this manner is about as near perfection as flesh and brain can approach, an adjustment to 1-500 of an inch being possible on clean-cut surfaces, even comparatively rough, but with smooth surfaces, like two pieces of iron or of smooth hard wood, they can be put in line with a variation of less than 1-2000 of an inch, by the finger and sense of feeling alone. After the pieces are put "even," let them be moved endwise in that position, until the cut piece just brushes against the saw. When thus, the second piece may be boldly cut off, and it will prove just as long as the first piece, provided the saw cuts square.

A saw bench is often suspected of being out of truth. That is, the saw arbor has got out of alignment with the "shooting board," through yielding of screws, shrinking of lumber, or settling of the floor. About the best way to detect and remedy the trouble is as follows: File and set the best saw you have with the machine. Square up and dress two sides of a good clean piece of lumber, as thick as the saw will cut, and from eight to twelve inches wide. Put this on one side for use in a few moments. Place a carpenter's steel square against the shooting board guide, and let the blade of the square rest against the side of the saw. Any considerable error may be detected in this manner, and then the blade of the square may be turned perpendicular, and the saw tested in that position also. This test, of course, only effects the table or saw bench, and the position of the saw thereto. After the above tests have been made, and the saw arbor adjusted as required by those tests, the piece of dressed lumber before described must be placed on the shooting board, and a piece cut from the end. Great care must be exercised to make sure that the saw does not crowd, or try to run one way or the other, through not being perfectly sharp or well set. If this tendency be exhibited in the least degree, the test will be useless. When the saw has been made to cut off cleanly, take a steel try square which is known to be accurate, and ascertain if the piece of lumber be cut off square. Should the eye and touch be unable to detect any error, either when tried on the edge of the piece or on its side, a final test may be made. Cut the piece of lumber through its centre, then (the piece having parallel sides and four square corners) set one piece on end, and place the remainder half on top of the first piece, but reversed, that is, one piece must be turned half around so the back edge will form a continuation of front edge of the bottom piece of lumber.

Now "squint" down along one corner of the two pieces of lumber. If the two pieces form one straight unbroken line, then that saw is undoubtedly in first-class shape, but should the two pieces form an angle but even so little out of a straight line, then the saw does not cut square, and must be further adjusted. The two pieces may be in line edgewise, and not so sidewise; in this case the saw cuts "plumb," but not square. If the edge be straight, but the side contain an angle, then the saw is adjusted for square cutting, but the table or saw is not level. With the fine iron saw tables now made, and the nice shooting boards or cross cutting guides, there is but few chances of a saw getting out of line. It must be done either by wear of the arbor or bores, or by springing of the saw-table through poor setting or a weak foundation. In splitting or ripping long lumber, trouble is often experienced by the blinding of the work between saw and fence. This trouble can be entirely relieved by using a short fence which reaches just to the first edge of the saw and then stops. Letting the fence run entirely past whole width of the saw is all well enough, and even necessary for certain kinds of work, but for ripping, the long fence is a source of danger. In rebating and grooving on the circular saw, a long fence is a necessity, in order to guide the work until its entire length has passed the saw. Among all the adjustable fences now made by machine manufacturers, the writer does not know of a single one who makes the fence adjustable in the manner here described, but it would prove a desirable feature for one and all makers to adopt.

ELECTRICITY ON TRAMWAYS.

BEFORE an electro-technical club in Berlin Herr J. L. Huber recently read a paper in which he gave some interesting details regarding the cost of working with storage batteries on the Hamburg street railway, of which line Herr Huber is the engineer.

In order to obtain trustworthy results, experiments were undertaken on a specially difficult line, both as regards curves and grades, which, in addition, crossed much frequented streets, so that all the difficulties met with in railroad traffic in populous cities were encountered. The road extends from the Rathhausmarkt, in Hamburg, to the Berthastrasse, Barmbeck, over the Mühlendamm, on which line grades of 30 per cent. are encountered. Herr Huber states, regarding the durability of the E.P.S. storage battery employed, that deterioration take place only in the positive plates; and this is the more pronounced the greater and more frequent the normal strength of current for which the plates are designed is exceeded. With a well-regulated management—that is, by an arrangement of storage batteries and car, such that with the heaviest grades and loads no abnormal current is drawn from the battery—the wearing out of the positive plates amounts to from 2 to 3 per cent., or, in round numbers, 2½ per cent. for 1,000 kilomètres travelled. If, in addition, the traffic be so arranged that with every charge of the accumulators only 50 per cent. of the distance is travelled which could be travelled with new plates, then a wearing out of the plates amounting to 50 per cent. is permissible—that is to say, that over 20,000 kilomètres (12,500 miles) can be run before renewal becomes necessary. A car which, including passenger and storage batteries, weighs 7,000 kilogrammes (about 7 tons), and which is to ascend grades of 30 per cent., such as occur on the Hamburg line, requires 800 kilogrammes of active material in the positive plates, and its renewal, including the cleaning of the grids, which can be used over again, as they are not oxidizable, costs 1s. per kilogramme (2·21b.)—that is, 4 pfennigs (½d.) per kilomètre run. That would be 0·8d. per car mile for renewal of plates. Under the same conditions the motive power required is ¾ horse-power hour per kilomètre (⅝ mile) run. The cost for attendance, oil, maintenance, &c., for one-horse power is 1d.; consequently this cost per car kilomètre is ¾d. To the above items must be added the maintenance, oil, &c., for the motor on the cars, which amounts to ¼d., and contingencies run up to an additional ¼d. The total cost, therefore, with the conditions given amounts to 1¾d. per car kilomètre (2·8d. per car mile), or ¼d. per tonne kilomètre (¼d. per ton mile). Comparing the cost of electric traffic with that of horses, Herr Huber states that to operate the usual one-horse car, which, including driver and conductor, carries 26 persons, 7 horses are required on the same line for one day of 100 kilomètres run. So that, as the electric car carries 31 persons, $8\frac{33}{100}$ horses would be necessary. The cost of maintenance for one horse during the last year, according to the *Jahresbericht der Strassen-Eisenbahn-Gesellschaft*, Hamburg, amounted to 1·96s. per day per horse; so that the cost per car kilomètre amounts to 2d. (3·2d. per car mile). It follows, therefore, that even to-day electricity is more economical than horseflesh, and the cost of the former can be considerably reduced by improvements. The results of experiments show that 88 per cent. of the energy stored in the accumulators can be drawn out, and Herr Huber only counts upon 80 per cent. for safety; that is to say, that of the electrical energy delivered by the dynamos 20 per cent. is lost by the use of accumulators, and this is independent of the length of the line and the power required upon the same, such as the overcoming of grades, &c. It is to be remarked, also, that for the electric traffic such as exists in Hamburg, any car driver can be employed and no trained men are necessary, as is the case with locomotives, so that the expense of trained hands is avoided. The above are the results of experiments which were carried out from the end of May to the end of December of last year with a public passenger car, and the distance travelled amounted to 12,000 kilomètres (about 7,500 miles). As these experiments were undertaken in public traffic on an ordinary horse road, difficult by its grades, and not upon a road specially constructed for the purpose, Herr Huber is of opinion that the life and power of competition of the storage battery is definitely assured.

STEAM-ENGINE ECONOMIES.

THE steam-engine as a whole—that is to say, engine, boiler, and condenser—uses in the production of power two fluids, a liquid, and a solid. The fluids are air and steam, the liquid is water, the solid is coal. Of these, the air, coal, and water all leave the apparatus at a higher temperature than they entered it. They must, therefore, be prefixed by the negative sign −. The steam leaves the engine at a lower temperature than it entered it. Therefore it must have prefixed to it the positive sign +, because the performance of work depends on the loss of heat, and of temperature, which are two different things of the materials employed to perform work. With the steam we need not now concern ourselves. The well-known formula $\frac{T - t}{T}$ expresses the efficiency of the engine. A moment's reflection will show that everything put into the apparatus cold and taken out hot represents a loss of efficiency. The three cold things are the coal put in the furnace; the air used to burn that coal; and the feed-water pumped into the boiler. We propose to consider here what economy could be effected by previously heating them all.

We shall assume that the temperature of the furnace is 2,000° Fah., which is a moderate assumption, but sufficient for our purpose. Taking the consumption of coal at 3lb. per horse per hour, and the sensible heat of the coal at 50°, we see that our 3lb. of coal must be raised through 1,950°. The specific heat of coal is 0·24; therefore, each pound of coal will require to raise its temperature to that of the furnace 1,950 × ·24 = 468 units, or, for 3lb., 1,404 units. But 3lb. of coal will develop about 42,000 units, the amount varying with the quality of the coal. Therefore, heating the coal up to furnace temperature demands about one-thirtieth of all the heat generated, or say, over 3 per cent. About 18lb. of air are usually required to burn 1lb. of coal, or, for 3lb., 54lb. of air. The specific heat of air is 0·23. Consequently, assuming the air to have a temperature of 50° we shall have 1,950 × 54 × ·23 = 24,219 units, or more than one-half of the whole heat generated by the fuel. Of this heat, however, a large proportion is surrendered subsequently to the water in the boiler. The escaping products of combustion go away, however, at a high temperature, varying between 400° and 600°. Taking the latter as probably that in an engine using 3lb. of coal per horse per hour, we have 550 × 54 × ·23 = 6,831 units wasted, or, in round numbers, a little over one-sixth of the whole heat generated, or very nearly 17 per cent. If then, it was possible to raise the temperature of the air entering a furnace to 600° for each 100lb. of coal used with cold air, 83lb. would suffice with the hot air. This is a very considerable saving, and it is a curious fact that so little has been done to secure even a part of it. Attempts have been made at various times—as, for example, on certain boilers in Woolwich Arsenal and by Mr. Alexander, of Cirencester—to raise the temperature of the air by using up waste heat, and these attempts all met with a certain success. The most elaborate attempt which has been made, however, in this direction took the form of an experiment carried out for more than three years, beginning in the summer of 1881, at the chemical works of the Pacific Mills, Lawrence, Massachusetts, under the direction of Mr. J. C. Hoadley. The description of this experiment occupies a quarto volume of 173 pages, published by Wiley, of New York, and Trübner, London, in 1886, to which book we must refer our readers for details. The apparatus transferred a part of the heat of the waste gas to the air entering the furnace. The boiler tried was one of fifty, all alike. They are externally-fired return tube boilers, 5ft. in diameter and 21ft. long over the smoke-box, which is 1ft. long. The tubes are 20ft. long, 3·5in. diameter, arranged in seven horizontal rows—four rows of eleven tubes each, one of nine, one of seven, and one of five, making sixty-five tubes in all. The fuel used is anthracite and bituminous coal. The grates are 5ft. 4in. wide. The heating apparatus consisted of tubes about 18ft. long, arranged in a species of oven turned over the boiler, through which oven the heated products of combustion escape. It is impossible to reproduce even in part the elaborate particulars of the results as given by Mr. Hoadley. It must suffice to say that the ordinary boiler had an efficiency, measured for the whole week's work day and night, of 68·87 per cent. with anthracite, and with bituminous coal of 64·61, while with the warm air the efficiency rose with anthracite to 79·2 per cent., and with bituminous coal to 74·96 per cent. The temperature of the escaping gas was 368° entering the heater, and 189° leaving it. The temperature of the air supplied to the furnace was 315°. This result was obtained, of course, by making the air and the hot gas travel in opposite directions. A blower was employed to propel the air through the heating apparatus. This consumed about 1 per cent. of the whole power of the engine. Summing up the results, Mr. Hoadley says: "It therefore appears that the net saving effected by the warm blast was from 10·7 to 15·5 per cent. of the fuel used with cold blast, which is the same thing as to say that discontinuing the warm blast would cause an increased consumption of fuel equal to from 12·3 to 18·9 per cent. of the quantity used with hot blast." Thus it will be seen that practice very fairly corresponds with the theoretical proposition we have laid down.

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* By JAMES F. HOBART, in the *Manufacturers' Gazette*.

It will be freely admitted that a saving of 10 to 15 per cent. in coal bills is of great importance, to say nothing of the reduction in the amount of smoke produced. The first cost of the apparatus, the space occupied, and the wear and tear, are items which, however, must not be overlooked. The apparatus used at the Pacific Mills worked for two years, at all events, uninterruptedly without requiring any repairs or renewals, and was last year in good order, with "some indications of reasonable durability." But it must not be forgotten that if the waste gases are used in this way, they cannot also be available for heating the feed-water, as in a Green's economiser. The steam user will have to choose between the two systems, and sometimes the one, sometimes the other, will commend itself to him. When space is not of much moment, there is a system of heating the air which is at once very inexpensive and extremely durable and efficient. It consists simply in using good bricks, not necessarily fire-bricks, as a regenerator on Siemens system. The hot gases are first passed through one stack of bricks for an hour, and then through another. The air supply is in like manner passed alternately through each stack. The system is so well understood, and so simple, that we need not explain it. The results likely to be obtained are so good, and the cost of the plant so small, that it is remarkable that it has not been freely adopted. To a certain extent, the draught will be affected, but in many cases there is enough draught and to spare, and in others a fan or blower will supply all the air wanted. The most expensive means of obtaining a draught that can be devised is a highly heated chimney.

In just the same way that the loss by using cold air and the gain to be obtained by employing hot air is calculated, we can ascertain the gain to be had from heating feed water. The liquid enters the boiler at 50°, let us say, and leaves it as steam at 300°, corresponding to a pressure of 52lb. per square inch. In order that this may take place, each pound of feed-water requires 1,155 units. If the feed entered the boiler at 300°, then in the boiler it would need to receive but 905°. The difference between 905 and 1,155 units represents the saving to be effected by raising the temperature of the feed-water. In other words, by imparting 250 units per lb., and so raising it from 50° to 300°, a saving of about 27 per cent. is effected regarding the matter in one way, and about 22 per cent. regarded in another way—that is to say, for every 100lb. of coal used with hot feed, 127lb. would be used with cold feed; and for 100lb. used with cold feed, 78lb. would suffice with hot feed. The advantage to be thus gained is fully appreciated on land, where plenty of space is available for heating feed-water in "economisers"; non-condensing engines also heat feed-water by the waste steam; but at sea, where such a saving would be more than ever desirable, nothing has been done in this direction worth naming. If by the aid of heat otherwise wasted the temperature of the feed could be raised to 369° Fah., a saving would be effected as compared with the existing plan of about 25 per cent. This is just what is claimed for the triple engine as compared with the ordinary compound. If it is worth while to incur the enormous outlay rendered necessary by altering engines or replacing them, surely it is worth while to stretch out our hands to grasp the saving which can be made in another direction. It was recently estimated that the introduction of the triple expansion system would involve an outlay of one million sterling per annum for some years. If 25 per cent. can be saved on the ordinary compound by substituting triple-cylinder engines, and 25 per cent. more by heating the feed-water, it is obvious that the new system would require only half the fuel used under the old. We do not venture to assume that so excellent a result would be realised in practice; but it does seem at least certain that to risk a few thousand pounds in experimenting would not be rash speculation. As to the argument that room would be required, it is enough to answer that less boiler space would be needed. If we do not do it in this country, then it will be done abroad, and then English shipowners will hold up their hands and say, "How is it *we* never thought of this?"—*The Engineer.*

PROF. CLEAVES' METHOD OF MAKING LARGE BLUE PRINTS.

THE following memoranda were presented by Prof. R. H. Thurston at the Washington meeting of Mechanical Engineers:—It gives me great pleasure to present to the Society a copy of a very large blue print made by Prof. E. C. Cleaves, of the Sibley College of Cornell University, by a new method devised by him, by means of which almost any desired size can be made.

By the common method the larger sizes are difficult to make satisfactorily, the plate-glass needed for the apparatus is very costly, and subject to serious risk of breakage, and the whole arrangement becomes clumsy and difficult of management. By the process adopted by Prof. Cleaves, no plate-glass is required; the apparatus is simple and easily and conveniently handled, and the size and cost of apparatus bear very little relation, the one to the other. Any size likely ever to be required in any work of the engineer can be as easily made as the smaller sizes, and the cost and difficulty of construction of the apparatus are never likely to be such as to constitute a bar to the use of this system of printing. There is no practical difficulty in getting up an apparatus to print a drawing 10ft. wide and 30ft. long, if it should be found desirable. That here exhibited in illustration of what can be done is 3½ft. wide and 8ft. long, and is probably the largest blue print yet made by any process.

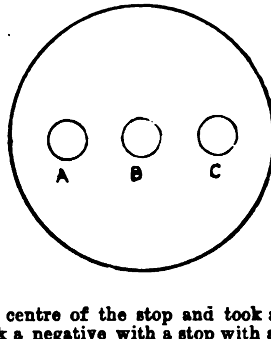
Prof. Cleaves' apparatus consists merely of a cylinder of a length exceeding that of the widest drawing to be reproduced, and of a diameter such that the longest tracing to be used can be wrapped around it with sufficient space to spare to give room for the clamps by which it is drawn into place and held. The cylinder is smoothly covered with felt and the sensitive paper carefully wrapped about it, the tracing to be copied being drawn over the whole and held smoothly in place by spring clamps which seize its ends. It is found to be easy to lay the tracing smoothly over the surface and to draw it into contact so perfectly that the work done by this method is even better and more certain than that produced by the ordinary plate-glass apparatus, even with the air-cushion now so successfully used with it. The print shown has a defect at one corner, but it is the only defective one yet made, and was selected to send, simply because it was feared that there might be some danger in sending it by express, and it was preferred to risk this rather than another. It is easy, with a little care and with some practice, to make these prints absolutely perfect, much easier than with glass. The apparatus being ready for use, it is mounted on a cradle, supported by its gudgeons, and is revolved in the sun by means of a cord leading from some convenient line of shafting; or it may be turned by hand until the exposure is satisfactorily completed. It requires a little more time to print a sheet by this method than by the old, as the tracing and the underlying sensitive paper is but one-half the time exposed to the rays of the sun. With these exceptionally large prints, however, for which only this process would be employed, this is not an important matter. They are not likely to be made every day.

THE STEREOSCOPE AND ITS APPLICATIONS.*

(*Concluded from p.* 408.)

THE images upon the ground glass cannot be inverted, but a perfectly equivalent experiment can readily be made with a glass negative. But let us notice the effect of the width of the lens upon the picture produced by it. Each part of the lens contributes to the picture. Now, I placed in front of an ordinary one-fourth size portrait lens, about 1⅜in. in diameter, a stop with an aperture $\frac{3}{16}$in. in diameter at *a* (Fig. 7), with its centre ⅜in. from the centre of the stop and took a negative; then took a negative with a stop with an aperture at *a*, of same size and at the same distance from the centre, and then took a negative with a central aperture *c*, of the same size. These negatives, now thrown upon the screen, manifest unmistakably the same differences that would be expected in pictures taken by lenses separated the same distance from each other. Prints from any two of them combined in the stereoscope give an effect as decided as any ordinary stereograph. Even the combination of the picture by the central aperture with one by a lateral aperture is very decided. It is plain, then, that when the full aperture of the lens is used, the resulting picture must be a fusion of many dissimilar pictures, and, in so far, must be wanting in precision. This will be true, of course, to the greatest extent of objects in the immediate foreground. Want of sharpness in cases of near objects is doubtless often attributed to other optical conditions, especially as a diaphragm in front of the lens is a remedy for this unsuspected cause of defect, as well as for many others. Sir David Brewster was so impressed with this defect of photographic lenses, that he suggested a simple pin-hole camera as the ideal camera, when photographic processes should have become sensitive enough; and as we appear to have reached unlimited photographic sensitiveness, Capt. Colston, of Paris, has recently given us an illustrated brochure upon the pin-hole camera. Experiments with such a camera some years ago, with wet plates, developed defects that deprive it of an ideal character. But to return to the stereographs by the lens. The subject was selected to bring out this fact. The object, pencils, pens, &c., ranged in distance from the camera only from 20 to 29in., and their maximum lateral distance from each other was 9in. Now, what is true of the pictures by different parts of one-fourth size lens must be equally true of the pictures by different portions of any lens, however small, even of a microscopic objective, if the objective is correspondingly small. If, therefore, a photo-micrograph be taken with one-half of an objective, and then one with the other half of the objective, these two combined in the stereoscope should give an appearance of relief that the microscope itself could not give, free from errors of interpretation, as to distance and form. And so they will. I have here a stereo-micrograph of sunstone, in which the crystals are located by the stereoscope, and the section shows depth and all the qualities of the ordinary stereograph. It was taken many years ago by Prof. O. N. Rood, now of Columbia College, and the method published, and it is a matter of surprise that in these days of photo-micrography no one has cultivated this branch, or indeed, that micro-stereographs of many objects are not in the market. I would just say that the method suggested, although giving results as stated, was abandoned by Prof. Rood for another, principally on account of difficulties in illumination. But we are not restricted to photo-micrographs in the application of the stereoscopic principle. As might have been anticipated, soon

FIG 7



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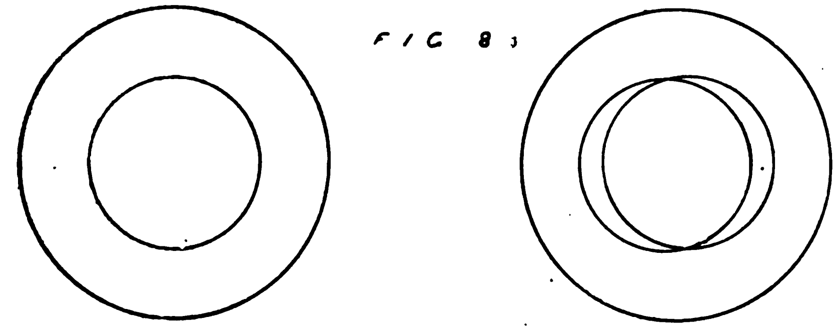
* Extracted from a lecture by Prof. CHARLES HIMES, Ph.D., delivered before the Franklin Institute.

FIG 8.



after the realisation of the great superiority of vision with two eyes over monocular vision, attempts were made to apply the principle in microscopic vision. The difference between the views of an object by the different halves of the objective was recognised, and the possibility suggested of presenting one to one eye and the other to the other eye, and thus obtaining microscopic vision in relief. Prof. Riddell, of New Orleans, seems first to have devised a binocular microscope in 1851; but in his first instrument the right eye looked through the right half of the lens, and the result was not stereoscopic, but pseudoscopic. In describing the appearance in it he likens a metal spherule to a glass ball silvered on the underside, and a crystal of galena to an empty box.

You might have inferred as much from the full discussion we have had, with this application in view, of the so-called camera stereoscope of Sir David Brewster. The pictures through the halves of the lens, as they are inverted, are similar in binocular character to those of the ground glass of the stereoscopic camera, and to produce stereoscopic effect it is necessary that they should be transposed; that the right eye should look through the left half of lens, and the left eye through the right half. Many optical contrivances have been devised to meet this requirement, but that of Mr. Wenham has done much by its extreme simplicity and cheapness, as well as effectiveness, to render the binocular microscope a possibility for all, and that, too, without loss of its monocular character.

But we have employed the term convergence of the optic axis in such a way that the impression may have been created that such convergence is necessary for stereoscopic effect. This was, indeed, almost a controlling view with the early investigators of the subject. Now, whilst there is necessarily always convergence of the axes, to some degree, in normal vision, I was convinced, many years ago, upon investigation, of the non-essential or secondary character of this condition in production of stereoscopic effect, and the subject has more recently been independently, most exhaustively discussed by Prof. LeConte Stevens.

It may be regarded as accepted that convergence is not necessary. Experiments may easily be made by anyone upon that interesting point by means of ordinary stereographs. By looking at a distant object, not too intently, and introducing before the eyes, at about the limit of distinct vision, an ordinary stereograph, after some practice, the habit of accommodation and convergence will be overcome. Four pictures may at first appear, but gradually the interior ones will approach each other, and finally coalesce, with resulting stereoscopic effect. In this case, controlled by the convergency theory, it was regarded as an essential condition of success by Brewster, Rogers, LeConte, Tyndall, and others, that the distance between similar points of the two pictures should not exceed the interocular distance, say, 2¾in. If by practice, however, anyone should acquire facility in thus combining the pictures of the ordinary stereograph, it will be found that, by cutting them apart, and gradually sliding the halves further apart, combination can be effected when the distance exceeds 3in., or even 4in. in my own case, and with complete stereoscopic effect, although, in such cases, the axes must be divergent. Still, in this case, there remains the necessity for movement of the optic axes, as they pass from points nearer together to other similar points further apart, a movement associated with normal perception of distance and form. But this perception of stereoscopic effect, whilst the optic axes are divergent, is far more common than might be supposed. In many, perhaps most, cases, in using a stereoscope there is this divergence. In many of the stereographs in the market, the distance between similar points greatly exceeds the average interocular distance, and the prisms do not produce superposition. Prof. LeConte Stevens, by comparing the foreground interval of a large number of stereographs with the deviating power of thirty different pairs of lenticular prisms, employed in the ordinary stereoscope, determined, that, for the average interocular distance, axial divergence is frequent in the use of the stereoscope. Just at this point, we must admit that, whilst play of the optic axes is important in our study of the form of objects, there are facts that indicate that binocular perception of distance may take place, when such movement cannot accompany it. Prof. Dove first tested this by illuminating the stereograph by an electric spark, an experiment since repeated by many, with production of unmistakable stereoscopic effect. So also an object illuminated by a flash of lightning exhibits relief. We cannot conceive of movement of the optic axes occurring in such brief intervals. The position of the pictures on the retinæ must therefore give us a criterion, not the sole one, but an important one. The theory of corresponding retinal points seems to meet the case. Stated briefly, the internal or nasal half of one retina corresponds to the external or temporal half of the other retina. Points are seen single when their images fall on corresponding points, the images of points nearer or more remote will not then fall upon corresponding points, and they will be seen double, although we may not be conscious of the fact, and most persons may have difficulty in verifying the statement. It is this doubling of images of points nearer or more remote than those observed, and the difference in character between those nearer and more remote, that accompanies all normal vision, that unconsciously aids at least, in our perception of distance.

Now, a few hasty suggestions as to some other applications of the stereoscope. When first introduced, its range of application seemed very restricted; even when it was widened in the number and character of its subjects by photography, it seemed restricted to objects of ordinary unaided vision. We have seen how not only the principle was soon made directly applicable to the microscope, but magnified stereographs were demonstrated possibilities. Application to extra-terrestrial objects was not anticipated. But about the same time, Rutherford and De La Rue discovered that they had stereographs of the moon. I do not know that they intentionally took the photographs with this in view. They had not taken their photographs from points far enough apart to give binocular parallax. But, if I wished to obtain a stereograph of a bust, I could either move my camera 3in. to the right or to the left, or what would produce the same effect, rotate the bust on a vertical axis through a small angle, so as to bring a little more of one side into view, and take a picture. This plan, by tilting the stage of the microscope for stereographs of minute objects, has already been alluded to. Now, it is true, as a general statement, that the moon already presents the same side to our view by reason of the identity of the time of its rotation on its axis and of revolution in its orbit. But it is not rigidly correct. The rate of motion varies slightly in different portions of the orbit, causing so-called libration in longitude, by reason of which a little more of one side is exposed to our view. The moon turns around just enough to afford us stereoscopic photographs at these times, which give the most surprising—in fact, exaggerated, effect. Wonderful as these are, I was unable to obtain in the market those by Rutherford at all, although advertised for sale, but found some by De La Rue. They manifest not only the form of the moon, but exhibit almost a pitted appearance, mountain ranges and solitary peaks stand out in bold relief. So, too, De La Rue has obtained stereographs of the sun. Between these two wide limits, the microscopic and the telescopic, lie all varieties of subjects and numberless questions, which the stereoscope can aid in investigating. The so-called "Phenomenon of the Horizontal Moon" has been discussed since the days of Ptolemy. The illusion of size depends on the illusion of distance. Sir David Brewster and Prof. Reute devised stereoscopic illustrations of this connection. That of Prof. Reute, Fig. 5, will be recognised as diagrams of convex and concave conical frusta, the smaller circles in each case being of the same size, but in the stereoscope, as they are made to assume positions of bases of the frusta, the one more remote appears larger.

From several diagrams of my own on this point, I select one of some theoretical interest. In it a single small circle is represented in the right-hand diagram by two equal circles at different distances (Fig. 8). Impressed with the necessary rapidity of movement of the optic axes in ordinary vision, my expectation was that the alternate combination of this circle, in succession, with the equal circles of the other diagram, would be so rapid, that the results could be compared, and the same circle be made to appear larger and smaller in succession. To my surprise, both frusta, the convex and concave, presented themselves at the same time, the same circle seemed to occupy two places at the same time, and with apparent size corresponding to the distance. The natural explanation was that it was an illustration of the rapidity of the movement of the optic axes, and our unconsciousness of it. But unfortunately for this view, Prof. Le Conte Stevens has called attention to the fact, since verified by myself, that it manifests the same character when illuminated by an electric spark. Again, there are phenomena which we cannot locate in space by direct observation, for want of time, and a single photograph assists us but little in their study. The photograph of a moving object, as a ball, only gives us the projection of its path, a stereograph would locate its path in space for us. To vary the application, the photograph of the electric sparks upon the screen exhibits a confused mass of interlacing lines. But by combining this with the stereoscopic mate, taken at the same time, this tangle of lines assumes form as the path of each spark locates itself in space. Application of this method to the photographic study of the discharges of atmospheric electricity might add to the value of such photographs. On the other hand, in the study of the forms of clouds simultaneous photographs of them, from points widely separated, might give invaluable information. But there are ordinary subjects which photographs with all their accuracy are utterly inadequate to render, of which they give us limited and perhaps illusory information. Impressed with this fact, a few years ago, when about to make a photographic study of the glacier system around the Matterhorn, I decided unhesitatingly upon a stereoscopic outfit, in spite of the extreme desirability of reducing impedimenta, where mule and man transportation alone were available. A few of the finest of these, as lantern-slides upon the screen, are almost meaningless; no explanatory statements can give them full value; even these with the bold peaks and their cloud banners only reveal their exquisite beauty and wealth of detail, as anyone may see, in the stereographs. But photography is not only not always essential, but not available in some most interesting investigations. Besides outline drawings and diagrams of all kinds, what has not yet been fabricated, can be drawn, the camera can be anticipated; ideal apparatus, forms suggestive or tentative, can be rendered stereoscopic, and representations of phenomena almost a substitute for the reality can be produced.

LIGHTON'S ANALYSING DIAPHRAGM FOR POLARISCOPE.*

THE following described piece of apparatus has been found by me to be of great help in the study of crystallography, and I have thought that a description of it to working microscopists through your *Journal* would help along the good cause of microscopy. We will suppose that the polariscope as ordinarily used has been placed in position, the polarising prism below the stage and the analysing prism above the objective. The apparatus consists simply of a cap with movable diaphragm placed over the eyepiece, as illustrated in figures 1 and 2. Fig. 1 is a sectional view and Fig. 2 a top view of cap of eyepiece.

The letters in both Figs. refer to the same parts. Let A indicate the axis of tube; B, Fig. 1, the eyepiece; C, the cap of eyepiece. The apparatus consists merely in a diaphragm plate, D, swinging from right to left on the pivot I, Fig. 1. This motion is given by placing the finger at the knob L. The amount of motion is controlled by the two small studs G. The diaphragm is pierced by a small hole H, ⅛in. in diameter. E is a screw in top of post I, Fig. 1, holding diaphragm in place. F is apex of cone of light formed by the image of source of light passing through the eyepiece.

Now, if the diaphram be so adjusted by sliding the cap upon the eyepiece that it will be on a level with this point of light a very interesting series of optical effects will be observed. The small studs, G, should be so placed that when the diaphragm is swung to the right or left the sides of hole, H, will just cut the axis of eye-lens (apex of cone of light). I will mention a few of the sights seen by its use as described above. In no case were the prisms of polariscope revolved. A crystal of chlorate of potash was selected which, upon simply revolving the stage, passed merely from an orange-purple to a dull grey. On introducing the cap and passing diaphragm from right to left a beautiful series of the most brilliant tints was seen—a fine

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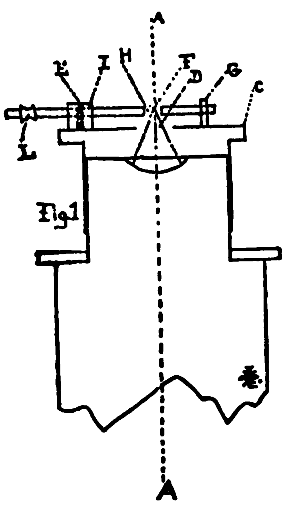
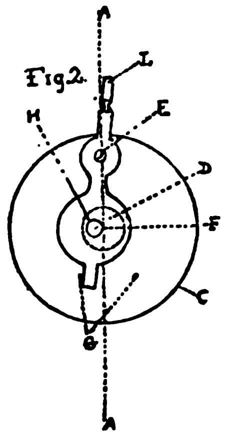
* By WILLIAM LIGHTON, Leavenworth, Kansas, in the *American Monthly Microscopical Journal*.





lue changing to purple, orange, and then to yellow, and lastly pale straw colour.

ction of fortification agate was taken which l a small crystal of pure quartz in one ı. With the diaphragm used as before from left the colour of the crystal was merged right green to magenta and then to a velvety red. With the usual revolution of the stage ours exhibited were green fading to a dull

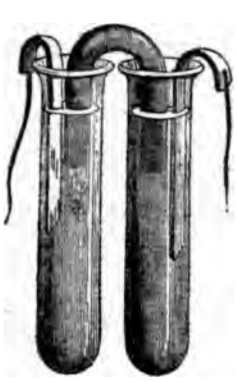
ı this apparatus there is not only a more and brilliant series of colours, but also a l intensification of points of structure. In o above-mentioned slides delicate lines of lisation were shown which were invisible ordinary circumstances.

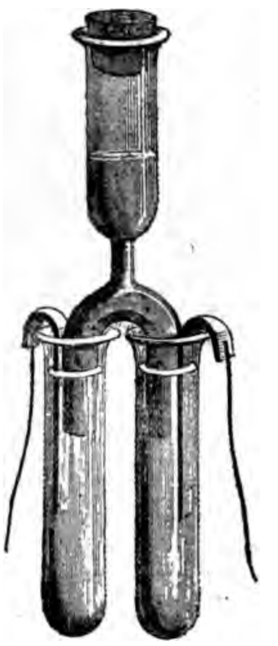
of the small, curiously-branched bones of d-horse, a fish common in this region, was ied and showed the bone cells in a remark- listinct way, they being quite indistinct ıt the diaphragm.

IDARD DANIELL BATTERY.*

sulphate of copper battery is probably more sed as a standard of electromotive force ny other. Various forms have been sug- and adopted. Among the features to be l are permanency and freedom from tendency ıl action. In these and other respects, the as usually constructed is defective, as it is tically a two-fluid cell. It is essential that tes should each be immersed in a particular ınd that the fluids should not mix. To this end, various means have been adopted. rous jar form is very commonly used. But cientific apparatus this is defective. The of the jar become filled with the battery ınd to start new this may require quite a process of cleaning. Then it sometimes ıs that metallic copper precipitates upon the s of the porous jar, rendering it quite *combat*. Thus the mere fact of the use of jar introduces an element of complication.

figures illustrate a very simple and cheap of cell that avoids most of the troubles affecting the Daniell battery. Two forms wn, one of the simplest possible description, er a modification designed to secure lower nce, and admitting of the convenient a septum of goldbeater's skin or other ane. The simpler form is constructed vo test tubes, a small bent glass tube, and ates and solutions. Two test tubes are in a stand. A piece of glass tubing ent in a smooth curve, so that n place it will extend from one to the other, wn. This should be about 3 mm. ($\frac{1}{8}$in.) in ıl diameter. A piece of copper for negative nd of zinc for positive plate, are provided. h a wire is connected by soldering. The de- solutions must now be prepared. The h is, of course, to be fixed by the experi- , according to the results he wishes to obtain he battery. The use of saturated solutions l. Assuming such to be employed, one of t tubes is nearly filled with a saturated solu- copper sulphate; the other one contains a ed solution of zinc sulphate. The latter is vier fluid. The bent tube is now filled ıe same solution of zinc sulphate. If it be hile thus filled with its two open ends down ɔn, it will not empty itself. The least jar or vill cause it to do so; but by careful handling hus be carried from one vessel to another. then filled it with the solution, which is lone by siphoning, it is carefully lifted up as described, and lowered into the solutions in the test tube. To be sure that no air bubbles rise into the bend, it is well to have the zinc sulphate tube filled to the higher level. Then, on introducing the bent tube, a little of the zinc solution will first siphon over and sink to the bottom of the copper solution. A slight mixing of the solutions is not prejudicial, provided no copper solution comes in contact with the zinc plate. The bent tube having thus been introduced, the copper plate is placed in the test tube containing copper sulphate solution, the zinc plate in the other tube, and the battery is ready for use.





It is of extremely high resistance, and no porous septum is used to secure more perfectly from mixture. A slight mixing of the solutions in setting up, moreover, cannot well be avoided. The other form overcomes these troubles, and also gives a cell of lower resistance. The bent tube is made of larger diameter. It may be nearly as large as the test tubes. To the apex of its bend a capillary tube, opening into a large tube, is connected. If desired, a septum may be tied over one of its lower ends. The tubes are filled with their solutions, the bent tube is placed in position, and by suction the liquid is drawn up until it rises through the capillary tube well into the larger one. The suction is stopped and the end left free. The liquid naturally sinks, but, owing to the small size of the capillary tube, with such slowness that a cork can be inserted, without trouble, into the suction tube. The plates are put into their places, and all is ready for use.

If a piece of membrane is used, it should be tied over the end of the tube which is immersed in the solution of higher specific gravity, containing the sulphate of zinc. It is well also, in this case, to pour into that limb through the suction tube a quantity of the zinc sulphate solution. The level of liquid in the test tubes and the length of the straight portions of the bent tubes must be so adjusted that enough liquid will be left in the test tubes after the filling of the connecting tube. To make this easier to effect, it is well to use test tubes of large diameter, or even small beaker glasses.

SCIENTIFIC NEWS.

CORRECTED elements of Barnard's new comet are published in Dun Echt Circular, No. 148. They are by Dr. H. Oppenheim, and were derived, by variation of the curtate distances, from observations on May 14th, 19th, and 23rd, combined with a single observation made at Bothkamp, June 16th. T = 1887, June 16·75991, Berlin M.T.; π—☊ 15° 10′ 45″; ☊ 245° 13′ 25·2″; *i* 17° 34′ 49·2; log. *q* 0·144420. The Ephemeris for Berlin midnight on July 11th is R.A. 17h. 15m. 37s., N. Dec. 6° 30′, the brightness being as ·9 compared to unity on May 14th.

The annual general meeting of the Liverpool Astronomical Society will be held this afternoon in the rooms of the Royal Astronomical Society, commencing at 3 o'clock.

The council of the Royal Geographical Society has conceded the principle of the admission of ladies as "fellows."

The University of Oxford have selected Mr. H. J. Mackinder, out of thirty candidates, as Reader in Geography. The Russian Government has determined to establish Chairs of Geography in the Universities of the Empire, and the first appointment, that to the University of St. Petersburg, will be made in the autumn.

At a meeting of the local executive committee for the British Association held last week in Manchester, the guarantee fund was reported as amounting to £10,345, a sum which is sufficient for the present without any further call on guarantors. The committee propose to provide space in the gallery of the Natural History Museum for the exhibition of instruments and specimens shown in connection with the sectional meetings. The Evening Entertainments Committee reported that the Mayor of Manchester had invited members and associates to a conversazione in the town hall on Tuesday, September 6, and that the soirée kindly offered by the Executive Committee of the Royal Jubilee Exhibition had been fixed for the evening of Thursday, September 1. It was stated that the lecture to working men, by Mr. George Forbes, F.R.S., on the evening of Saturday, September 3, would be on the electric light, and the Manchester and District Edison Electric Light Company, Limited, had undertaken the experimental illustrations in connection therewith. The Hospitality Committee reported that their efforts to secure the presence of eminent foreign men of science at the meeting had met with great success. Of those invited nearly 100 have already accepted, including Americans, Germans, French, Russians, Belgians, and men of other nationalities. Not merely will the numbers be altogether unprecedented, but in each of the leading branches of science the most eminent foreign representatives will be present. In physics, chemistry, and biology the attendance will be exceptionally large, and in these subjects the meeting is certain to produce permanent results of great value to science. The excursions committee reported that a list of thirteen excursions had already been arranged for Thursday, September 8th, the list including Chester, Chatsworth, Bolton Abbey, Hornby

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T. O'Conor Sloane, Ph.D., in *Scientific American*.

Castle, Crewe and Horwich Railway Works, Stonyhurst, and the Isle of Man. For Saturday, September 3rd, several excursions have already been arranged, including one to the salt-mines at Northwich, to Tatton Park, to Buxton, Knutsford, &c., and a marine dredging expedition will be made from Liverpool.

At an influential meeting held in Leeds last week under the presidency of the Mayor, it was determined to invite the British Association to that town in 1890.

The meeting of the French Association for the Advancement of Science will be held at Toulouse, from Sept. 22 to 29 next. Those intending to be present should give notice to the secretary at Rue Antoine-Dubois 4, Paris, before July 15.

The congress of the German Authropological Society will meet at the beginning of August at Munich.

At a meeting of representative electricians, telegraph engineers, and others interested, presided over by Mr. Preece, F.R.S., it was decided to celebrate the jubilee of the electric telegraph by a dinner on July 27 under the chairmanship of the Postmaster-general. It may be remembered that the first successful attempt to establish a practical electric telegraph was made on July 25, 1837, between Euston and Camden stations.

Telephonic communication between Paris and Rouen can now be carried on at the rate of a franc for every five minutes' use of the line. The success of long-distance telephones in Belgium has induced the Government to establish the line over a stretch of 82 miles; but it should be noted that the franc is payable, whether the person wanted can be "called" or not.

The Geologists' Association is about to visit Cornwall during its long excursion, which will commence on August 8. Arrangements will be made for examining the structure of the country between St. Austell and the Land's End, and of gaining an acquaintance with the mineral industries of the county.

A well-known daily paper having published an article on Cycling, was promptly "corrected" from Coventry, and now there is some little argument as to who first invented, suggested, or described the safety bicycle. In No. 227, p. 424, Vol. IX., there is a design by Mr. F. W. Shearing, which is probably as nearly "first" as any other illustration.

The report of the committee on Pasteur's preventive system of treating hydrophobia has produced some extraordinary statements. A well-known Sunday sporting and dramatic paper actually protested "against these foolish wise men's proposal that 'preventive inoculation' should, like vaccination, be made compulsory on all citizens of all ages," and then proceeded to explain how foolish such a proposal is—or, rather, would be! We gave the names of the committee on p. 411. The secretary of the Paris Academy of Medicine states that the letter read by M. Peter, purporting to give an account of Cantini's unsuccessful inoculations, and to have been written by Prof. Tommasi, was a joke or a hoax. On the other hand, it is amusing to read that Pasteur's claim to priority is being disputed.

Hay fever is so troublesome an affection to many members of the Anglo-Saxon race—it appears to be confined to them and to have originated in this country—that any scientific hypothesis of its cause is welcome. Dr. Morell Mackenzie's new edition (the 4th) of his work on the Etiology and Treatment of Hay-fever seems to have given rise to misconception as to the supposed origin, and on the other hand it is pointed out that the names of the grasses which are the alleged culprits in the shape of their pollen are incorrectly given in some cases, or else they have been wrongly accused. It would be interesting to learn how the pollens of the grasses are distinguished one from another. The rose is also credited with producing what is known as "rose cold"—a subject which is treated in an appendix by Dr. Mackenzie. At a recent meeting of the American Laryngological Association a paper on the subject was read by Dr. J. Roe, in which the conclusions arrived at were set out in order—the most important being that "the affection recognised as hay fever is due to local irritations brought in contact with the sensitive areas in the nose;" and that by careful treatment of the disease of the nasal tissue, combined with that of other portions of the respiratory passages below, hay fever can be cured.

In some further experiments with safety-lamps, carried out at the Neepsend Gasworks, Sheffield (p. 406), the Clifford lamp seems to have been the most successful, as it generally "went out." A full report of these experiments will no doubt be published in an authoritative form before long.

The question of musical pitch in the bands of the British Army has been put on its proper footing, by an intimation from the Commander-in-Chief that there is no objection to the adoption of the French pitch if the expense of altering the instruments is not allowed to fall on the public funds.

The Commission appointed by the University of Pennsylvania under the will of the late Henry Seybert to investigate the so-called phenomena of modern spiritualism have come to the conclusion that there is nothing extraordinary in any of the manifestations that is attributable to anything more mysterious than legerdemain. The commission report that the demonstration of the trickery of slate-writing is conclusive, as is that of the purely physiological origin of the rappings. It was the common experience of the Seybert Commission that "as soon as an investigation worthy of the name begins, all manifestations of spiritual power cease."

Vivisection.—An amended report is issued as a Parliamentary paper containing returns from inspectors showing the number of experiments performed by license on living animals, whether painless or painful, during 1886. The persons licensed to perform such experiments are 64 (48 in England, 16 in Scotland) in number, and their names and qualifications are given in full; of these only 54 have used the privilege. The number of experiments reported was 1,095, of which 458 were performed without anæsthetics; these were, with few exceptions, experiments in inoculation, and consequently painless. As the duration of inoculation experiments goes on from the first puncture till the animal recovers, dies, or is killed, it is possible that during this lengthened period pain may be developed. It has therefore been decided to attach a special condition to the license of all who peform such experiments to the effect that if pain be caused after the main result of the experiment has been attained, the animal must be killed under an anæsthetic. In forty cases the return states that the experiment was of a painful character, but in 32 of these the amount of suffering could have been but very slight.

Finding the Time.—M. d'Abbadie has described an easy method of finding the time to the French Academy of Science. It is intended to be useful for observers of physical phenomena, and to enable them to dispense with an intermediary. Two instruments of small cost are required: one, a prism of glass, called a "dipleidoscope," and having one of its angles fixed in the meridian parallel to the axis of the earth. About noon one sees in it by reflection two images of the sun which blend into one at the moment of true noon, and in order better to determine the moment one notes with a seconds watch the contacts of the first and second edges. The mean of these two instants gives the true noon. The equation of time published in the *Annuaire du Bureau des Longitudes* permits the true time to be deduced afterwards, and consequently the advance or retardation of the pendulum, and its rate. The other instrument gives more exact results. It consists of a little lens furnished at its focus with five wires, fixed and equidistant. When required it can be directed far from the meridian. The moment of passage of a star across each of the wires is noted, the sum of the instants noted is doubled, and divided by 10, giving the second and tenth of a second when the star was behind the central wire. In this way the sidereal time of the passage is obtained. A simple calculation gives the mean time by a table published in *Connaissance des Temps*. Both of these instruments ought to be fixed in position by a competent person.—*Engineering*.

Photographic Lenses.—Messrs. T. S. and W. Taylor, of Slate-street Works, Leicester, send us their new catalogue, into which they have introduced a new series of lenses, and reduced the prices of some of the more commonly-used sizes. Improved machinery and an increased outfit have enabled them to do that in connection with the smaller sized lenses.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE BINARY STAR OΣ 298.

[27554.]—With reference to Mr. Gaudibert's remarks on this star, computing from Dr. Doberck's elements, I find the position at present

1887·50 : 60·75° : 0·42″;

and, from elements computed by the Russian astronomer, Prince N. Dolgorukow (*Ast. Nachrichten* No. 2531), I find

1887·50 : 64·27° : 0·40″,

a fairly close agreement.

According to Doberck's elements, the periastron passage took place in 1881·762 (P = 4·7°), and, according to Dolgorukow in 1882·22 (P = 3·4°), and, as the eccentricity of the real orbit is considerable (about 0·5), the annual angular motion is now considerably greater than the mean. I find annual motion at present about 12° per annum. Schiaparelli's measure seems to agree fairly well with both orbits.

June 28. **J. E. Gore.**

DOUBLE STARS, β 619, &c.

[27555.]—Regarding the double stars mentioned in Mr. Gaudibert's letter (No. 27472, p. 389), I find that four of them have been observed during the present season—viz., β 619, Σ 2114, OΣ 298, and ν Coronæ Bor. In the case of β 619 the elongation is very slight; but the mean result of three nights gives 358·78° as the position angle. Σ 2114 is now a very easy pair, the distance being greater than 1·50″. P.A. 159·31°, and I have readily seen it with the aperture reduced to 4in. With respect to OΣ 298, I am not able to confirm Mr. Gaudibert's angle of 345°, or to see the stars separated. On three occasions there appeared to be a possible elongation *p.* and *f.*, the mean result being 83·48°; but that this is very slight will be seen from the fact that the separate readings of the micrometer range from 76° to 117°. The distance, perhaps, may be as much as 0·35″, although this is, of course, purely estimation, and on several occasions the star has been noted as "round." ν Coronæ Bor. has invariably been noted as single. For purposes of useful micrometrical work I find that any pair the distance of which does not exceed 0·50″, is too close for really satisfactory results with an aperture of only 10in., and good nights are not so plentiful as to allow of time being wasted over a class of objects which are the legitimate work of a refractor of 20in. aperture. There are, moreover, many pairs which are well within the reach of moderate apertures of which scarcely any measures exist. **Kenneth J. Tarrant.**

Letchford House, Pinner, June 29.

STARS VISIBLE BY DAYLIGHT—DOUBLE STARS—ANTARES.

[27556.]—May I recall to "F.R.A.S.'s" recollection, àpropos of his suggestion in letter 27515, the report of the experiments made at the Watson solar observatory at the Washburn Observatory in 1882. "No stars," says Professor Holden, "were seen at any time"; and the same result attended the experiments made by Prof. Langley at his mountain observatory near Pittsburgh, and by Prof. Harrington at Ann Arbor. Two of the funniest statements about the visibility of stars in daylight will be found in the *Astronomical Register*, Vol. III. p. 78, and Vol. IV. p. 271, the latter one being really a little too strong. From my own experience in pointing out Venus and showing stars to people through the telescope in the daytime, I doubt whether ninety-nine out of every hundred persons would recognise a star visible in the daytime *as a star* if they saw it. When the exact position of Venus is pointed out (and of course Venus is far brighter than a star), the usual sort of thing one hears is, "What, do you mean to tell me that that tiny little white point is the planet Venus?" As to the visibility of stars to the ordinary observer down a coal-mine, I simply believe a syllable of nine-tenths of the ents.

experience of Stephen Blackpool in "Hard " referred to by Mr. Proctor in the foot-note 5 of his smaller Star Atlas, is a sample of nost people believe on this subject. Undly stars have been seen by day. G. P. saw Sirius with the naked eye in broad sun-and Schmidt states that at Olmutz he found tars of the first magnitude began to be when the sun was 40' above the horizon; en, Schmidt and Bond were astronomers, ry keen-sighted ones. It is my firm belief ordinary man or woman would not know a the daytime if they saw one, coal-mine or no ne.

Gaudibert's (letter 27472, page 380) vision escope are both unique. He states that the n angle of O Σ 298 is about 345° now, and he at this object is divided with 550 on his eflector. How this can be the case I have eption, any more than I can understand how an annual motion can have been 5° (I sup-*ars* is a slip of the pen for *degrees*) during few years, as I always thought the motion smaller star of a binary pair was more rapid pproaching apparent periastron (I may, of be mistaken in this supposition), or how can be called very close. I have no time at to look for very recent measures of any of udibert's objects; but the following ones w the character of the pairs mentioned by have extracted them from my marginal in my Gledhill's "Handbook of Double

9. De. 354·0° : 0·38" (2^n) 1878·46. Eng. ·330" (6^n) 1814·17.

l. β 75·1° : 0·5" ± : (1^n) 1878·48. "Very (No other measures known to me).

98. Binary, period 68·8 years, Doberck; 70·3 Dolgorukow. The following measures will ne motion since 1877.

Σ 298.	De.	295·8°	0·8"	(5^n)	1877·53
„	β.	310·7	0·27	(2^n)	1878·33
„	Hl.	335·0	0·26	(4^n)	1879·46
„	β.	350·3	0·36	(3^n)	1881·42
„	Sch.	7·5	0·33	(4^n)	1882·47
„	Eng.	36·7	0·17	(3^n)	1883·65
„	Pe.	49·0	0·30	(2^n)	1884·44
„	Eng.	104·9	0·29	(7^n)	1886·68

ably the last angle is a little too large. I say it would be about 110° or 115° at pre-

Σ 135·7° : 1·34" : 1880·07. Pe. 157·7° : 1·42" : 1885·53

De. 279·3° : 0·35" : (5^n) : 1876·34. Rev. J. J. Perry 267·5° : 0·31" : 1882·4

OΣ 55·9° : 0·37" : (4^n) : 1846·56. Pe. 48·0° : 0·38" : (3^n) : 1884·89

OΣ 72·2° : 0·61" : (3^n) : 1845·80. β round ½^m) 1881·5. Eng. 78·3° : 0·22" : (5^n) : 1883·84

. 181 6° : 1·11" : (2^n) : 1874·94. Eng. 193·2° : 1·51" : (6^n) : 1883·71

æ.	Pe.	138°	0·17"	(4^n)	1883 58
	Eng.	146·9°	0·20"	(8^n)	1883·64
	„	166 8°	0 28"	(16^n)	1884·61
	„	164·6°	0·38"	(10^n)	1885·63
	„	158 0°	0·43"	(5^n)	1886 65

omes to Antares seen by "M." (letter 27516, must have had its origin in a spurious image of r character to the ones seen by Dembowski, and others, and alluded to in a former comtion of mine. Shortly after Mitchel's ry of the *comes*, a large telescope in America eve the instrument was the 9⅓in. refractor shington, the object-glass of which was d by the Clarks in 1862) showed not one, *comites* to Antares, a circumstance proof much annoyance to poor Mitchel. The 8th magnitude is a very distant one noted th as being on an angle of 129·5° at 33·1sec. from Antares. It is in the field of view low power.

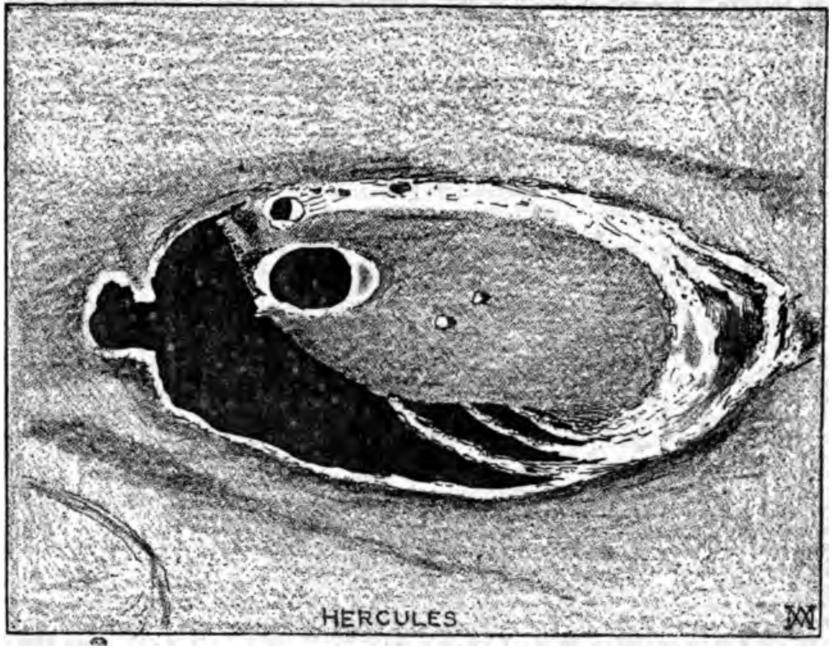
H. Sadler.

RETROGRESSION OF NIAGARA.

7.]—HAVING seen from time to time such differing statements as to the rate at which ceeds, I am induced to seek through your for some reliable information on the subit is a most important geological question, g, as it should, a well-defined clue to the nation of the duration of the present general n of the earth's surface.

Ours," 10th June, p. 341, it is stated that, g to Professor Woodward, of Washington, he rate of about one mile in 2,200 years. I ewhere seen it stated that since these falls st known they have receded only a few It is, I believe, seen with perfect certainty y have cut back about seven miles through d rock limestone, I believe. Does there of this only "one mile" more, and what is after that? I should be deeply interested iving any information from competent y on a subject of such universal interest.

J. H. C.



HERCULES.

[27558.]—HEREWITH I inclose a drawing of this fine wall-plain, made about 8.30 on June 26th. Definition was good, and I was able to use 400 on 8½in. Calver even with field lens removed. With the higher magnifiers, the walls of Hercules seemed very complex; the curious terraces on W. came out by glimpses with their alternations of light and shade. The N. rim of central crater was very bright, and I seemed at times to see some object upon it; also something just to S.W. of crater which interfered with the great shadow. The crater on E. wall of Hercules was conspicuous, and there seemed to be a smaller one further N. upon the wall. Between the larger crater on E. wall and the great shadow was a depression and apparently a ridge. The appearance of the S. ramparts quite bore out Schmidt's delineation. The usual two small objects were seen upon the floor, which seemed darkest at its N. end.

Llanelly. **Arthur Mee.**

MEASUREMENT OF MAGNIFICATION IN MICRO-OBJECTIVES.

[27559.]—IF Mr. Brokenshire (27482) will reckon his 10in. from back lens of objective to the plane side of eye lens of ocular, he will, I think, not get far wrong, for, on consideration, he will find that the objective, though it contains a dozen lenses, is but one magnifier—one eye, so to say—and yields but one image. So also with the ocular; that, as a whole, is only one magnifier, and yields but one image. If the 10in. be measured from any part of the objective to any part of the ocular, other than those indicated, some element in the magnification will of necessity be omitted from the reckoning, and an erroneous result obtained. The size of the image projected on to the table by the camera lucida does equal that of the image seen in the microscope when the distance from camera to table equals that from camera to back of objective—at least, so I find it in my own instrument. I don't know of any method of obtaining the magnifying power of any series of objectives and oculars except actual measurements by micrometer and camera lucida, carefully made and tabulated for future reference.

After Mr. Brokenshire has determined the powers of his various combinations of objectives and oculars and tabulated them, he can without much difficulty also determine the magnifying power of each objective and eyepiece separately by the adoption of a simple expedient. Place the microscope in position for an ordinary observation; put upon the stage a stage micrometer and focus accurately, taking care that the draw-tube is pulled out so as to make the body 10in. from back lens of objective to eye side of eyepiece; now remove the eyepiece, and hold over the aperture a piece of ground glass or tracing paper; this will receive the image of the micrometer lines as magnified by the objective only, and such image can readily be measured by means of fine-pointed compasses. This image will be found to be very much less than that obtained when the eyepiece is used, and indicates the magnifying power of the objective alone. For instance, if the total power of any combination (say, No. 1 eyepiece and 1in. o.g.) be 75 diam., and the image as given by the objective alone, under conditions as above, be 15, it will be evident that the objective has a power of 15 diam. and the eyepiece 5 diam., and will also show that the so-called 1in. o.g. is in reality a ⅔in. (This happens to be the case with my glasses.) Theoretically, a 1in. ought to magnify 10, a ½in. 20, a ¼in. 40, &c.; but glasses are not made theoretically exact in this particular—indeed, the English denomination of object-glasses is altogether misleading. My ¼in. (a Beck) has a power of 45, and 1/16in. (Siebert) nearly 200. To get the 10in. of micro. body accurately measured, cut a piece of straw to that length and drop it down inside of micro. body; if the body be short of 10in., pull out the draw-tube until the top end of the straw is just level with the top of micro. body; then remove the straw, and proceed to work.

Micro. measurements, to be of any real value, do require great care in the making of them. The focussing must be exact, and every adjustment and correction made for cover glass, &c., over the object to be measured. But when these conditions have been observed, the result is satisfactory.

Chorley, Lanc. **F. J. George.**

[27560.]—WILL F. R. Brokenshire (27482) excuse my pointing out that his heading is a little at variance with his requirement as explained by himself—viz., the combined magnifying power of his several objectives with various eyepieces? He has already discovered that the adjustment of the collar of high-power objectives affects their magnifying power, consequently in preparing a table of amplifications with various combinations, it would be requisite to record the position of the collar with all such objectives.

I don't think he will find any much better or simpler plan than that he appears to have adopted; and provided he always arranges the camera lucida, so that it is exactly the same distance from the paper in all cases, he will not only have a pretty accurate means of comparison between his various combinations, but can also make a fairly accurate measurement of any object by first placing an accurately-ruled micrometer on the stage of his microscope and carefully sketching the divisions on his paper and then replacing the micrometer by the object he wishes to measure, taking care, if great accuracy be desired, to focus without altering the fine adjustment, so that the relative positions of all lenses may remain identical in both cases.

A distance of 10in. has been adopted as a standard for convenience of calculation; but any distance at which distinct vision can be attained would do as well, provided that said distance is a constant quantity.

Gamma Sigma.

SNAKE-BITES AND THEIR REMEDIES

[27561.]—THE "Thanatophidia of India," a splendid work by Sir Joseph Fayrer, contains life-sized illustrations, in their natural colours, of the chief deadly snakes infesting the inhabited portions of that vast region. This costly book is largely distributed to the hospitals and other public establishments of the Indian Empire, at the expense of Government. Each species is fully described, with a full account of experiments on animals and birds, both by bite, and injection with hypodermic syringe, all ending in the melancholy summary gentleman referred to has followed "S. and D." and others in this discussion, and is "living to fight another day." He is writing all right on other matters.

"Rover" says Lazonby platform was overrun a few days ago with two Midland vacuum engines. I have made particular inquiry, and the last time that platform was overrun was in January last, and then only one engine was on the train.

"Rover" says, *re* Bow accident, the Government inspector in his report said "he had no doubt the brake was put on by the *guard*." Major-General Hutchinson's report says nothing of the kind. It says—"In the absence, therefore, of any other explanation, it seems reasonable to suppose that *one of the guards* must have inadvertently moved the tap in his van, and have thus unintentionally applied the brake"; although just previously he says—"These taps are not in a position to render this probable." He says further—"This collision also raises the question as to whether, when a train of carriages fitted with the automatic air-brake is being drawn by an engine not so fitted, the air should not in all cases be discharged from the reservoirs."

"Rover's" quotation from last half-year's brake returns—"Total failures of brakes to go 'on,' 89; 80 due to vacuum brakes alone, against 9 due to all other systems"—is wrong also. The following figures are correct:—

Failures to act:—

Westinghouse	8
Vacuum automatic ball valve	3
Leak off	4
Simple vacuum	80
Other brakes	2
Total	97

It will be seen that "Rover" cannot help falling back upon the simple vacuum and "leak-off" brakes.

It is the ball-valve vacuum, "Rover," we are dealing with in this discussion; all other kinds are dead, therefore the true comparison is:—

Westinghouse failures	8
Ball-valve	3

Now, "Rover," just tell us how, with two engines on a vacuum ball valve train, and the second driver has his ejector in the "running" or "feed" position, and does not interfere with it or his air-valve after starting, how the vacuum in the reservoirs would be all destroyed and the brake rendered useless, as was the case with the Westinghouse brake at Crook?

Leeds. **Samuel Davies.**

CONTINUOUS BRAKES.

[27568.]—Mr. Kiernan says in his letter to the "E. M." (27409) that I did not take into account the time required to fill up the brake-cylinders and opening the passage from the small reservoirs to these cylinders. This would be difficult to calculate: this time is, however, so small that, practically, the Westinghouse brake may be considered as instantaneous in its action. At all events, this time is included in the difference between the theoretical value I found and the experimental—that is to say, one second; this difference is mostly due to the resistances caused by the bends of the pipes. If the driver's valve is open, so as to produce a reduction of 5lb. or 6lb. in the main-pipe, it will be heard and seen that all the blocks are applied at one time to the wheels.

I beg to assure Mr. Kiernan that I have never said that the present form of the automatic vacuum brake was not a good one. I am also ready to admit that the automatic vacuum brake is, in its present state, a very serviceable apparatus under ordinary circumstances, and that it meets most of the requirements of English railway working. But, at the same time, it cannot be considered as equivalent to the Westinghouse, either in point of economy or quickness of application.

It is very probable that the automatic vacuum brake will be adopted by most railways in this country if the railway men interested in the adoption of the Westinghouse do not take energetic steps for the purpose of having the latter brought more prominently before the public and the railway authorities. No Act of Parliament will ever be passed recommending the adoption of one special brake. It will be a fine result if the use of automatic brakes is enforced by law on railway companies.

Mr. Samuel Davies has a subtle way of reasoning, when he says I admit that the Westinghouse brake cannot be graduated. However, he has clearly shown one thing—viz., that, under this term, he understands the possibility of moderating the brake power, not only from a low pressure to a higher, but also from a high one to a lower one, without the blocks having to leave the wheels.

We have, however, shown that the absence of the latter mode of regulating the power in the Westinghouse was not prejudicial to that brake, and was not accompanied by *any inconvenience* in practice. If it were so, its use would have been discarded long ago on the Rocky Mountains. It remains now to Mr. Davies to show us what are the dangers arising from the mode of working the Westinghouse brake on long inclines.

There is some truth in the remarks which Mr. Samuel Davies passes on those correspondents he calls "the friends of the W.B. Company"; but, at the same time, we find that the same remarks apply with equal force to some of the supporters of the vacuum brake. Most of the "awkward cases" are generally started by the latter. We cannot allow them to mislead public opinion. I am sure that it is here no question for us of being the friends of this or that brake company; but simply the supporters of a particular system of brake which fulfils the requirements of the Board of Trade. I wish this brake question to be treated fairly and honestly, each party remaining within the bounds assigned by courtesy and reason.

I am sorry to say that there are but few serious correspondents on both sides. The correspondence displays too often more zeal than earnestness.

I would strongly urge our correspondents not to make any assertions that are not substantiated by real facts, and to give always reliable practical data in proof of what they advance. For instance, Mr. Kiernan says that undoubtedly the automatic vacuum brake can work properly in thirty carriages, but no real proof is added to this assertion.

In his answer to the seven questions of "Loco," Mr. Davies would have done well to oppose to triple valves, ball valves, not piston-rods.

How is it that the hand-brake is used on the Lickey incline along with the automatic vacuum? This shows that the brake is not trusted to itself. I do not understand this, for a leakage could but apply the brakes more fully.

The use of vacuum brakes, or rather atmospheric pressure to work brakes, seems an anachronism when high pressures are as safe, and do not require the use of bulky apparatus which is often difficult to lodge under a railway vehicle.

Manchester, June 27. **E. Gobert.**

RAILWAY BRAKES.

[27569.]—Your correspondent, Samuel Davies (27534) has at last awoke to the fact that this discussion is loose and rambling. No doubt it is; but who are the ramblers? Surely such references as those to Wootton, Bow, Blea Moor, Manor Park," &c., as well as "the quibbling about areas and contents," is beside the mark, and ought never to have been introduced into this discussion: but "an evil tree cannot bring forth good fruit," &c., is very applicable here, where the barrenness of your correspondent's case, and the sterility of his ground is so apparent as to lead him to charge to the Westinghouse brake collisions that have occurred through *defective* block signalling and the infringement of the rules of the signalling departments. I hope you will bear with me, when I ask your readers to discard all such statements as "the mere quibblings" of a sadly benighted mind. I am surprised to find he has not yet learned to distinguish between a *delay* and an *actual failure*. A *delay* is not a *failure*, and may occur from a variety of causes outside the control of the driver, and not be the fault of the brake; but, for want of an excuse, the brake is saddled with the blame. In this discussion, I take it, we shall have nothing to do with delays, pure and simple, but will leave such matters to the fervent eloquence of Messrs. Davies and Harold Brown, and content ourselves by concentrating our forces on the study of *actual failures of brakes to go on*. According to Board of Trade returns, I find, on a more careful examination, there was *one* failure in case of accident and 92 failures in ordinary circumstances. Total—Vacuum failures 83, Westinghouse 8, and chain 2. (See Table).

Actual Failures, Railway Co.	Name of Brake	Class 1. Failure of continuous brake to act in case of accident	Class 2. Failure or partial failure to stop a train under ordinary circumstances.
N. London	Chain brake	—	2
L. and S.W.	Auto. vacuum	—	3
Midland ...	" "	—	4
C.L.C.	Non auto. vac.	—	2
G.N.	" " "	—	32
L. and N.W.	" " "	1	11
M.S. and L.	" " "	—	10
M.S.J. & A.	" " "	—	3
Metropolitan	" " "	—	6
N.E.	" " "	—	1
S.E.	" " "	—	5
D.W.W. (Ireland)	" " "	—	2
G.S. and W. (Ireland)	" " "	—	1
M.G.W. (Ireland)	" " "	—	2
G.E.	Westinghouse	—	4
L.C. and D.	"	—	1
Midland ...	"	—	2
N.E.	"	—	1
		1	92

The Westinghouse mishaps—they were not failures strictly speaking—were due, 6 to neglect of couplers and guards, 1 due to neglect of guard to put on his hand brake, and 1 a driver neglected to look at his air gauge. All the faults or delays in the return against Westinghouse are not equal to the one Carlisle collision. Let Sam Davies turn to page 94 of return, and see that in one day on the Brighton line 10,627 stops were made by signals, &c. Although 10,627 trains made these special stops, who will say there was any danger on the block system? Only Samuel Davies, I venture to say, who will be maintaining next week there were 10,627 chances of the Bow accident occurring. The number of brakes fitted in six months proves nothing as to which is the best. At one time men cried "Eureka," and began putting on chain brakes at a great rate; at another simple vacuum. Mr. Davies is scarcely correct in his figures: instead of 159 engines, he should say only 71 have been fitted with auto-vacuum brake, and one auto-vacuum engine on G.N. has been removed. Then of the coaches, most of those fitted with auto-vacuum have only been changed from other systems, and simply shows how companies are throwing away shareholders' money with changes. The trains Leeds to London are short, and well looked after; these trains did this work in 1882. Were they not Westinghouse then? I am under impression they were. It is very much to be regretted that the Board of Trade has now "shirked" all responsibility for the correctness, and practically says, "Here are the figures as *returned by the companies*." Ought they not to take the trouble to see if the companies make true returns?

Now as to the Blea Moor tunnel collision. I happened to be there, and the brake had nothing to do with it; it was the defective block working, as can be easily proved by the fact that the signalman at Dent Head was dismissed for giving "line clear" when the train was in the tunnel; the signalman at Bleamoor was reduced to a porter for being the indirect cause of him so doing, and is now at Leeds parcels office, Wellington Station, where Sam Davies might call and ask for Dan Hewitt, who will give him some information on this subject which he is sadly in need of. He will also tell him why the guard of the first train was reduced to porter, and why the brake and the locomotive men were exonerated from all blame, and are with us to-day, with the exception of poor Butler, who is dead and gone. The Manor Park case is open to the same criticism, only, if you please, Sam, it was a *copper* tube that burst, connecting the triple valve and the cylinder; copper had no business to be used—it should be *best* iron. Again, I must protest against these "flimsy" got-up cases brought forward by Mr. Davies as brake failures: in every case he mentions the brake went *on*. How can a brake be said to fail if it goes on and stops the train? **Rover.**

RAILWAY JOINTS—LONGITUDINAL AND ACROSS SLEEPERS—DECIMAL COINAGE, &c.

[27570.]—Referring to Messrs. Lanchester's Gobert's, and Harvey's letters at various times on the above subject, will you kindly permit me to say, that when I became a civil engineer (more than forty years ago if memory serves), all joints were directly supported by a sleeper beneath them, yet the jarring and bumping was then worse than it is to-day. I do not believe this can be cured by a reversion to the old system of joint sleepers. Quite the contrary. Little by little engineers were induced to discard it, and adopt the suspended joint. It is probable that long experience has demonstrated it superiority to the profession. The shock felt in passing from one rail length to the next, cannot, I fear, be entirely overcome; it is inherent in the system of forming a track of short pieces (comparatively) of iron. Many engineers worked at the "continuous rail" problem (myself amongst them), but with no practical success.

It may seem a very easy thing to newspaper correspondents to devise a "non-bumping" permanent way; but let them try to reduce their theories to practice, and I think they will rack their brains considerably before they succeed. If I understand Mr. P. M. Harvey aright in letter 27496, he would make the joints *tight* to remedy the jolt complained of. Would he? Well, I have known a piece of permanent way shoved over laterally a couple of feet and more on a hot day, because the joints were not left large enough to allow for expansion. So much for close joints.

Regarding longitudinal versus cross sleepers, I think it was I. K. Brunel who introduced the former on the Great Western Railway. Anyway, he was the advocate of the system, and stuck to it, I believe, to the last. However, as long ago as 1846 or 1848, I well remember that it was our experience that it was easier to surface the line with cross sleepers than with the longitudinal ones—I mean to keep the level and alignment true under traffic. Even on the Great Western they seem to be tacitly admitting this now, if one is to judge by the quantity of "cross-tie" track they are putting down.

The smoothest tracks I have ridden over were fish-plated, with joints between rails. There are some rough lines in England, but our three friends must be hard to please if they don't find many smooth enough. Would not some engineers in present practice give their opinion on these matters? is many years since I retired from the profession. "E. L. G." seems quite satisfied with our coinage, ghts, and measures. At least, he raves against substitution of the decimal system. My rience has led me to a different conclusion. early part of my professional life was d in Great Britain, where in computation d the usual dose of our abominable sys- f measures. After some years I moved untry where the currency was decimal, and ights and measures also to some extent. The hus afforded us in calculation was instantly us "Britishers," and we could not avoid sting the ease with which portions of our could be done now, with the trouble the operations formerly entailed. It was often arked in the office that as pounds, shillings, pence had been replaced by a more convenient rency, it was a pity the innovators had stopped ort in their work, and not swept away cubic ards as well. Taking our measurements in feet and decimals, and computing quantities by the yard, was as anomalous and vexatious there as here. Since then I have lived where the decimal system prevailed in its entirety, and though I did not work there as an engineer, I could not help feeling how immeasurably superior it is to our complicated arrangements. Though I have done w h rock cuttings and ashlar masonry, our out- eous tables pursue and persecute me yet. A rel of barley different from a barrel of oats, and arrel of potatoes different from either! The st trifling calculation is rendered more cumber- ne than it need be by our barbarous currency measures.

Religious (?) intolerance has a great deal to do th some people's opposition to a reform in our thmetical tables. Because the French were ilty of deplorable excesses and irreligion at the ne of the great revolution, these wiseacres seem some way to imagine that there must be a con- tion between a decimal currency and atheism! nce remember a clergyman in a preface to his k objecting to Pitman's phonography as "a lking horse to infidelity!" This worthy and ightened divine has been long since gathered to fathers, but his spirit I am sorry to say still s.

Edward M. Richards.

range, Enniscorthy, Ireland, June 27.

THE COUPLING QUESTION.

571.]—YOUR three correspondents (27445-6 in your issue of 17th June, are very good of different opinions on this subject. r" is very confident that "Rover" goes bottom of the question" when he says, ng couplings are of no use." I am quite ce. you, Mr. Editor, thought so you would not r columns with this correspondence, and I ask " unter," "Rover," and all who hold this view of uselessness, how they can possibly know? Has there ever yet in England been a self-acting competition worthy of the name, or, I may say, even a lifting gear trial, nor would English railways as a body permit a fair test or trial that would settle the question.

Our American cousins have a very different opinion, born of experience of the true value of the automatic coupling, and now even as I write they are settling to work (by the joint action of officials on lines covering 40,000 miles) to carry out an exhaustive series of tests planned on almost identical lines as those urged for this country by one "Pioneer" in the *Times* last October, which correspondence was referred to in the House of Commons at the time, and has been reprinted in America and much discussed there.

In this matter we shall find, as in so many beneficial and practical inventions, America once again shows the way, and that to automatic couplings we must ultimately come when there is a fair field and no favour. I assert what I know, and on what I have seen, when I say that self-acting couplers, even for English miscellaneous stock, can be provided which will beat any record in coupling operations.

The coupling-pole and looser links are merciful makeshifts to the men, and a rest-and-be-thankful stone for the railway officials; but they are but steps on the way. **Loose Links.**

[27572.]—IN answer to 27537, p. 417, I beg once more to state that liability to "knock waggon end out" does not exist in "Silke's," and I would ask "Rover" not to take up valuable space by making the assertion again. The plan of barbarously handling frail models was also once tried upon mine by a certain booby, fortunately without damage, and certainly without the result mentioned by "Rover." I beg further to state that one of the "imperfections" of my coupling consists in its not being designed to fulfil absurd requirements, such as coupling on to a draw-bar hook in the absence of the corresponding coupling device.

A line joining the buffers when compressed to full extent, gives the distance at which the frames of my coupling are fixed on the carriage. The link of each projects a certain determined distance, this distance being somewhat less than the length of the slot in the frame. Therefore, when buffers of two meeting carriages are rammed home, there is still some space in the slot behind the link. When two carriages are being coupled the link on one enters the jaws on the other until buffers are slightly compressed (this compression corresponding to that effected with the present screw-coupling), the locking piece then drops, and if the carriages are closed upon one another still further, the link simply plays in the slot behind the locking piece. This coupling is specially designed for long buffers, and the frame would in each case correspond with the length of buffer stock used with it, projection of link and length of slot remaining constant measures. I should be much interested to hear opinions of "Rover" and others as to the best length of buffer. One result of the Nine Elms farce has been to show the public that the coupling question is not likely to be decided by the A.S.R.S., any more than Admiralty patterns are likely to be chosen according to the tastes of sailors.

Silke.

COMPOUND ENGINES.

[27573.]—YOUR article on the compound steam-engine has reminded me of an incident which strongly illustrates the slowness of the English mind in adopting anything new except, as someone lately said in the "E. M.," quack medicines.

I was at Rouen in 1836, and went over the iron-foundry of Messrs. Barber and Rowcliffe. They had just put up a steam-engine to drive the blower of their blast furnace, and I found it to be a compound engine. I had a book knowledge of steam-engines, and expressed my surprise, saying that Woolf had invented these engines many years ago, but that in England their advantages were thought fallacious. Mr. Rowcliffe said that they were used in France, and found to save coal, and that the reason why they were not used in England was that they, of course, cost more to make, and that in England coals were so much cheaper that economy in them was not so much considered. I had no practical knowledge, and could not argue the point; but, with insular pride, thought the French must be wrong, and I continued to say so. In subsequent visits to Rouen, some twenty-five years afterwards, I found reason to believe that they were right, and that we had been for twenty-five years obstinately wrong.

The engine was at work till some three years ago, and, from what Mr. Rowcliffe said, I conclude that there must in 1836 have been at Rouen other compound engines at work.

London, July 2. **C. M.**

RIBBED BOILER TUBES.

[27574.]—YOUR correspondent, "Engineer" (letter 27549, p. 419), criticises my letter without fully understanding the subject. Screwed or riveted studs in boiler plates have been well known for more than twenty years; they have never been generally adopted for two very good reasons, one being that drilling the necessary holes greatly weakens the plate, and the other is that the inner surface of the boiler is so broken up as to prevent proper cleaning. The object of my experiments was to determine the proper proportions of the studs or ribs, to test by actual experiment their exact value for steam-raising purposes, and to devise a method by which the necessary projections could be produced on a boiler-plate without weakening it, and without interfering with the smooth surface, which is absolutely necessary inside a boiler. My claim is not for projections into the fire space of a boiler, but a method of producing them which overcomes the objections which up to the present time have prevented their general use.

Thos. Fletcher.

NOISES IN THE EAR.

[27575.]—THIS and its accompanying deafness (sooner or later) has long been a *bête noir* to the medical profession; the talented Toynbee, of Savile-row, whose unique models of the aural tract and of its mechanism attract considerable attention in the Museum of Surgeons, Lincoln's-inn-fields, having lost his life during his endeavours to pass as an experiment a gas over, or perhaps even into, the eustachian tube, this being one of the seats of the aural derangement.

The late Dr. Gully, of hydropathic fame, suffered often from this noise, *tinnitus aurium*, and he told me he thought it was caused by the passage of the circulating current of the blood through a congested (and therefore impeding) state of the aural parts. Ministers of religion and of medicine find *tinnitus* often present amongst those suffering from dangerous acute diseases, while the symptom is one frequently proved to be caused by overdosing of drugs, notably quinine, a striking illustration of the law, *Similia similibus curantur*—i.e., as drugs cause certain symptoms when used in excess, then when similar symptoms appear from disease those same drugs are in this case calculated to be curative. As to this one symptom—i.e., cerebral congestion—I commend chinchona, aconite, belladonna, bryonia, iron and its salts, mercury and its salts, sulphur and its combinations as worthy of study.

The Lydney Dispenser.

A QUESTION IN OPTICS.

[27576.]—IN the classical article "Transit Instrument," in the *Penny Cyclopædia*, by the late Rev. R. Sheepshanks, referring to the subject of a meridian mark, Mr. S. thus writes:—"An obje which is not very distant may be seen sharply de fined when the aperture of the object glass reduced." The advisability or otherwise of ha a meridian mark is not here in question; bu to *rationale* of the improved definition, and appar she shortened focal length, gained by reduction but aperture. With my own instrument of 2¼ir not. ture and 30in. focal length, I can only con upon one terrestrial object (save trees), wall not more distant than about 300 yar mean the full aperture I have to draw the turpen- ocular so far out in order to get a good details of the wall, that the "wires" that *fuzz*. On reducing the aperture to 1in., I f ine, then slide the ocular in again to a poi both wires and the details are fairly defin simultaneously. It does seem that if the spherical aberration be duly corrected, the only effect of a reduction of aperture would be to cut off a certain amount of light. If the spherical aberration be not properly corrected, the *central* rays have naturally the *longer* focal distance; but in this experiment they seem to have the *shorter*.

Perhaps some of your readers may kindly throw light on this subject. **George Hunt.**

Hopefield, West Dulwich, July 2.

PAINTERS' OPTICAL ERRORS.

[27577.]—THERE are some terrible absurdities in some of the best Academy pictures this year, as an article in *Nature* points out—rainbows with the colours in a fancy order, improved on that of the spectrum; scenes where the spectator faces the full moon, though the sun is over his right or left shoulder; and gibbous moons with their "terminator" sunward. But the most hopelessly false in optics is the beautiful picture (624) of the first Act of the Queen's reign, "Early Morning of 20th June, 1837," of which the writer in *Nature* has not perceived the full error. The straight, dark bars *may* be meant, as he supposes, for aërial shadows of the window bars in a foggy or dusty atmosphere, or they *might* be for similar shadows cast on the walls and woodwork. In the latter case, what is wrong is not their divergence, but their straightness, none of them crooking in and out, as all should, over the mouldings and varying surfaces. But if meant for mere beams, through mist or dust in the air, the error is in our seeing several instead of only one. Such shadows can only be seen by an eye nearly in the very plane of one, so that whatever their number the same eye can only see one of them at once. **E. L. G.**

MARSHALL'S METHOD OF PROPELLING VESSELS.

[27578.]—I HAVE read the articles on this subject with much interest, as some years ago I devoted a considerable amount of time to working out a similar idea. Like a great many other contrivances—the horizontal windmill for instance—it seems at the first blush to promise great possibilities; but however it may look in theory, it is a most wasteful way of utilising power. I had a small flat-bottomed boat fitted as per sketch herewith, and had some experiments between the relative efficiency of a pair of paddle wheels and a cylinder something after the plan of those Mr. Marshall employs, with this difference: that the water expelled by the piston astern was not drawn in after the piston on its return stroke, but was supplied through a continuation of the cylinder, open to the bow. Mr. Marshall's arrangement is, by the way, a most unmechanical one, as the back-

From the second and third equations:

$$\frac{1}{s} = \frac{1}{2f} - \frac{1}{F} \quad \text{or } s = \frac{2Ff}{F - 2f}$$

$$\frac{1}{r} = \frac{1}{2f^1} - \frac{1}{f} \quad \text{or } r = \frac{2Ff^1}{F - f^1}$$

These give the radii in known quantities, and from them $(\mu - 1)$ is readily found by the first equation.

If q be the ratio of the radii, that is s/r:

$$q = \frac{Ff - 2ff^1}{Ff^1 - 2ff^1} = \frac{\frac{F}{f^1} - 2}{\frac{F}{f} - 2}$$

Orderic Vital.

ORIGINAL ELECTRIC EXPERIMENTS.

[27585.]—IN your issue of the 1st inst. is a letter under the above heading, giving the details of certain experiments made by its writer. Perhaps it will be well for the sake of some of your readers that I should add a little of my experience in the same direction, and leave them to judge the course they prefer to adopt.

First, then, let me say that I find the Credenda steel tube answers very much better than gas pipe for hollow spindles.

Secondly, I find metal driving wheels for the particular purpose are much better than wood. I turn a V-groove in their edges, and then fit into his groove a ring of indiarubber; it runs far veeter than does the glued leather.

Thirdly, I find it desirable to varnish both sides the glass discs. It is necessary to do so. Cer[illegible]y I don't use the nasty paraffin.

[illegible]urthly, I use ten to twelve threads of very [illegible]ire for each brush. The reason for using so [illegible]hreads is that some one or more of them is [illegible]sure to make metallic contact with the [illegible] while if only one thread of wire be used it [illegible] sure to escape touch with many of the [illegible] don't varnish the sector where the brush [illegible]s; this part must always be kept clean. If [illegible] points are attended to, the machine will never [illegible]o freely excite itself when it is turned round. Borrowed excitement is never required with a properly constructed machine.

The action noticed in respect to the electricity coming on and going away with a rush, in the machine having a fixed plate between the revolving plates, is a change taking place in the electrical condition of the parts. It will be found that the charge or current in the outside circuit becomes plus and minus alternately with about each five or six revolutions. Mr. Thomas Gray, C.B., has had one of these machines for more than two years. He properly calls it his alternating current machine.

As to the "Wimshurst bundle," instead of "my single fine wire," I really don't know what to say—it surprises me; but then some makers, I know, do use and sell simply outrageous productions, and call them anything they choose. It must be that the writer of the letter in question has been unfortunately mixed up only with these faulty productions; for, let him look at the large 7ft. machine made for Kensington, and he will find brushes small enough; the four brushes together weigh less than two grains; again, the sixteen brushes used in the large machine at the Royal Institution weigh together less than four grains. I could name some others, but then they are with private owners, and those I mention are quite enough to settle the bundle part of the business.

J. W.

NEW SEASON'S TEAS—A NOTABLE VOYAGE.

[27586.]—WHAT is meant by "new season's teas," and when is the season for tea? In the spring, I suppose, as the crops generally arrive here about a little after midsummer.

Will Mr. S. E. Peal kindly say, and also give some information about Ceylon tea? which has apparently been the cause of extraordinary statements in the papers.

Very little notice has been taken of a rather remarkable performance which was brought to a conclusion on Saturday evening, June 25. The *Moyune*, belonging to the China Shippers' Mutual Steam Navigation Company, brought the first cargo of new season's teas after a quick run of 35 days from Hankow. But this is the point. She passed Dover at a quarter past 12 p.m., and reached Gravesend at a quarter past 5, and entered the Royal Albert Dock at about 7 p.m., steaming direct in through the new deep-water entrance. Ten minutes after entering the dock, her cargo was being discharged, and within ten minutes of the chests being slung on the quay, samples were on the rail to London. It may be mentioned that the vessel entered the dock three hours after high water, although drawing over 22ft.

As this is Jubilee year, I will conclude by wondering what they would have thought of such a performance 50 years ago.

Nun. Dor.

EXERCISES IN PRACTICAL ASTRONOMY FOR BEGINNERS.—II.

THE TRANSIT: ITS ERRORS AND ADJUSTMENTS.

[27587.]—THIS instrument consists of a telescope fixed at right angles to an axis, which, being placed level and due E. and W., causes the telescope to revolve in the plane of the meridian. In the eyepiece are fixed wires, generally 5 or 7, and the instrument being set on a star or other object, the times are noted as it passes over each wire; a mean of the transits is then taken as the transit over the mean wire.

.........188 Observer.	188	188	188
Name of Star.			
R. A. Decl.			
h. m. s.	h. m. s.	h. m. s.	h. m. s.
Wire 1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
Sum .2	.2	.2	.2
Mean of Wires			
R.A.—Mean Approximate Clock Error.			

The above requirements can never be exactly fulfilled, and as it is impossible to produce perfect adjustment mechanically, the amount of each error is ascertained, and suitable corrections applied to the Observations.

1.—Collimation error.

Due to the optical axis of the telescope (i.e., the line passing through the centre of the object-glass and the middle of the central wire, or rather the mean of the wires) not being at right angles to the axis of motion.

To determine the error.

(1) By a Meridian mark.

FOR COLLIMATION ERROR.

(*By Meridian Mark*).

.... 188

Distance between wire and mark, circle E. (d_e) = $\pm$ if mark $\frac{\text{E}}{\text{W}}$

Distance between wire and mark, circle W. (d_w) = "

2 |

$\frac{1}{2}(d_e - d_w)$ = "

Interval of wires =

(Or value of micrometer or scale divisions if either be used).

Collimation error of middle wire =

Correction of mean wire =

"

Collimation error (x) = Circle East.

Observe a distant mark with the circle of the instrument East. Estimate or measure the distance (d_e) of the central wire from it, in terms of the interval of central wire from the next.

Reverse the instrument on its pivots E. for W., and again note the distance (d_w).

Call d_e and d_w + or − as the mark is E. or W. of the wire.

Then $\frac{1}{2}$ difference of the two distances, $\frac{1}{2}(d_e - d_w) \pm$ the distance of the central wire from the mean wire (see "Reduction to mean wire,") × value of interval of wires in seconds of arc, is the error (x).

Find the value of $\frac{1}{2}(d_e - d_w)$.

Multiply this by the value of the interval of wires in seconds of arc, giving the error of the central wire.

Add its correction to mean wire, giving x. Circle East.

The distances d_e and d_w can be measured by a micrometer on the eyepiece, or obtained by estimation as indicated above in terms of the distance between the wires of instrument. The value of the micrometer divisions or the distance between the wires in time is easily found by the transit of a star and converted into seconds of arc. (See "Determination of equatorial intervals").

If a horizontal scale be observed, as a Meridian mark, at a known distance away, the value of its divisions in seconds of arc can be at once computed.

(2) By reflection from Mercury.

FOR COLLIMATION AND LEVEL ERRORS.

(By reflection from Mercury.)

COLLIMATION ERROR.

.... 188

Distance between wire and reflection, circle East (d_e) = $\pm$ if $\frac{\text{E}}{\text{W}}$

Distance between wire and reflection, circle West (d_w) =

4 |

$\frac{1}{4}(d_e - d_w)$ =

Interval of wires =

(or value of micrometer divisions if it be used)

Collimation error of middle wire =

Correction to mean wire =

Collimation error (x) = " Circle East.

Observe the reflection of wires from mercury, Circle East.

Estimate or measure the distance between the central wire and its reflection (d_e) in terms of the intervals of wires.

Reverse the instrument and again estimate or measure distance (d_w).

Call d_e and d_w + or − as the reflection is E. or W. of the wire.

Then, $\frac{1}{4}(d_e - d_w) \pm$ the distance of central wire from mean wire × value of interval of wires in seconds of arc, is the error (x).

Find the value of $\frac{1}{4}(d_e - d_w)$.

Multiply this by the value of the interval of wires in seconds of arc, giving the error of the central wire.

Add its correction to mean wire, giving x.

To correct this error, if of sufficient amount,

Move the frame carrying the wires by means of the screws near the eyepiece.

2.—Level error.

Due to the axis about which the instrument moves not being horizontal.

To determine this error.

(1) By reflection from Mercury.

LEVEL ERROR.

Distance between wire and reflection, circle East (d_e) =

Distance between wire and reflection, circle west (d_w) =

4 |

$-\frac{1}{4}(d_e + d_w)$ =

Interval of wires =

(or value of micrometer divisions if it be used) =

Level error (y) = "

This is carried out in just the same manner as the determination of Collimation error.

Then, $-\frac{1}{4}(d_e + d_w)$ × value of interval of wires in seconds of arc is the error (y).

N.B.—By this method the error of Collimation and level are usually determined at the same time.

(2) By the level.

FOR LEVEL ERROR.

(By spirit level.)

.... 188

Distance of centre of bubble from centre of level (d_e) = $\pm$ if bubble $\frac{\text{W}}{\text{E}}$

Distance of centre of bubble from centre of level (d_w) =

2 |

$\frac{1}{2}(d_e + d_w)$ =

Value of division =

Level error (y) =

Place the striding level on the pivots and note the distance of the bubble from the centre of the level (d_e). Circle East.

Reverse the level East and West and again note distance of bubble (d_w).

Call d_e and d_w + or − as the bubble is W. or E. of the centre.

Then, $\frac{1}{2}$ the sum of the two readings, $\frac{1}{2}(d_e + d_w)$ × value of divisions in seconds of arc is the error in question (y).

Find the value of $\frac{1}{2}(d_e + d_w)$.

Multiply this by the value in seconds of arc of a division of the level giving the error (y).

The value of the divisions of the level should be found by fixing it to a mural circle.

Half the difference of the readings gives the error of the level itself.

Half the sum or difference, according to the numbering of the scale divisions, of the reading of the two ends of the bubble gives the position of its centre.

To correct this error. Raise or lower the moveable point. **Sm.**

(*To be continued.*)

POISONOUS TREES.

[27588.]—JAVA and the Archipelago generally is the centre of poisons, animal and vegetable, and no races are so prone to make use of them as the varied tribes grouped under the general name of Malay. The "kris," or serpentine dagger, which has become almost a symbol of treachery and revenge, has a terrible reputation; but from my own observation I almost doubt if it is ever poisoned at all in the real sense of the word. The Malay never grinds the kris, but is always rubbing the blade with a green lemon or the juice of a young pineapple mixed with orpiment. The effect at first is to remove the rust, but a thicker coat succeeds, and in time a rough damascene is formed, with a notchy edge, and the effect of a wound from a weapon of this sort needs no explanation to anyone who has suffered from a rusty nail or needle. The poison of the sumpitan, or blow-tube darts, is, however, very real. The Bataks, that singular race inhabiting Central Sumatra, and the only known people who combine cannibalism with civilisation enough for a written alphabetical language, are very skilful in its use. They obtain it from two sources—one the upas tree, and the other an allied species called the "ringgus." The juice of this latter is most virulent, and burns the skin like boiling oil. I have many a time seen coolies brought in howling dismally, with heads and faces swollen to pantomimic size from having incautiously struck an axe into the "ringgus."

The only way to attack it is for the woodmen to [illegible]ive themselves a thorough coating of grease, and
[illegible]en then the risk to the eyes is so great that it is
[illegible]erally allowed to stand. This tree probably
[illegible] rise to the fables about the upas ("upas" is
[illegible]nese for poison of any kind). The upas
[illegible]n, however, requires to be used quite fresh, as
[illegible] hours' exposure to the air converts it to a
[illegible]ly black resin, quite harmless. Another
[illegible] is obtained from a species of vine bearing
[illegible]rs of bright red fruit, the size of a cricket
[illegible]containing a number of seeds in an intensely
[illegible]r pulp. The effects of this are very rapid. I
[illegible] seen the Balak creep up, sumpitan in hand,
[illegible]here a troop of gibbons were yelling their
[illegible] chorus from a lofty tree-top, and scarcely
[illegible] a minute elapsed between the despatch of the
[illegible]ile and the crashing fall of the struck ape.
[illegible]n the gigantic and formidable species of orang-
[illegible]n, which haunts the forests of the east coast,
[illegible]s paralysed by two or three of these tiny darts.
[illegible]ne of the most famous poisons of Java is
obtained from the bamboo. The young shoots of the cane, when they first appear, are covered with fine brownish hair; this, under a powerful microscope, appears as bayonet-like spikes of silex, infinitely sharp, and I think hollow, though I could
[illegible]ot be quite sure. This hair, administered daily in
[illegible]al quantities in the food, brings on ulceration
[illegible]he bowels, simulating malignant dysentery.
[illegible]ction must be of a mechanical, rather than
[illegible]cal, nature, just as with the terrible effect on
[illegible] of the spores of the common puff-ball. It
[illegible] dreaded by the Dutch and all Europeans
[illegible] Java. A Dutch official told me that
[illegible]eaths among European planters, &c., put
[illegible]sentery and diarrhœa, were really due
[illegible]aboo-hair and the jealousy of native

[illegible]ntion of the Burmah nettle tree by
[illegible] D. [illegible] recalls the stinging tree of Australia.
[illegible] are two varieties: one (*Laportea gigas*) is
[illegible] all along the east coast, from Shoalhaven
[illegible]wards; it grows only on the richest soil, and
[illegible] is no surer sign of good "sugar land" than
[illegible]dance of stinging tree. It is sometimes a tree
[illegible]0ft. or more in height, with thick bark, and the
[illegible]d so soft as hardly to deserve the name; but
[illegible]ally it is a large shrub, with leaves resembling
[illegible] pumpkin—rough, hairy, bright green, and
[illegible]metimes a foot across. The stings are on the
[illegible]derside, and easily seen by the naked eye. The
[illegible]her tree (*Urtica* sp.) is much smaller, the leaves
oval, notched and polished above; the stings are far larger, and extend over the stem as well as the leaves. This kind is especially abundant and virulent near Cardwell, N. Queensland. The effect of the sting on a human being is very painful, like incessant pricking with hot needles, with great swelling of the glands of the armpit; but on the horse it produces absolute mania and death. I was once traversing the dense scrub near Cape Byron when I heard some distance ahead that fearful cry which nothing but the extremity of pain and terror will force from a horse. Pushing along the track, which was hedged with Laportea, I came on a man ruefully contemplating his expiring horse, the torn up ground and broken shrubs showing the severity of the death struggle. He said that the animal, which was young and restive, had backed into a clump of nettle trees, and, as he expressed it, "I just had to look on while she smashed herself to bits agin the trees." Curiously enough, horned cattle are unaffected by it, and I have even seen them eating the leaves when grass failed. The usual bush remedy is the juice of the "cunjeboy," a species of Arum always found in the same locality. The small leaved stinging tree is remarkable for being only harmful when young, the leaf of the full-grown tree being quite devoid of stings.

While on this subject, a hint to some of your readers who may happen to live by the sea, and to be annoyed at night by cats. Get a few fresh starfish, cut them up, fry them in grease, and distribute them where the disturbers most frequent, and they will give no more trouble. This recipe I had from the late Frank Buckland.

Tukang Besi.

GAS REFUSE AS AN INSECTICIDE.

[27589.]—I CAN thoroughly corroborate the opinion of "Hortus" on the valuable properties of gas lime properly applied to land. In a fresh state it is so acrid and caustic in its nature that any kind of growing vegetation is killed outright; but under the careful manipulation I have practised, the application of this chemical product is most remunerative as an insecticide. There are a number of localities in our Northern counties where carrots are devoured before obtaining half their natural size by the larva of the carrot fly, myriads of small maggots boring through the roots till dried up. This pest has been long ago described by the specialist on Agricultural Entomology, Miss Ormerod, as Psylomia Rosæ. She used "soluble phenyle" with effect; even infected plants recovered. Two years ago, I happened to be staying at a house where the old Scotch gardener was lamenting to me that he could never raise a carrot, and asking if I could recommend a remedy. For some time I had been thinking of gas lime, having heard many similar complaints from other men, who had to buy carrots at a distance, although they sowed annually on their own ground. Now for the experiment. It was autumn, and I told "Mac" directly he had got the bed ready for the future season (about October) to procure half a large cart load of gas refuse from the gasometer, three miles off; to trench the ground 2ft. deep, spread the lime on the bottoms, then fill up with the original soil, to leave the ground alone all the winter. In early spring, during heavy rains, to dig deep, and thoroughly; then to go over the plot occasionally with the fork, so as to loosen the earth, and assist the gaseous product to evaporate. He carried out my advice fully, and on the following year's visit to that house, old "Mac" took me to the kitchen garden to show me an unusually fine bed of Altringham carrots. There they were, with rich green foliage of stout, healthy proportions. I sent an account of my success to a local newspaper, where the City Gasometer Company read it, and wrote to me for verification, ending by their sending out printed memos. to our horticulturists. The gas liquor insecticide must be plentifully diluted with hot water. This, when cold, and further weakened with cold rain water, can be used with a syringe for all hard-wooded plants, squirting across them so as to avoid wetting the roots. **Eos.**

Carbolic Acid as a Safeguard Against Insects.—Many people do not know how easily they can protect themselves and their children against the bites of gnats and other insects. Weak carbolic acid sponged on the skin and hair, and in some cases the clothing, will drive away the whole tribe. A great many children and not a few adults are tormented throughout the whole summer by minute enemies. We know persons who are afraid of picnics and even of their own gardens on this account. Clothing is an imperfect protection, for we have seen a child whose foot and ankle had been stung through the stocking so seriously that for days she could not wear a leather shoe. All this can be averted according to our experience, and that [illegible] believe of many others, by carbolic acid judiciously used. The safest plan is to keep a saturated solution of the acid. The solution cannot contain more than 6 or 7 per cent., and it may be added to water until the latter smells strongly. This may readily, and with perfect safety, be applied with a sponge. We have no doubt that horses and cattle could be protected in the same way from the flies, which sometimes nearly madden them, and it even seems possible that that terrible scourge the African Tsetse-fly might be kept off in the same manner.—*Lancet.*

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61903.]—**Harmonium.**—"Queen" seems to think that I hold a "wrong opinion" (p. 420) about something or other, because, on p. 87, I said, "Whether broad or narrow, it makes no difference in that matter." If "Queen" will kindly refer back and endeavour to understand the full meaning of "in that matter," he may alter his opinion; because I said simply if his reeds vibrated freely through the apertures in the open air, they ought to do the same when the pan is closed and they are on their wind. "In that matter" it makes no difference whether broad or narrow. It seems now that the pallet apertures of the bottom octave of 16ft. were not large enough; but the affair has ended happily, for "Queen" is satisfied with his harmonium. He now asks whether there is any difference in the make of pans for broad and narrow reeds? There is a difference in the make of pans from different makers, and also between those that are solid and those that are built up; but, provided the apertures are large enough, broad reeds can be used on any pan. Whether they yield the best results in that case is another matter. That is where the superiority of the Mustel comes in: the channels are proportioned to the reeds and the effect desired.—ORGANON.

[62000.]—**Steam.**—The engine is non-condensing, and has very short steam passages. I wish to know about how many feet per minute or hour she would use. Much obliged for your answer; but what amount is 25lb. per horse-power, as I know not. —C. A. BENEY.

[62237.]—**Colours (U.Q.)**—What do you mean by "print stains?" If printing ink, use turpentine.—SM.

[62458.]—**Air Propeller.**—The only device that will apparently suit "R. A." is a blowing engine, or one of the air-pumps used in modern refrigerating-machines.—S. D.

[62462.]—**Bookbinding.**—Why not use it the same way as the gold leaf?—Glaze the part and put on the leaf, using much cooler tools? But it is not worth while using such stuff, which will soon lose its colour. Letter the label without using anything; but getting a good impression: rub into that a little gold size mixed with yellow ochre, and when tacky dust on Bessemer powder, or one of the bronzes, and wipe off when dry with a hare's foot or a bit of cotton wool.—J. Z.

[62468.]—**Compensated Pendulum for [illegible]
Day Clock.**—I don't think much of this [illegible]
quâ pendulum; but a cap of brass could [illegible] in
secured to the glass rod by means of [illegible]
plaster of Paris mixed with gum-wa[illegible]
water. If necessary, the end of the [illegible]
suppose, be increased in diameter to [illegible]
a screw thread be turned on it, [illegible]
similar thread in the cap and the [illegible]
named, would make a fast job.—[illegible]

[62473.]—**Engine Query** [illegible] of [illegible]milarly to
rect—the average pressure i[illegible].—You [illegible]ise with him.
as back pressure in h.p. c[illegible]n l.p. cylinde[illegible]mptom of a
loss between cylinders, wh[illegible]linder, less the [illegible] was very
with the engine; the erro[illegible]h varies considerable seven
—very stupid not to not[illegible] of course, lies with and has
average in l.p. cylinder is [illegible] it (on my part). Th[illegible]and
before, and that in h.p. [illegible]bout 11lb.—or, say 10, as [illegible]
is the back pressure on [illegible]ylinder 2lb. or 3lb. more
honours—if you are [illegible]that piston. *Re* books for
will stick to it, "Ran[illegible] good mathematician, and
haps; and also "Ree[illegible]dine" is as good as any, per-
Of course, it is not [illegible]'s" and "Saxton's" works.
ledge; you must be [illegible]rely a matter of book know-
and show what yo[illegible] prepared to launch out a bit
opinions in "h[illegible]know, and the reasons for your
Bristol. [illegible]hours" examinations.—T. O.,

[62474.]—Fo[illegible]
opinion never al[illegible] **Zincs.**—"May difference of
diction as appe[illegible]ter," &c.; but surely such a contra-
not a differen[illegible]ars under this heading on p. 327 is
matter of fac[illegible] of opinion, but a difference on a
benefit of [illegible], which ought to be put right for the
doubt, all [illegible]readers. Those who replied are, no
must be [illegible]estimable gentlemen; but some of them
to know [illegible]rong, and it would really be interesting
[illegible] whether the hard red deposit on the zinc of a bichromate cell is "chromic alum" or "mercury chromate." There are six replies, and I should think the querist must be fairly puzzled by the advice offered. Where is "Sigma"?—MAG. EST VER.

[62481.]—**Measuring Taper Tanks.**—I don't think this can be easily done without actual trial with so many gallons of water, having a wand on which the height can be indicated for future use; but "E. L. G.," or some other of our mathematical readers, can perhaps tell you if it is possible to work such a sum by arithmetic.—SELIM.

a food preserver, combined with, or rather in solution in, glycerine. A Mr. Barff patented boracic acid as an antiseptic of food (milk to fish) under the name of boro-glyceride; it is to be seen quoted in most druggists' wholesale price-lists.—THE LYDNEY DISPENSER.

[62692.]—**Springs.**—Here is a query which gives no particulars as to how many turns per minute are required, and also pull. There is no difficulty in making a drum revolve for half a minute if it has to do but very little work.—T. C., Bristol.

[62692.]—**Springs.**—In the "melopiano" there is a spring 18ft. long by 2in. wide, contained in a drum 6in. in diameter and 2½in. deep; this, acting on a small gearing, keeps a bar in rapid oscillation (50 per second) for half an hour at each winding.—S. BOTTONE.

[62693.]—**Duration of Tropical Twilight.**—"Reymond's" difficulty probably arises from the fact that what astronomers call twilight practical people would very probably call night. For instance, at no time until after the 21st of this month is the sun more than 18° below the horizon. Therefore, according to astronomers, the darkest night we are now having is only twilight, lasting from sunset to sunrise. (See "Astronomical Notes for July," p. 405, "E. M." for July 1). Probably, most people would call it night when they can no longer see the time by their watch, or read a letter in the open air. Here, in England, we are generally sensible of a rapid diminution of light during about a quarter, or half an hour, at about 4.30 p.m. in winter, up to 9 p.m. in summer, that is, about half to three-quarters of an hour after sunset. The most daring "poetical license" occurs in Lord Beaconsfield's "Popanilla," where, in a tropical island, a twilight of "four or five hours" succeeds the setting of the sun.—NEPHESH.

[62694.]—**Silvering Without Battery.**—I have done two grandfather's clock-dials as follows:—Having thoroughly cleaned the article, mix a small quantity of nitrate of silver with water (say three parts full) in a small pomade bottle; when dissolved add a little salt to precipitate silver; then rub this on article with salt and whiting, using a little water. When sufficiently silvered, dry, and lacquer. Will be pleased to give any further information, if required. N.B.—Don't put your fingers in the silver solution before putting in salt.—DUFFER.

[62698.]—**Legal.**—"Cheltenham" has no re-
dress; there is not much law for beekeepers; but if
pl he had seen the swarm go off, and had kept them in
six ight, he could have followed them and claimed
one iem; but he would have been liable for damage
He trespass.—J. I. S.
machi
As to 2698.]—**Legal.**—You have no right to enter
single fi neighbours' gardens to bring back a swarm
it surprises nd although your "honest neighbours,"
use and sell them, had told you where the bees had
call them any could not have got them back without
the writer of of the occupier of the ground.—B.SC.,
fortunately mix
ductions; for, le gal—**Poor Rate.**—The law on
made for Kensing ment and collection is contained in
enough; the fou . 41, and in 45 and 46 Vict. c. 20.
two grains of a V, has taken a dislike to you, pay
large m that groove, as possible, and then he won't
togeth as the means l . You have got to pay the
other. But, having ediately after it is issued,
thting, I cannot ag payment before the levy is
opinion is that in dr h.
electricity in the form . TO MR. BOTTONE.—
between the point of the d ts; hence the 10 cells in
the glass; glass being co When freshly charged
ductor of heat, and the vitr res on a short circuit;
nothing to absorb the heat, light four such lamps
a minute fracture, and the del.—S. BOTTONE.
arising at intervals followi
along the cut, for if we turn nsions 30c.p.—To
light, we find a line of light Siemens armature,
regularly entering the body of t und with ½lb. No.
shows the differences between th igh, 4in. wide, ⅜in.
cut. This line of light clearly a cores. Wind the
fracture in the glass, the light bein . 20 d.c.c. Will
the edge, thus the piece of glas nan can drive it
separated the width of that line, wh
be, for the light could never be refle or a ten days'
Sometimes when the glass is thin, th odio" to go to
lutely goes right through. A cutter k here are occa-
he has got the cut by the musical hum th to Norway,
out as he draws the diamond along, and i visiting, I
found on close examination that these s Geiranger
very regular, like the teeth of a fine saw, . steamers.
the detonation of these minute fractures th y answer-
the musical note, and thus arises the expre
'sweet cut.' That electricity is generated be
the point of the diamond and the surface o ing the
glass, cannot be doubted, for when we ha inns all
diamond with a coarse cut, minute films o glaperi-
are thrown aside by the diamond, and as they fall te.
on the glass seem alive with electric action. I
would add here that it is my opinion that glass not
annealed would be better isolated than the annealed.
I gather this from the manner that a glazier's

few years (since I was in Norway) prices may have risen on a few of the more frequented routes, but not, I think, to any great extent. However, it is only fair for me to state that one of the leading guide-books estimates the usual cost at a country inn at from 5s. to 6s. a day. Of course, the charges depend much upon what you have, a meat supper naturally costing more than (what used to content me) a basin of porridge and milk. Personally, I have rarely been over-charged, albeit it is often supposed that the "rich (?) Englishman" is made to pay more than a Christiania student would pay for the same meal. Be this as it may, of the general honesty of the people one meets with I can certify that I have not seen it surpassed in any other country I have travelled through—most certainly not in England. As an instance of this I may mention the following:—Many years ago I had been staying some weeks at the Hotel Victoria in Christiania, when I left it, after paying my bill, for a few days' excursion in Thelemarken. On my return to the hotel the waiter came to me with the information that he had discovered (during my absence) a mistake in my account; in fact, that I had paid him some five shillings too much! I believe that, as a rule—of course, not without exception—the Norwegian peasant is too proud, and has too much self-respect, to be a rogue. Not knowing what "Sodic's" tastes may be with regard to mountain scenery, and having no practical knowledge myself of photography, I have some hesitation in suggesting any one of some half-dozen localities that might best suit him. Hardanger is in all parts beautiful, but wanting in boldness of mountain form when compared with the region about Gudvangen, and that of the head of the Nordfjord (where you have three valleys with their lakes and glaciers). The sky-lines in Hardanger are too flat to please me. However, the route from the fjord up to Skjæggedalsfos is a fine excursion, and there are perhaps a few others worth making. But if "Sodic" wants to be in the heart of the grandest scenery in Norway, where there is good accommodation and steamboat communication twice a week with Bergen, and all places on the Sognefjord, let him at least try Aurland (lodging at Brun's house), which his map will show him lies on a branch of that fjord a few miles above Gudvanger. A week may well be spent there after staying a couple of days or so *en route* at Gudvangen. Gudvangen is often crowded during the season, but it is at all times a charming place. Of course "Sodic" would now and then row over from Aurland to neighbouring points on the fjord. After leaving Aurland he might pass two or three days at some station on the Lyster branch of the Sognefjord (*vide* guide-book). To make Bergen headquarters would be, I venture to think, a mistake; but a day or two may be devoted to that picturesque town on first landing.—J. R. CAMPBELL.

[62710.]—**Electric Communication.**—Galvanised iron wire will do if properly insulated and thick enough—say ⅛in. thick. Four to six Leclanchés will be ample.—S. BOTTONE.

[62710.]—**Electric Communication.**—Galvanised iron wire will do. No. 11 B.W.G. is about the size you want. No. 17 copper, however, is easier to work. Connect as shown in "E.M." of July 1st, reply to query No. 62598, using six batteries at each end instead of three.—JOHN THOMAS GARBUT, Leeds.

[62711.]—**Telephone Circuit.**—A double wire is not necessary; but it is better than using earth. You get louder results by using a return wire—at least, such is my experience.—SM.

[62711.]—**Telephone Circuit.**—Provided the "earth" is well made it will answer very well; if you cannot connect well to earth, use return wire.—PRINCIPIA.

[62711.]—**Telephone Circuit.**—Double line wire, or two wires, are not at all necessary; each can be used as return. See my reply to No. 62710.—JOHN THOS. GARBUT, Leeds.

[62711.]—**Telephonic Circuit.**—Earth for return; but as distance is short, use the same kind of earth connection at both ends—say, the water-pipes. Solder your connections.—J. FLETCHER, Burnley.

The "Yorkshireman" Drill Chuck.—Mr. Morris Cohen, of Kirkgate, Leeds, sends us a useful little drill chuck, which has been named the "Yorkshireman." It is made with a parallel shank or plug, which can be easily adapted to fit any lathe; and the hardened steel jaws will hold small drills with either straight or taper shanks. Mr. Cohen says it is the most simple and convenient chuck in the market and the lowest in price. It is
fo certainly simple and convenient, and we should
and in k it must also be the cheapest. It will tak
by a sheet em an eighth of an inch down to need
taken up the

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors

Since our last, "Sm" has replied to 62237.

62280. Warming a Chapel with Hot Air, 207.
62288. Flannel, 207.
62289. Burnishing Bowls, 207.
62290. Grinding Tools for Haydon's Cutter Bar, 207.
62300. Schuckert's Ammeter, 207.
62304. Equation, 207.
62314. Violin, 207.

62478. G.W. Goods Engine, p. 304.
62489. Rock Crystal Spheres, 305.
62490. Mirror, 305.
62491. Boiler Query, 305.
62494. Speed and Feed of Saws, 305.
62507. Perkins' Boiler, 305.
62509. Sextant Vernier, 305.

QUERIES.

[62715.]—**Southport Sailing Carriages.**—Will any reader kindly send a description of these? Full particulars of dimensions, construction, and rig, with, if possible, a sketch would much oblige.—V.

[62716.]—**Slide-Valves of Model Engine.**—Will some kind reader inform me how to set the slide-valve of a small model engine, ⅜in. bore, 1¼in. stroke; the size of steam ports and slide-valve? Should the valve have any lap over the steam ports? How must I set the valve to get the most power from engine, and the beat of exhaust steam to be distinct as in large engine?—MINER.

[62717.]—**Dynamo Design.**—I am much obliged to Mr. Bottone for his answer, but I do not quite understand yet. I have got 4lb. of No. 20 wire on my armature, and I want to know what to put on the F M.'s to shunt-wind. Also, could any of your readers tell me how much wire, and what size, is put on one of Mather and Platt's No. 3 size Manchester dynamo, to give 50 volts, 60 ampères, at 1200 revolutions, compound wound?—LIBERATOR.

[62718.]—**Friction Clutch.**—Will some kind reader give me some good form of friction clutch for 3in. shaft with detail sketches and figured dimensions?—A. E. B.

[62719.]—**Ice House or Refrigerator.**—I have a cellar 12ft. long, 3ft. 9in. wide, 7ft. 7in. high, which I am desirous of converting into either an ice house or refrigerator, in which to keep perishable goods in hot weather. Will some reader of "E.M." kindly suggest the most economical method of constructing the same? I have a gas engine which can be used for a fan.—BIRKENHEAD.

[62720.]—**Franklinisation.**—Can any kind reader explain this form of curative electrical treatment? Reading a medical work a short time ago, I came across a paragraph stating that for severe nervous disorders "Franklinisation" was far superior to all other remedies—in fact, that it was an absolute specific. The patient was directed to sit on an insulated chair, but no further information was given. I wish to know how this particular kind of electricity is generated and applied in these disorders, and whether the apparatus would be expensive, and any other particulars likely to be of service.—NERO.

[62721.]—**Zigang's Electric Trumpet.**—Would anyone inform me how 1. To fix the armature or vibrating plate of "Zigang's Electric Trumpet" described in your issue of June 24, and what material is it made of? Also, does it cover all the inside of the brass tube. 2. What quantity, and what size of wire to wind magnet with? 3. Is yoke of magnet wound entirely closing up one end of tube?—EMIL. G. BERGERSEN.

[62722.]—**Engineer's Storekeeping.**—Can some fellow-reader kindly inform me of a modern system of keeping an engineer's stores, such as the arrangement of books, and the plan of receiving things from the works, &c., and issuing to men? Any particulars giving the best mode of thoroughly keeping a store will oblige, or would like to correspond with some one.—F. C. T.

[62723.]—**Sounding the Whistle when Trains are Approaching a Railway Station.**—Some eight or ten weeks ago an article appeared in the daily papers respecting the cost per annum of sounding the whistle on the several railways in the United Kingdom. As I have a wish to know, can any kind reader give me the information and oblige?—J. STEELE.

[62724.]—**Organ Mechanism.**—In [illegible]
"Catechism of the Organ," I find in a descriptio
Leeds Town Hall Organ, that on the solo org
of a number of mechanical contrivanc
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on drawing the stops labelled flu
and pressing middle C of clavi
tenor C of bassoon, the middle
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mechanism
—T. B.

[6272
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[62726.] — **Photographic — Ferrous Oxalate Developer.**—Would Mr. Bottone kindly say what course he adopts with an under-exposed plate? I use the iron and oxalate in proportions one to five, frequently omitting bromide. Nevertheless, though my negatives are fully exposed, they often require twenty minutes to half an hour for complete development. Edwards' ready-made iron developer brings them out at once. What is wrong with my developer? The plates I use are "Edwards," and the "Ilford."—P. H. K.

[62727.]—**Moulding Machine.**—Would some kind friend answer the following? Suppose a pattern of a moulding that was required was given you on paper, can anyone tell how to strike out the shape of the cutter that would be required? The shape of cutter would be a different shape to that of pattern moulding. How is it done?—YOUNG MACHINST.

[62728.]—**Stamping Sheet Steel.**—I have steam power, and propose to set machinery to make in the cheapest possible way, from sheet steel, a large quantity of working parts (which must be true and smooth) of say six different shapes, some having slots therein, and some bent, and ranging from 1-16 to ⅛in. thick, the largest being 7in. by ⅝ by ⅛in. Can they be stamped true enough from cold metal to require little or no hand work? What sort of plant is necessary, approximate cost of same, how many pieces (of one sort) could be done at once, would the sheets be first cut in strips; how should I proceed to case-harden a quantity; what sort of apparatus would be necessary to nickel plate them, approximate cost of same, and how must they be prepared to plate? Will some experienced reader please tender the above information? What might be the cost (having machinery) to finish up, say 100,000 such pieces?—STAMPING NOVICE.

[62729.]—**Leg Out of Joint at Knee.**—A lady friend of mine has been suffering from the above for this last nine months past—three months of hospital treatment at Plymouth included. In the first place her leg was weak, and she slipped and put her leg out at the knee. She had assistance, and her knee was supposed to be set; but, unfortunately, it proved a failure, and all the doctors have done to help her has not been successful in either allaying the swelling and pain at the knee (she can only move with the greatest difficulty by the aid of crutches) or help her to walk. Some doctors recommend amputation, others say it will cause her death. No two doctors agree. Can any one help her in her difficulty. I may add the knee is about three times the size it ought to be. Some have suggested iron supporting the leg above the knee, others condemn iron.—ANXIOUS ENQUIRER.

[62730.]—**Æolian Harp.**—I have recently bought an Æolian harp, and am much pleased with its performance. The point upon which I seek information is the note to which the strings should be tuned. The strings are arranged in two rows, and are twenty in number. Would it succeed if I tuned the upper row to one note and the under one to another, so as to make a sort of accompaniment to the upper row? I should also like to know whether there is any means of lessening the unpleasant throbbing sound produced by low notes. Any information will much oblige.—ÆOLUS.

[62731.]—**The English Language.**—1. When was the use of the personal pronoun "thou" abandoned? The disuse is to me doubly astounding as "thou" is still in use in German and French, these two principal factors in the English language. 2. Astounding also is the absence in English of the French *u*, and the German *ü*. How is it explained? 3. How did the Saxon guttural *ch* happen to be dropped in English? Was it ever used? 4. Where does *th* come from? How and when was it introduced in the English language?—A FOREIGN STUDENT.

[62732.]—**Electric Control.**—Will someone kindly give the easiest and best method of controlling a continuous rotary motion like a chronograph, by an electro-magnet and a circuit from standard sidereal clock. I understand how it is done with a vibrating pendulum, but not in the case of a continuous rotary motion regulated by a governor or fly. I can get an electric current from the standard clock every second or every minute. A sketch will oblige.—CHRONO.

[62733.]—**Toning Prints.**—Can anyone kindly inform me why, when attempting to tone prints (especially vignettes) on ready sensitised paper, the half-tones often turn pink and the darker parts a dirty-looking brown? I frequently obtain these results, both with the acetate and the carbonate baths. I well wash the prints previously.—L. N.

[62734.]—**Earwigs.**—Can you suggest anything [illegible] keep earwigs out of the house? A cousin of mine says [illegible] come in from outside and get into his boots and into [illegible] places where they are not [illegible].—[illegible] FARMER.

[62735.]—**Vulcan**[illegible]—W[illegible] tell me if I can [illegible] answer for the [illegible] metal articles [illegible] that will [illegible] vulcanite, [illegible] nor the [illegible] I want [illegible] almos[illegible] Pleas[illegible] [illegible]

[illegible] bichromate cells. My objection to these cells are: 1. Size. 2. They want charging too often. This and the cleaning takes up too much time. What I want is a small, but powerful battery, that can be used for half an hour each night. I have sometimes spoilt a trick through my assistant forgetting to slide the zincs into the solution. I would like a battery in which the zincs could be left and with sponges or something to prevent the liquid running out should they by accident get upset. Could I use a secondary battery? Any information will be thankfully received.—MEPHISTO.

[62738.]—**Piano Wrest-Plank.**—TO MR. DAVIES. —I have made a brass wrest-plank for my piano. I have got it all ready to put on, but am at a loss to know what cement to fix it with—will glue answer? I am told it will crack and jar. Of course I am going to fix the plate with screws, but I understand it should be bedded with cement. Can you help me?—APOLLO.

[62739.]—**Lathe.**—Will some one tell me if I could bore out a half-horse-power cylinder by hand on a 4in. lathe, without back gear, with a half-round bit? If not, at what speed should I have to drive lathe? My lathe is a triangle-bar one.—ESSEX.

[62740.]—**Hot-Air Engine.**—I have made a dynamo by following the instructions given in these pages by Mr. Bottone. I now want a small hot-air engine to drive it, something simple and easy to make. I have a lathe, plenty of tools, a little spare time, but not much cash. Any information on this subject with drawings, or the dates of back numbers, will oblige. The dynamo will light up four 5c.p. lamps.—MEPHISTO.

[62741.]—**Cameras without Lens.**—In our last week's number there appeared a short account of cameras without lens being used in France. Can any of "ours" give a description of such camera, including the mode of focussing, &c.? It seems too good to be true. But I suppose it is only used for brightly lighted views; it savours of the card and pin-hole dodge.—J. G. BRISCO.

[62742.]—**Staffordshire Bricks.**—Is there any compound or combination of chemicals and compounds which could be added to the ordinary (red brick) clay to make blue Staffordshire bricks? I have heard of something similar being worked—is it a patent? I should be pleased for any information on the subject.—WM. ARNOTT.

[62743.]—**Bracelets.**—I shall be very much obliged if some kind reader will inform me the best way to make 15ct. edging for bracelets, and the best metal to put in that will eat out quickly? Also the best acid to use to eat out the metal without damaging the gold. Also do. for 9ct. gold, and the best alloy for making good silver solder.—AN IMPROVER IN DOUBT.

[62744.]—**Deposit of Nickel and Silicon.**—Would a brother subscriber kindly inform me the best solution to use to deposit nickel on gauze or muslin, and how to proceed? Also how could I deposit silicon from flint or silicate of potash? The method of proceeding. I should feel favoured if any in the trade would help me.—NONPLUSSED.

[62745.]—**Scented Tobacco.**—Does our friend "Eos," who wrote so interesting a description of the various kinds of tobacco a little while ago, know how to scent ordinary cut tobacco—say Returns, Honeydew, Turkish, &c.? The scent mainly used appears to be cascarilla. Will that do if applied in the shape of an extract or a decoction?—NUN. DOR.

[62746.]—**Indiarubber Air Balls.**—How are these made?—T. Q.

[62747.]—**Silvering Glass.**—Wanted, a simple recipe for silvering all kinds of glass goods with good films?—E. J. R.

[62748.]—**Photo-micography.**—Can anyone tell me how to find the exact enlargement of an object? Given, that the power of objective and eyepiece combined, and the distance from object to focussing glass of camera are both known?—F. R. S., EDIN.

[62749.]—**Leclanche Zincs.**—Do these require amalgamation, or not?—PRINCIPIA.

[62750.]—**Railway Working.**—Will any of "ours" kindly inform me what books would be most serviceable for me to stud[illegible] of telegraph engineer under a rail[illegible] comp[illegible] Stretton help me?—R. B.

[illegible] Which is the best ar- [illegible] 500 at a time? Whether [illegible] how to regulate current

[illegible]ries.—I have 12 small [illegible] same from dynamo or [illegible] one ampère per cell. [illegible]o or battery?—In [illegible] regulate current?

[illegible] have made a [illegible]th three strings. [illegible] same?—A POOR [illegible]

[illegible]—Will Mr. A. H. [illegible]s give a certain [illegible] sample of so-called [illegible]

[illegible] **Furnaces.**—To [illegible] the last few years [illegible]her's injector furnaces [illegible] desirous of avoiding, if [illegible]ience of blowing, I made [illegible] pressure of 5in. of water. [illegible]er with closed instead of [illegible]erted), as in Mr. F.'s pattern, [illegible]o get as good results as with [illegible]e the air jet from fan was ⅜in. [illegible] 1in. diam., which at the gauze [illegible] same size as Mr. F.'s, while in [illegible]out 5-32in. diam, and opens into a [illegible]ich is cut away at the underside [illegible]urner. I have since made a few [illegible]and find that by coupling the nozzle with a two-legged siphon, I get with [illegible]sing the closed burner, practically, the [illegible]ast—viz. 5in. while with foot blower (which gives a pressure of 30in. of water) and open ended burner, I get only 1⅝in. water pressure. By using the closed burner and small nozzle with foot blower I get the full 30in. pressure in siphon. Hence, in the case above mentioned, there is an apparent loss of 28in. of water pressure. Of course, I am aware that in actual work the nozzle is not closed as with the water siphon; but even under the most favourable conditions there is always some back pressure, and consequent escape of air (and gas) at the open end of the burner. Why does Mr. Fletcher use the open-ended burner?—MONS.

[62756.] — **Ice Making by Compressed or Liquid Carbonic Acid Gas.**—Can any of your readers give me details of this process?—POLE.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, July 6, and unacknowledged elsewhere:—

C. V. DE SAUTY.—Rev. J. H. Cole.—S. H. Gillam.—J. C.—Gwalia.—J. K. N.—Ralph.—Bryn.—E. Gobert.—One Willing to Learn.—Corporal.—W. R. S.—Cicero.—B.—Anceps.—R. L. H.—Country Solicitor.—Mechanics.—A Fellow of the Royal Astronomical Society.—J. S.—John W. Hillier.—Chas. Provis.

FUNNEY. (So far as gold coins are concerned weight is the best test; as to silver, experience of the feel and weight. Acid would be of no use, as it would be necessary to file the coins before applying it. Bank clerks and booking clerks have little difficulty in detecting base coins.)—J. R. (How can anyone say? It is a matter for assay. See the article Pyrites in Ure's Dictionary and Mitchell's "Manual of Practical Assaying.")—T. H. (Watch the discussion, or if a speedy remedy is required, consult a medical man. It is mainly due to indigestion.)—H. K. R., Yorks. (Not new, by any means, and of no practical use. We do not know who invented it, and we are unable to discover any invention in such a device.)—C. W. T. (T[illegible] old lacquer must be cleaned off, and the ra[illegible] quered. The paste named is of no use for the[illegible] —ARGOS. (Not sufficiently definite, or o[illegible] interest. See Langdon's "Application of [illegible] to Railway Working," Macmillan and [illegible] various arrangements.)—S. H. (What is [illegible] the number attached to your query? [illegible] reference to hair under that number [illegible] recently given recipes for depilatories. [illegible] use of the electric spark, but it takes [illegible] (You could coat it with a black [illegible] blacking, if it is a polished leather [illegible] dress it with a mixture of castor [illegible] you merely want to hide the cra[illegible] dices. 2. To prevent the light ac[illegible] modeller's clay, or a mixture of [illegible] depends much on what you m[illegible] AN ENGLISH MECHANIC. (If y[illegible] learn all about telephones, [illegible] mitters, why not read up your [illegible] you will find the information [illegible] book on the subject is Du M[illegible] phone, and Phonograph," [illegible] there is no work giving [illegible] BATTERSBY. (Watt's "[illegible] Crosby Lockwood and Co[illegible] really needed; but it mi[illegible] cure his "Electro-Depos[illegible] was noticed last week [illegible] The price is 12s. 6d.)—[illegible] not write to the paper [illegible] or why write at all? [illegible] described in our colu[illegible] is brought out you [illegible] see it will be sent t[illegible] tery you name—at [illegible] search our back vo[illegible] no doubt you will [illegible] chemicals you sp[illegible] determining the [illegible] nature of the [illegible] Lacquer, collo[illegible] mended; but [illegible] be cleaned [illegible] something a[illegible] devices in [illegible] mean chlo[illegible] tion of co[illegible] precipita[illegible] of crea[illegible] form a [illegible] KIDDE[illegible] the be[illegible] bit of [illegible] siona[illegible] wors[illegible] heated.) — COSMOPOLITAN. (Pour some paraffin-oil into their nests, or place saucers with castor-oil in them about the scenes of their labours.)—H. KALB. (Do not quite understand. A piece of thin yellow pine is as good as anything for mounting such apparatus; but we really do not know what you may mean by "an ordinary microphone.")—R. G. (See one of the handbooks—say Capt. Abney's treatise, published by Longmans. The only way to answer the other question is to try the lens; anything else would be guesswork.)—A FIFTEEN YEARS' SUBSCRIBER. (If you can find no mention of the fact in the works named, probably the writers considered it so well known as not to be worth mentioning; but most certainly the humble bees—there are several species—can sting, B. lucorum, the wood humble bee, being rather too free with its weapon sometimes when its nest is incautiously approached. The male bees are without stings.)—COL. ROSS. (Really, neither subject is in our line at all.)—OMPAX. (Please read "Hints to Correspondents." The query is distinctly a commercial one, and as such has been necessarily excluded.)—MIGNON. (There is nothing to prevent you from dropping, changing, or adding to your names to any extent you please. But every step you take of the kind subjects you to the necessity of being always able to prove your identity. If you go and insure your life in the two Christian names, and afterwards drop or change one, or marry in only one name, you must not wonder one of these days if difficulty arises. The best way is to leave such matters as they are.)

A New Washable Truss.—An Important Invention.—Harness Xylonite Truss is the most perfect appliance ever invented. It gives complete comfort and support without irritation. It has a beautifully smooth, flesh-coloured surface, and is guaranteed to last a lifetime.—Address: MEDICAL BATTERY COMPANY (Limited), 52 OXFORD STREET, LONDON, W.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MLI.—BY NEMO.

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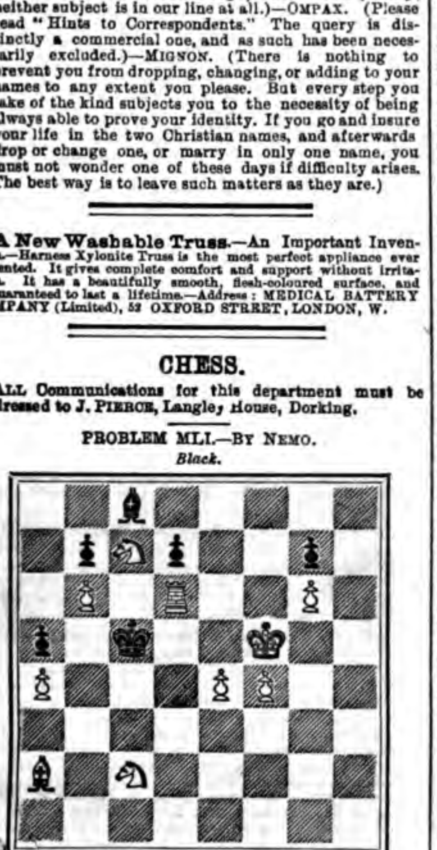

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2. K-B 4 (a).
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2. K-B 5 or 7.

ORRESPONDENTS.

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WORTH £100 GRATIS.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JULY 15, 1887.

THE STORAGE OF ELECTRICAL ENERGY.*

THE storage of electrical energy has already played an important part in recent developments, and as it promises to have a still more important and useful future, Mr. Elwell's translation of Planté's work will be welcomed—all the more readily because the original is very scarce. Modern devices, in the shape of accumulators or storage batteries, are perhaps more convenient —they are certainly more readily "formed" —than Planté's famous cell; but it is probable that in the long run the latter will be found to be more economical and less troublesome. At any rate, those who have never read Planté's work in its original language will be glad of this translation, for it includes the "main results" of the researches contributed by the author to the Paris Academy of Sciences or published in various scientific periodicals for a period of twenty years—that is, between 1859 and 1879. We say "main results," because, according to Du Moncel, Planté had made experiments with the oxides of lead applied to the lead plates of his cell, and gave them up because he found the coating would not adhere, while he obtained satisfactory results with the simple, though more slowly formed, lead plates. In his preface, however, Planté says that the first part of the work comprises a description of the experiments and apparatus he had made known for accumulating and transforming the energy of the voltaic battery by means of secondary currents, and we must, therefore, assume that he did not publish the experiments he made with the oxides of lead. Those who know something of the nature of the man—a student of science of the first grade—will readily understand that Planté would publish only what he knew could be utilised with advantage, although he says himself that he thought he ought not to pass over in silence some of the ideas which the results of his experiments presented, and the real or apparent analogy which they show with natural phenomena. The spirit in which he wrote his work is well shown by the quotation from St. Augustine, "Quæro, Pater, non affirmo"; and though he felt that he ought to describe such applications of his discoveries as had suggested themselves to him, he did so more with the idea that he might be helping on the progress of science than that his own views were to be accepted as absolutely true. Those who are interested in the development of the accumulator or storage battery will find the first part of Planté's work a valuable help in comprehending the principles and in understanding the history of electrical storage, as it is termed, for it treats of the "Accumulation and Transformation of the Energy of the Voltaic Battery by means of Secondary Currents." Although it is only within the last seven years that much attention has been paid to the storage battery, the discovery of the principle is as old as the century, for it was in 1801 that Gautherot first noticed that platinum or silver wires which had been used to decompose saline water possessed the property of giving an electric current after they had been cut off from the voltaic battery with which they were used. Gautherot does not seem to have done more than record the observation, but Ritter, of Jena, who made the same discovery in 1803, constructed the first secondary cell with pieces of gold separated by cloth discs moistened with a saline solution. This storage cell, inactive in itself, could, after being submitted to the current from a voltaic battery, give a current in the opposite direction for a few moments, and Ritter proceeded to make experiments with other metals, and obtained from his secondary cells all the effects produced by ordinary batteries. The arrangement of the elements was, however, too clumsy for application, either in scientific research or in commerce, and the discoveries of Gautherot and Ritter were almost forgotten until in 1826 De la Rive called attention to the fact that a secondary current could be obtained from platinum plates in a voltameter filled with slightly acid water, or even in distilled water. That was called a polarisation current, and the subject was investigated by Faraday, Schoenbein, Wheatstone, Poggendorff, and many others, including Planté, who, in 1859, commenced a research having the special purpose of comparing the secondary currents produced by voltameters of various metals in different solutions, by taking observations directly after breaking the primary circuit. The results of these experiments are set out in some detail, with diagrams of the apparatus used, and a little study of them may prevent other investigators from travelling over unproductive ground. Planté found that the adherence and insolubility of the peroxide of lead, added to its affinity for hydrogen, contribute to produce a more intense secondary current of longer duration than that obtained by the use of other metals. He also found that lead covered with a coat of its peroxide when placed in acidulated water acts in a manner exactly the reverse of zinc when placed in similar conditions, for it tends to decompose the water by absorbing hydrogen, and so becomes the positive pole of a cell if connected to a plate of lead not oxidised, while pure zinc tends to decompose water by absorbing oxygen, and so becomes the negative pole, or positive element, of a cell in which it is opposed to any other metal. Planté having made that discovery followed it up, with the success we know he attained; but in this work he points out why Ritter did not invent a really useful secondary cell. If salt water is used in the voltameter when lead plates are experimented with, chloride of lead is formed around the negative poles, which is scarcely soluble and a very bad conductor, so that the primary current is rapidly diminished and the secondary itself is much weaker than when water and sulphuric acid are used: the difference is as ·08 compared to 1·5. That explains why Ritter, who nearly always used a solution of salt, did not obtain any marked results with lead, and therefore failed to make the discovery which will always be remembered as that of Planté. In 1860 the latter made his first secondary cell by rolling up two long lead plates with a thick cloth between them, and then immersing them in a jar containing water and sulphuric acid (10 to 1). The size of the plates generally employed by Planté is about 24in. long by 8in. wide, the width, of course, representing the height of the coil when the plates are rolled up. A battery containing nine cells thus constructed, and having a total surface of ten square mètres (107·6sq.ft.), was exhibited before the Paris Academy of Sciences on March 26, 1860, and a bright spark was obtained from the terminals after passing the current from five small Bunsens through it for a few minutes. It was not long before Planté found that there were objections to the form of his cell: the interior action could not be observed; the resistance was increased; and the cloth becoming rotten might allow the lead plates to come into contact, and so destroy the action of the cell. He therefore constructed batteries with two series of parallel lead plates, and used them for several years; but subsequently returned to the older form with a modification in the method of separating the plates, which enabled the phenomena taking place inside the cells to be watched. The plates, cut to shape with terminals left on, are rolled round a wooden cylinder or former, strips of indiarubber being used to separate them. These strips, of which four are required for every two plates, are about a third of an inch wide and a sixth of an inch thick. A lead plate being laid on the bench, two strips of rubber are placed longways of the plate, and another shortways at the edge to prevent buckling over when rolling. Another lead plate with its terminal at the opposite end is then laid on the strips of rubber, and two shorter strips are laid on that. The former is placed in position, and the two plates are rolled up together, in such a manner that their surfaces are everywhere kept apart by the strips of rubber, and one terminal is in the centre of the coil and the other on the end of the outside plate. A cross stamped out of guttapercha with a hole in the centre for the passage of the centre terminal is then warmed on one surface and pressed on to the coil, which it helps to keep in position, and which may be further secured by other means—e.g., rubber bands if desired. The terminal tongues are generally coated with a composition of wax and resin to prevent the acid solution creeping up. To "form" the secondary cells, they are charged a number of times and discharged in proportion, the object being to obtain upon the surface of the plates those layers of oxide and reduced metal, the finely-divided state of which favours the development of the secondary current. Planté gives full details of the manner in which he experimented so as to learn the best method of "forming"; but he points out that "time" is an essential factor. If he tried coating the lead plates with oxide already prepared, as is asserted, he probably discarded the method as unsatisfactory, and there being no special demand for secondary batteries, he did not persevere in an attempt to discover whether he could by any means "form" his storage cells in a more rapid manner. In this respect, be the facts what they may, Planté must be regarded as the real inventor of th[illegible] secondary cell, and as his device is no[illegible]ject to the restrictions of the pate[illegible] anyone can make it, and probably [illegible] it is as useful as and more durabl[illegible] modern "improvements." At a[illegible] this work those who wish to exp[illegible] find ample information, and ma[illegible] not valuable hints which may le[illegible] discoveries. It is for that rea[illegible] Elwell is to be thanked for p[illegible] work at the service of inve[illegible] English dress. The first pa[illegible] said above, of the most pr[illegible] workers in electrical sc[illegible] second part, in which Pl[illegible] of the possible applicati[illegible] there is much that [illegible] account by a lecturer [illegible] tricity. The fifth par[illegible] of Planté's rheostatic[illegible] made to give all the [illegible] trical machines and [illegible] other portions of t[illegible] things which will [illegible] electricity.

THE THEOR[illegible]

By R[illegible]

WE shal[illegible] as i[illegible] accurately, [illegible]

The eno[illegible] machines [illegible] used in [illegible] packing, [illegible] extent [illegible]

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* The Storage of Electrical Energy. By GASTON PLANTÉ. Translated by PAUL BEDFORD ELWELL. London: Whittaker and Co.

VOL. XLV.—No. 1,164.

into various forms iron and steel both hot and cold.

Fig. 53 represents a vertical section of a

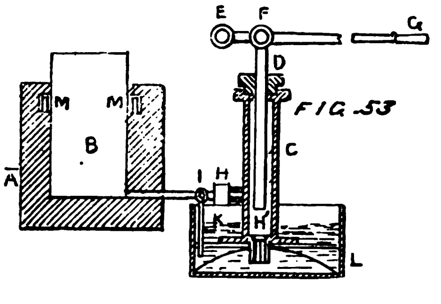


FIG. 53

hydraulic press. *a* is a cast-iron cylinder, and *b* a plunger or ram working in it, being kept water-tight by the leather collar *m m*; this collar is horseshoe shaped in cross section, being supported by a copper ring, and when the water in the cylinder is under pressure it enters the collar and presses its sides closely against the ram and the sides of the cylinder, thus making it water-tight. The action of this machine depends upon the fact that the pressure of liquids is equal in all directions, so that if you impress a force of *p* pounds per square inch on any part of the surface of water in a close vessel, it will exert that pressure on every square inch all over the interior surface of such vessel.

c is a force-pump of small diameter, furnished with an inlet valve *h′*, and an outlet valve *h*, as shown, and it is fixed in a small water tank or box *l*. In the pump barrel is a solid plunger *d*, packed water-tight by an ordinary gland, or leather, at the top, and actuated by the handle or lever *g f e*, *g* being the handle, *f* the point of connection with the pump plunger *d*, and *e* the fulcrum or dead centre.

The water forced through the valve *h* passes along a small tube into the cylinder *a*. In this tube is a relief cock *i*, by turning which the water is allowed to flow back into the tank *l*, and the pressure is taken off the ram, the water returning to the tank through the pipe *k*.

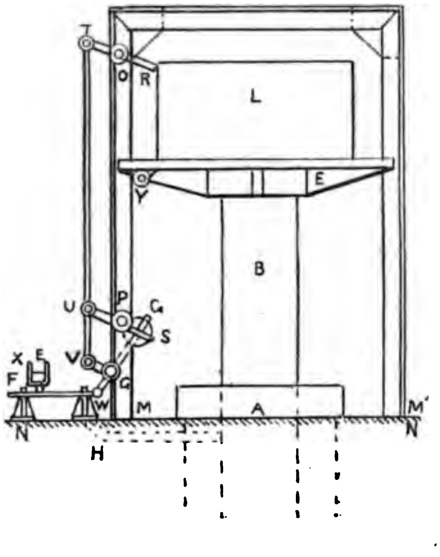
When this machine is in action, it is evident that there will be *the same pressure per square inch* on the bottom of the ram *b* as there is on the bottom of the pump plunger *d*; therefore,
n. the total pressures on these elements will vary
as their area, but these vary as the squares of
singl eir diameters. If, then, P equals the pressure
it surpri pump plunger *d*, and P′ that upon the
use and s their diameters respectively being D and
call them
the writer o will $P' = P \times \frac{D'^2}{D^2}$.
fortunately m
ductions; for, y the principle of moments, if F =
made for Kensi pounds applied at *g*, P being that
enough; the fou
two grains: of a plunger *d*, $P = F \times \frac{g\,e}{f\,e}$, and com-
large m that groo
togeth as the meal
othed. But, havin o formulæ we have $P' = F \times \frac{g\,e}{f\,e}$
thiting, I cannot
opinion is that in gregate force upon the ram *b*.
electricity in the fo
between the point of the ple, let the force applied *a g*
the glass; glass being 6in., *f e* = 3in., D = 1in..
ductor of heat, and the v.
nothing to absorb the hea } $P' = 120 \times \frac{36}{3} \times \frac{12 \times 12}{1 \times 1}$
a minute fracture, and
arising at intervals follo tons—a pressure which
along the cut, for if we turn ed by one man; and if
light, we find a line of light er pump, with a plunger
regularly entering the body o are four times as great,
shows the differences between obtained, and these
cut. This line of light clearly d with two or three
fracture in the glass, the light l so that commencing
the edge, thus the piece of cylinder *a* compara-
separated the width of that line, istance is sufficient
be, for the light could never be strength, he con-
Sometimes when the glass is thin pump, and in due
lutely goes right through. A cutt est to obtain the
he has got the cut by the musical h is fitted at the
cut as he draws the diamond along, of head as may
found on close examination that the tended to per-
very regular, like the teeth of a fine
the detonation of these minute fractures.
the musical note, and thus arises the e hing textile
'sweet cut.' That electricity is generate wo to four
the point of the diamond and the surfa for three,
glass, cannot be doubted, for when w e quality
diamond with a coarse cut, minute films eriod the
are thrown aside by the diamond, and as t mine the
on the glass seem alive with electric act or if it
would add here that it is my opinion that gla ump to
annealed would be better isolated than the ann
I gather this from the manner that a gla

restore it, for it will sometimes happen that the pressure will fall by the water sweating through the pores of the cast-iron cylinder, especially if the casting is not a very close one.

In large works, such as iron yards where "hydraulics" are used for bending, pressing, and riveting iron, and they are therefore constantly being charged and relieved when in use, the pumps are worked from the general shafting of the establishment, or by a special engine, as may be most convenient, and they do not pump the water directly into the cylinders of the hydraulic machines themselves, but into an intermediate vessel termed an accumulator.

This accumulator is itself a sort of hydraulic press, but has a very long stroke in order that it may hold enough water to serve several short-stroke presses at once. Its table is heavily loaded to secure the required pressure, and it is automatic in throwing its pumps out of gear when full, and starting them again when it begins to empty. This is simply managed by stops attached to the table of the accumulator, which actuate a fork, by which the driving strap to the pump shaft is shifted from the fast to the loose pulley, and *vice versâ*. The general arrangement of the accumulator is shown in Fig. 54. *a* is the hydraulic cylinder, which is sunk in the foundations, being principally below the ground line *n n*; *b* is the ram, fitted and packed in the usual manner; *c* a table which works between four vertical guides, of which two are shown at *m m*, *m′ m′*. These guides may conveniently be made of stout angle irons, properly braced together to give the necessary rigidity.

FIG. 54



L is the load necessary to give the required pressure on the water in the cylinder *a*.

o, *p*, and *q* are dead centres fixed on the standard *m m*; *r t* and *s u* are tappet levers working on the dead centres *o* and *p*; *v q w* is a bell-crank working on the dead centre *q*; *t u v* is a vertical rod connected with the tappet levers and the bell-crank by pins at *t*, *u*, and *v*; *w f* is a horizontal bar connected with the bell-crank by a pin at *w*, and supported in guides as shown. It carries a fork *x*, which controls the pump-shaft belt, shown in section at *e*; *y* is a stud on the table *c*, which operates the tappet levers *r* and *s*.

As the cylinder *a* is filled by the action of the pumps (not shown in the sketch), the table *c* rises, and the pin *y* pressing on the end *r* of the lever *r t* depresses the end *t*, and rod *t v* thereby, through the bell-crank *v q w*, drawing the fork *x* to the right, and so throwing the band *e* from the fast to the loose pulley on the pump shaft, stopping the action of the pump.

If now the stored water is drawn off to the presses served by the accumulator, the table will descend, and the stud *y* coming in contact with the extremity *s* of the lever *s u* will raise the rod *t v* and again place the strap *e* upon the fast pulley on the pump-shaft, when the pumps will start and replenish the accumulator. The arm, *w g*, of the bell crank should be prolonged above the dead centre *q*, and have at its end a weight, *g* to retain the automatic gear in position after it has been operated by the stud *y*; otherwise the vibration of the machinery may cause the belt to travel until the pumps are accidentally thrown into gear, unless the tappet end *r* of the lever *r t* is made of such a length that the stud *y* cannot pass it.

In Bessemer steel works almost everything is actuated by hydraulic apparatus: the converters are tipped and righted by hydraulics, the ladle or shank for receiving the molten steel is carried on the jib of an hydraulic crane, and the jigger cranes for lifting the cast ingots and other work from the pit are hydraulic. The simplicity of the hydraulic crane is alone a great point in its favour. There is no machinery to take up room or get in the way of the workmen, and it is noiseless in its action. The levers too for actuating the different hydraulic apparatus can all be brought together into a box at the end or side of the shop (like the levers in a railway signal-box), so that all the machinery can be actuated by one attendant without his having to leave his post.

The weight of the load L must be proportioned to the pressure per square inch required, and the area of the accumulator ram; so, if *p* = pressure per square inch and D = diameter of accumulator ram in inches, L = 3·1416 D².*p*. Let *p* = 2,000lb., and D = 18in.; then L = 3·1416 × 18 × 18 × 2,000 = 2,035,757lb. The weight of a cubic foot of cast iron is 450lb.; hence the bulk requisite to give the above weight will be 2,035, 757 ÷ 450 = 4,556 cubic feet. This need not be placed on a table at the top of the ram, as it may more conveniently be suspended from a cross head and allowed to rise and fall in pits at the sides of the hydraulic cylinder. The example I have taken is exceptionally large, as in many works 1,400lb. per square inch is considered a maximum, and this would reduce the bulk of the load weight to 3,189 cubic feet.

In the figure the dotted lines *h h* represent the pipe passing from the pumps to the hydraulic cylinder *a*.

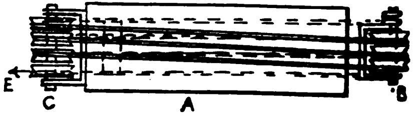
The hydraulic principle has been very successfully applied to hoists and lifts for heavy and light loads, and at present, with the rapidly increasing height of our buildings, there is an equally rapid increase in the demand for lifts.

A very compact telescopic hydraulic lift was some years since designed by a Mr. Holden, of Bradford, the idea being to save vertical space in the ground below the lift. Instead of making the ram in one piece, it is formed like a telescope, so as to shut up in falling to one-third or one-quarter of its full rise, similarly to telescopic gas-holders.

It is not necessary that the stroke of the hydraulic cylinder attached to a hoist shall be equal to the required lift, for by a system of pulleys the travel of the hoist may be made greater than the stroke of the ram; but, of course, the gross pressure on the ram must, in that case, be made proportionately greater than the load to be lifted.

In Fig. 55 is shown the plan of a hydraulic cylinder and ram fitted with pulleys for multiplying the velocity of the motion. *a* is the hydraulic cylinder; *b* a set of loose pulleys on the head of the ram; *c* a similar set fixed to the closed end of the hydraulic cylinder; *d* a stud to which one end of the hoisting chain is made fast; and *e* the end of the chain which passes away to the hoist; the chain being passed round the pulleys at each end of the hydraulic as shown.

FIG. 55



It will be seen by inspection that if the ram be advanced one foot there are seven portions of chain, each of which must be lengthened by a foot, and therefore seven feet will, altogether, be drawn in of the length of the hoisting chain, hence the rise of the hoist will be seven times the stroke of the ram.

Suppose a lift is required for a warehouse to raise five tons, including the weight of the cage and chains, to a height of 50ft., then with such an arrangement as the above, the stroke of the ram must be $50 \div 7 = 7{\cdot}14$ft., and the resistance to be overcome by the ram is 35 tons besides friction; say, then, that for safety we provide a pressure of 40 tons, that is, 89,600lb. gross, on the ram. Then, if we have a pressure available of 700lb. per square inch, the area of ram requisite will be $89{,}600 \div 700 = 128$ square inches corresponding to a diameter of 12·776in.

For such purposes as hotel lifts and others, where only small loads of a few hundred pounds at most are lifted at once, the ordinary pressure of the mains will in some cities suffice, and it is in such cases that the telescopic lift is found of great advantage.

Suppose the ordinary pressure in the mains of a given town to be 150ft., that will give a pressure per square inch $= 150 \times 0{\cdot}434 = 64$lb., as a quantity of water 1in. square and 1ft. high weighs 0·434lb.

If, then, the outside weight to be lifted is 800lb., the area required will be $800 \div 64 = 12{\cdot}5$sq.in., so that a ram 4in. in diameter will be sufficient.

It will be seen that hydraulic cylinders may also be used with advantage in working dock and fixed wharf and warehouse cranes, where heavy loads have to be dealt with; but we have not space to enter into further details in connection with these machines.

(To be continued.)

THE SEYBERT COMMISSION ON SPIRITUALISM.

WE mentioned on p. 436 last week that the Seybert Commission appointed by the University of Pennsylvania had reported the results of their inquiries into "spiritualism," and a few particulars may not be without interest. Shortly before his death, Mr. Henry Seybert presented to the University of Pennsylvania a sum of money sufficient to establish a Chair of Philosophy on condition that the University should appoint a commission to investigate all systems of morals, religion, and philosophy which assume to represent the truth, and particularly of modern spiritualism. Mr. Seybert was, it seems, in his later years much interested in spiritualism, having, it is said, "fallen a prey" to the wiles of a coterie of slate-writers, spirit-form projectors, &c., and by a codicil to his will he left the sum of 60,000dols. in order that a proper inquiry might be made. The University accepted the trust, and appointed a commission, whose "preliminary report" is of such a character that if they follow it with a "final" communication the result will be the same. The commission appointed consisted of Dr. Joseph Leidy, professor of anatomy and a well-known naturalist; George A. Koenig, professor of chemistry; the Rev. George S. Fullerton, professor of moral and intellectual philosophy; Coleman Sellers, civil engineer; Dr. S. Weir Mitchell, the neurologist; Dr. William Pepper, Provost of the University; Prof. Robert E. Thompson; Dr. Horace Howard Furness, one of the trustees of the University; Dr. James W. White, and Dr. Calvin B. Knerr, the chairman being Dr. Furness, who, it is said, was really anxious to accept spiritualism if he could be convinced of its truth. With that exception, the commissioners entered upon the inquiry without any prejudice whatever, and the sum and substance of their report is that the manifestations submitted to them were fraudulent, in the ordinary meaning of that term. All the mediums with whom they had sittings turned out to be impostors. In what is called "independent slate writing," where messages are assumed to be written by some disembodied force either on the inside of closed double slates or on the underside of single slates held under a table, the exposure of fraud was complete. Two mediums, one a man and the other a woman, both held in high repute among spiritualists, were detected in fraudulent practices. The man was seen in the act of substituting prepared slates of his own, on which pretended spirit messages had been written previous to the séance, for the slates brought by the visitors. The woman was caught writing the messages herself on the slate held in her lap under the table by the detective aid of a small mirror which the commissioner placed on his knees, and which showed her hand at work on the other side of the table. It is true that these two mediums appeared to have been the only ones examined for slate-writing; but the commission inferentially condemn all slate-writing mediumship as imposture.

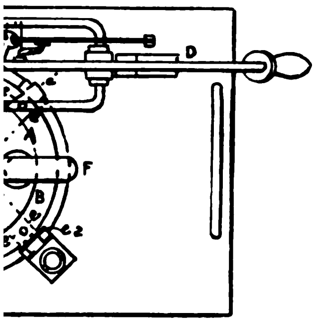
As regards "spirit-rapping," the commissioners report that they certainly heard raps, and could not explain them; but, as they say, "the difficulty attending the investigation of this mode of spiritualistic manifestation is increased by the fact familiar to physiologists that sounds of varying intensity may be produced in almost any portion of the human body by voluntary muscular action. To determine the exact location of this muscular activity is at times a matter of delicacy."

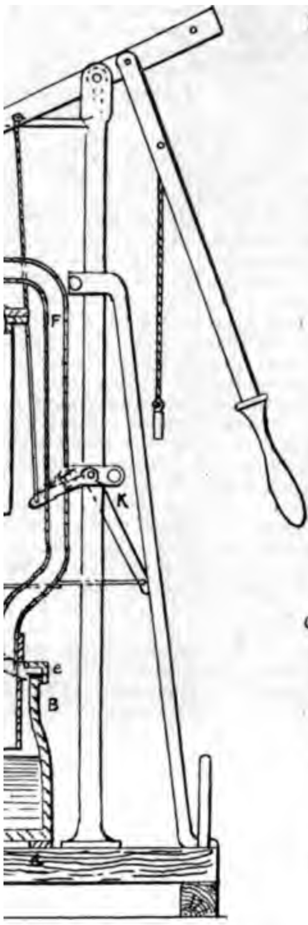
If the commission refrain, then, from offering "any positive conclusion" on that branch of the inquiry, they are positive enough as to materialisations and the special lines of mediumship. Nothing but fraud has been encountered. It appears that the mediums regarded the commission as hostile from the first, and some of them are charged with having prevented investigation by demanding prohibitive fees. This is applied in particular to an artist in spiritual photography, who, according to the report, not only asked an extravagant fee, but also exacted conditions as to the supervision of his mechanical process which would have made any inquiry a complete farce. He probably had good reason for stipulating for such conditions; but some members of the commission are as familiar with the details of photography as he is himself, though they may not be so well acquainted with his method of producing what is termed "spirit photographs." The Seybert Commission, then, have corroborated what has been said by scientific men in this country; for in their summing up they say they did not, in all their investigations, discover a single novel fact, and are "forced to the conclusion that spiritualism, as far, at least, as it has been shown before them, presents the melancholy spectacle of gross fraud, perpetrated upon an uncritical portion of the community." The report occupies an octavo volume of about 160 pages, published by the J. B. Lippincott Co., of Philadelphia, and, "preliminary" as it is, is a sufficiently crushing exposure of a remarkable series of impostures.

THE FLEUSS FREEZING MACHINE.

IN the notice of the American Exhibition, p. 355, we mentioned the Fleuss domestic hand ice machine as a useful contrivance amongst freezing apparatus, and we now give the details of its construction as patented in this country by Mr. H. A. Fleuss, Newtown, Isle of Wight. The object of the invention is mainly to produce a portable freezing or refrigerating machine capable of rapidly freezing or cooling comparatively small quantities of water or vaporisable liquid. The patentee effects the freezing of the bulk of the liquid by the well-known process of vaporising a portion of the liquid by means of a vacuum, aided by the absorption of the vaporised steam by sulphuric acid or other absorbent of aqueous vapour. Fig. 1 shows a plan view, and Fig. 2 a vertical section of the machine. Fig. 3 shows a vertical section on a larger scale of the delivery valve of the pump and of the parts employed for preventing escape of oil from the oil chamber which is above this valve. Fig. 4 shows a vertical section of the piston and part of the piston rod. Fig. 5 shows a vertical section of the lower end of the pump cylinder and of the suction-valve, and Fig. 6 shows a vertical section of the joint between the acid receptacle and its lid. A is a vessel to contain the liquid to be frozen. B is a glass vessel containing sulphuric acid. C is the cylinder of the air-pump. D a hand lever by which the piston-rod of the pump is worked up and down. The lever is shown to be formed in two parts jointed together—this is convenient, as it allows of the apparatus being packed in small space. E is the lid of the vessel B, it is formed of lead and has an angle-iron ring e (Fig. 6) around its outer edge. Above the lid is an iron ring e^1, with arms radiating from it (Fig. 1). The glass vessel stands on another iron ring e from which iron straps e^2 are carried upwards. The ends of the radial arms are made to enter holes in these straps. Each arm has a screw e^3 passing through it, and the end of the screw is made to bear upon the top of the angle iron ring e so that by turning the screws the lid can be forced downwards on to the top of the glass vessel or jar. To make a tight joint between the lid and jar which shall prevent the escape of acid and also be air-tight, the patentee forms a groove all round the outer edge of the cover as shown in Fig. 6; in that is an elastic ring Z. The thin tongue of lead z left below the groove does not extend to the outer circumference of the top of the jar, so that when the lid is forced down on to the top of the jar, the thin tongue of lead makes a liquid-tight joint round the inner circumference of the top of the jar which the sulphuric acid cannot pass, whilst the elastic ring Z maintains this joint and makes an air-tight joint round its outer circumference. In this way the elastic ring is protected from being injured by the acid. To still further insure obtaining a tight joint the top of the jar and the underside of the outer circumference of the lid and its elastic ring are painted over with paraffin, and whilst the paraffin is still soft and the jar and lid warm, the lid is put into its place on the top of the jar and forced down by the screw bolts. In this way a most perfect joint is obtained.

The lid E is provided with a filling hole closed by a plug, and also it is formed with two sockets into which are soldered the ends of two pipes F G, which pass upwards and carry a tap H. The tap has extending from it a disc I, which forms the lid or cover of the vessel A. I^1 is a ring of soft material interposed between the top of the vessel A and the disc I to secure a tight joint. The vessel A is held up by the vacuum in the apparatus. A nozzle I^2 is also provided below the disc to allow of the neck of a flask being held up to the tap in place of a vessel A of the form shown. By the tap H a communication can be opened between the interior of the vessel A and the pipe F leading to the acid vessel B. The socket into which the lower end of this pipe enters is, as shown in Fig. 2, carried down nearly to the level of the acid in the vessel, so that all air or vapour passing down the pipe F is brought into close proximity with the acid. The pipe G is closed at top—a branch pipe G^1 is led off from it to the bottom of the pump cylinder below the suction valve. Whilst the pump is being worked the acid in the vessel B is kept agitated by an agitator-blade J^1 on a vertical axis J which [illegible] out through a stuffing-box in the lid E [illegible] arm extending from it which by [illegible] coupled to one arm of a bell crank K [illegible] arm of which is linked to the leve [illegible] advantage derived from carrying [illegible] on a vertical axis is that the axis [illegible] out through an ordinary stuffi [illegible] which the acid does not come [illegible] The pump is formed of a pisto [illegible] be worked up and down in a [illegible] C, which has above it a smal [illegible] containing oil or other liqu [illegible] vaporise under a vacuum. [illegible] L is at the apex of a co [illegible] bottom of the cylinder, so [illegible] formed around the suctio [illegible] down stroke of the pist [illegible] of oil is caused as here [illegible] at the bottom of the c [illegible] the piston n is mad [illegible] conical hollow so tha [illegible] stroke it may fit cl [illegible] the bottom of the [illegible] end of the down st [illegible] piston enters the [illegible] the cylinder is th [illegible] on the undersid [illegible] piston complet [illegible] past the pist [illegible] oil, so that [illegible] ually expell [illegible] suction val [illegible] the greate [illegible] piston. T [illegible] the liftin [illegible] stem and [illegible] parts ar [illegible] The suc [illegible] tendir [illegible] direc [illegible]





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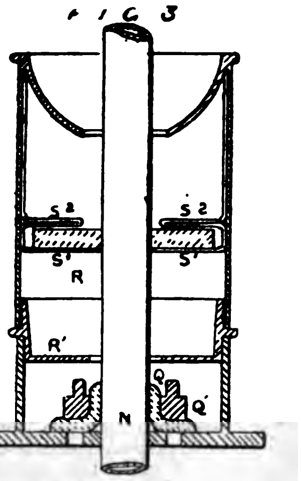

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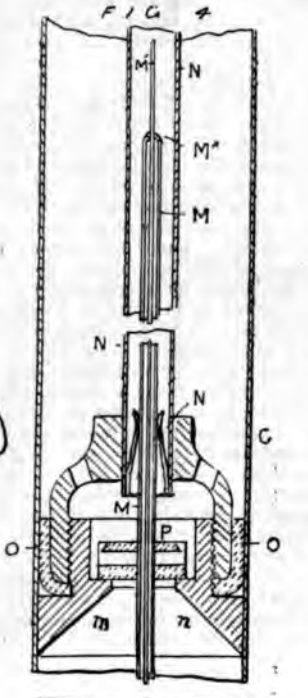

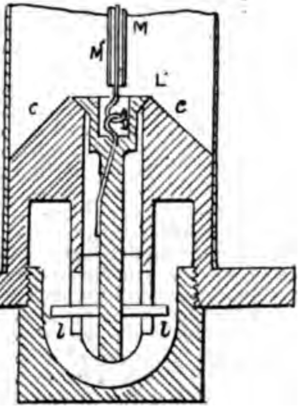

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The way in which the piston or pump bucket is formed is shown in Fig. 4. A leather, O, forms a tight joint between it and the pump cylinder C. The valve P is formed of a disc of leather with a central hole formed through it up through which the tube M passes. Above this is a metal disc carrying on the top of it another disc of leather. The holes through the leather discs are made to fit the tube M easily. Q is the delivery valve at the top of the cylinder C: it is composed of a disc of leather resting above openings formed through the cylinder cover. The disc is formed as an hydraulic collar with a flange or inverted cup-shaped projection standing up from its centre, which embraces the piston-rod so that it makes a tight stuffing-box joint where the piston-rod passes out from the top of the cylinder, as well as serving as a valve. The disc of leather with its conical upward projection is kept in form by a metal ring Q^1. Above the top of the cylinder is an oil chamber R, so that the delivery valve may be always covered with oil. R^1 is a disc passing across the interior of the oil chamber—it serves as a stop to prevent the delivery valve from being lifted too high on the upward stroke of the piston. At the completion of the up stroke also, when oil is forced from the pump cylinder into the oil-vessel, it prevents the oil from being thrown violently upwards, the only passage through it being just above the delivery valve. To prevent any oil which may be ejected upwards through this hole being thrown out from the top of the oil-vessel, the piston-rod is made to pass through a hole in the centre of a disc of leather S—this disc of leather is between two stops s^1 s^2, which keep it from moving too far up and down with the piston-rod. The stops are carried by the cover of the oil chamber, and this cover is coned downwards, as shown at Fig. 3, to still further insure that no oil shall be ejected from the chamber. Any oil entering the bottom of the oil-chamber and rising up through it must, as will be seen, pursue a very circuitous course before it can escape at the top. T T are small cavities in the side of the pump cylinder C; the bottom of the pump piston passes above these cavities just at the end of its upward stroke. The quantity of oil in the apparatus should be such that at the end of the upstroke of the pump piston the space above the piston may be full of oil, and the oil should also stand about to the level of the disc R^1. In working the pump, towards the completion of the up stroke, some of the oil above the piston passes into the cavities T T in the sides of the cylinder, and when the piston has risen above these cavities the oil within them falls to the bottom of the cylinder, and serves at the completion of the next downward stroke to sweep out all air from the lower part of the cylinder, as before explained.

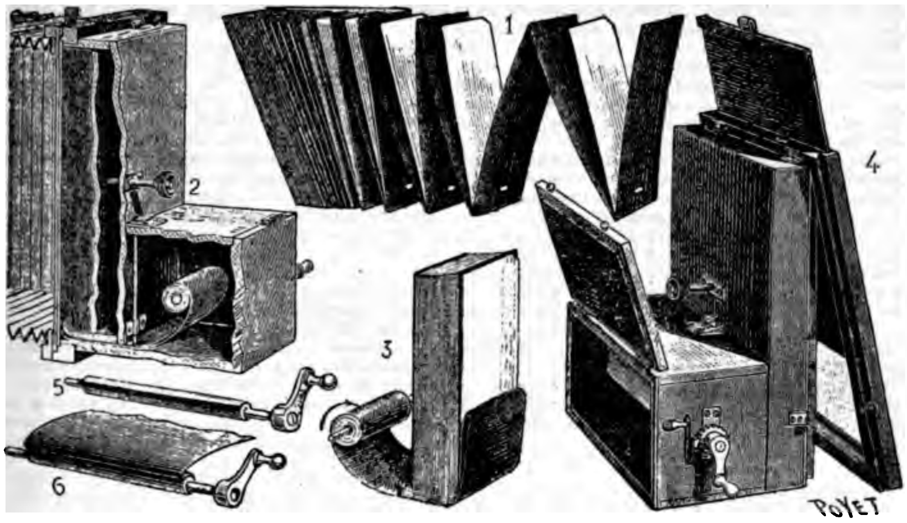
The action of the apparatus is as follows:—The tap H being closed, a few strokes of the pump are given until a good vacuum is obtained in the vessel B containing the sulphuric acid. The vessel A containing a small quantity of liquid to be frozen is now applied to the disc I or nozzle I^2, and the tap is opened. The vacuum then at once holds up the vessel. The pump is now again set to work to remove the air which was contained in the vessel A. Any vapour given off from the liquid is absorbed by the acid, and this continues until by evaporation of some of the liquid the remainder is frozen. In order to be able to obtain solid blocks of ice in the above manner, a small quantity of liquid should first be frozen in the vessel A, and then a further quantity of liquid may be introduced into the vessel through a tap U (see Fig. 1) and frozen, and so on until a block of the desired thickness is obtained.

PERRON'S PHOTOGRAPHIC APPARATUS.

THE Perron photographic apparatus and process are entirely new. The process consists in the use of sheets of gelatino-bromide of silver emulsion, with a view of obtaining ordinary negatives without the intervention of glass, which is always heavy, fragile, and cumbersome. The process is completed by a special frame, which permits of using these emulsions for a large number of exposures, without recourse to the special light of a laboratory to effect the substitution of them.

The emulsions are composed solely of the usual substance spread upon those gelatino-bromide plates which are so universally employed, thus permitting of the use of every known kind of development without any change in formulas, and securing an absolute transparency in the negatives. Glass or supports of varying transparency are entirely suppressed, and one has no longer to bother with those special baths that are used to give certain of these supports the necessary transparency. Finally, the apparatus that permits of the use of these plates in the open air for the various exposures has been so studied as to make it adaptable to all existing cameras without exception, thus causing merely an expense for a slight change, and allowing every one to use all his own *matériel*.

The emulsions come packed in cardboard boxes that contain a package of black paper in folds. (Fig. 1.) Between the folds of this paper are inclosed the sheets of emulsion, which are glued to it by their lower edge, and are thus protected



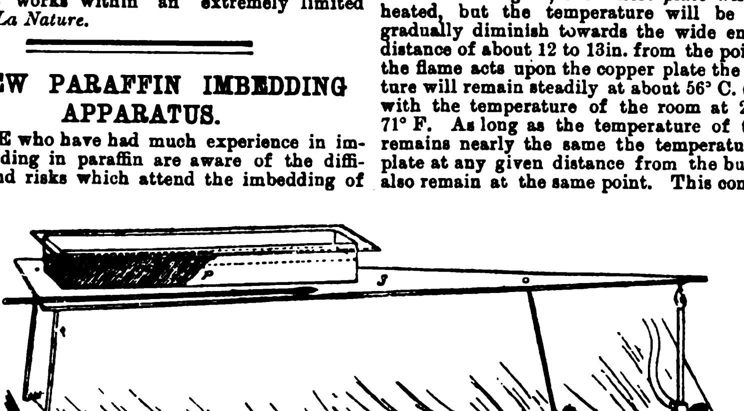
on both faces. The frame consists of a sort of box sufficiently deep to hold one package of emulsions, which a movable board with a regulating screw permits of holding against a very clear piece of glass set into the back of the flap door of the apparatus, and corresponding exactly to the plane of the focus (Fig. 2). After the package of emulsions has been put into the box, the first sheet of black paper is passed through a slit and made to engage with a groove in the axis of a winch, that permits of unwinding it from the exterior (Figs. 2, 3, and 6). Each sheet of black paper is provided with a hole, through which runs a verticl rod (indicator), whose head is visible on the outside. When the paper is rolled up, so that a sheet of emulsion is in place, and ready for exposure, the rod falls into the hole and shows that the winch has been turned sufficiently. When, after an exposure, it is a question of removing the plate that has been exposed and of substituting another for it, it is only necessary to raise the indicator so as to free it from the hole, and then to turn the winch until the indicator falls into the succeeding aperture. This brings the next plate into position. This process goes on until the exhaustion of the package, which contains 12, 24, or 36 plates, that permit of taking on the same excursion just as many negatives with one frame and without having recourse to a laboratory.

Upon returning home, the emulsions that have been exposed are taken out through the back of the frame by unrolling them, and it is possible either to continue with those that remain, if the package has not been exhausted, or to put in another package if the first has been all used up. After all the usual operations of developing and fixing, the negatives are immersed in a peculiar solution of gelatine, which, after they are dry, gives them strength and extreme flexibility. They are then spread out upon very clean glass to dry. The plates after this have the appearance of absolutely transparent paper, and possess the flexibility and strength of taffeta, and can be sorted out without any danger of their being torn. The negatives can thus be placed between the pages of an indexed register, and be stored with numerous works within an extremely limited spaces.—*La Nature.*

A NEW PARAFFIN IMBEDDING APPARATUS.

THOSE who have had much experience in imbedding in paraffin are aware of the difficulties and risks which attend the imbedding of delicate objects on account of the danger of over heating the imbedding mass. The trouble with thermostats, or heat-regulators, is that they get out of order and give trouble, aside from the difficulty which arises from the variations in the pressure of the gas in the pipes which supply the burners, and which is entirely beyond the control of most forms of the thermostat. To avoid this, Dr. C. S. Dolley, of the Biological Department of the University of Pennsylvania, began a series of experiments with copper bars, which were heated at one end by means of a Bunsen burner, so that the heat conveyed by conduction to the remote end of the bars gradually diminished in intensity because of its being constantly radiated into the surrounding air, according to well-known laws stated in the textbooks on physics. It was found that, with the room at an approximately constant temperature, there was a point along the bar, at a certain constant distance from its heated end, where the temperature of 55° C. could be maintained, and where, if there was placed a copper cup filled with hard paraffin, the latter could be kept just at the point of fusion for a long time without endangering the objects to be imbedded. These results showed that it was possible to utilise an apparatus of this type for imbedding purposes. That led the writer of this to begin a set of experiments with a very simple modification of the foregoing type of apparatus, with the object of getting rid of the usual water-bath entirely in the process of imbedding, and to also use the paraffin itself as a means to indicate how far away from the source of heat it would be safe to allow an object to remain while it was being saturated.

The object was effected in the following manner: A triangular sheet of copper, slightly less than $\frac{1}{16}$in. thick, 18in. long, and 10in. wide at one end and running to a sharp point at the other, as shown at *s* in the accompanying figure, is supported horizontally upon two legs at the wide end, and at some distance from the pointed end by another leg, these three legs constituting a firm tripod base for the whole device. Under the pointed end of the triangular plate of copper is placed a small Bunsen gas-burner, with an aperture of about $\frac{1}{8}$in., and connected with the gas-supply of the building by means of a rubber tube. If the flame is allowed to burn steadily at about half its full force, and permitted to play upon the copper plate at a distance of about 1in. from its extreme point, as shown in the figure, the whole plate will soon be heated, but the temperature will be found to gradually diminish towards the wide end. At a distance of about 12 to 13in. from the point where the flame acts upon the copper plate the temperature will remain steadily at about 56° C. (133° F.), with the temperature of the room at 22° C., or 71° F. As long as the temperature of the room remains nearly the same the temperature of the plate at any given distance from the burner will also remain at the same point. This constancy is due to the fact that the heat which is conducted through the copper plate with constant rapidity from its source—the burner—is radiated into the surrounding air at an equally constant rate, and, as one passes towards the wide end of the plate from the burner, trials with the thermometer show that there may be found an infinite number of points in succession at which the temperature is very nearly constant.



In order to use the paraffin itself as an indicator of the proper temperature, and in that way dispense with a thermometer altogether, if desirable, it was necessary to use a new type of cup in which to melt the paraffin. The paraffin-cup or trough, *p*, shown in the figure, is made of copper, tin-lined, and is 6in. long, 1¼in. wide, and 1¼in. deep. In practice the cup is half-filled with paraffin and placed lengthwise on the copper plate, with its narrowest side towards the flame, and about 9in. from it, as shown in the cut. The paraffin-cup may be covered with a strip of glass to exclude dust. If the burner plays upon the plate as directed, and the trough is in the proper position, in about an hour it will be found that the paraffin in the trough has been melted at the end nearest the burner, but has remained congealed at the other. Moreover, it will be found that the point where the melted comes in contact with the nearly frozen paraffin is very constant, and it is just at this point where it is safe to place objects which are to be imbedded. The paraffin which remains congealed in the trough is represented in the cut by the shading at the remote end of the trough, the clear space below the dotted lines nearest the flame indicating the portion which remains molten.

It is clear, from what has preceded, that a shorter cup or trough filled with soft paraffin melting at 36° C. may be placed still farther away from the burner, alongside of the vessel containing hard paraffin fusing at 56° C., while mixtures of turpentine and paraffin, or chloroform and paraffin, would remain molten at a still greater distance from the flame.

The applications and possibilities of this new device will be readily appreciated by histologists and embryologists, since it can be quickly seen if objects are in danger from overheating by simply noting whether the point where the paraffin remains molten in the trough has advanced farther from the flame. This can be easily observed through the transparent cover of the trough.

For large laboratories, where a number of students are engaged in imbedding, a simple modification of this device suggests itself. For such a purpose a horizontal disc of sheet-copper, of the same thickness, but 3ft. in diameter, would afford room for a large number of paraffin imbedding-troughs, which could be arranged in a circle around and some distance from the centre, at which point a larger burner would be applied underneath. The temperature in such a device would diminish from the centre towards the periphery of the disc. The troughs would be placed upon different radii upon the surface of the disc, just as two or three troughs may be placed upon different radii of the triangular plate, which is practically the sector of a disc, as described above. For imbedding delicate objects, small cups made of tinfoil, pressed into shape in circular, taperin moulds, may be satisfactorily employed with th apparatus, in the same way as the trough Ti device described above can be made by an , of smith for about two dollars.—*John A. Ry* ans. "*American Naturalist.*"

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evening, we do so at the exp give my ex imbedded
of the heat we decide to pre dy on mysel out. The
are thus brought into opera fit my patien reintroduced
plants and retarding thei most his life.
endeavour to urge forwa diminishin hined by the
evaporation and radiat I think i d steel cutters

Evaporation is the operation to be studied in
the dryness of the ous syste culty whatever in
active when the nece worry, or needed for the two
urgent; but evapora distressi model mandrel-head.
producing cold, an mornin sed, as it stands being
the rapidity of the t to think cylinder-base, if gauged
points out the r can give f an inch will answer
greater capacit ey relief.— linder-fit would admit an
sensible in the r chuck which, at its outside,
and the temper andth of an inch; that is to
up the temp which is possible between.
supplied by CTRIC chuck-recess.
is the practic INS erlooks the fact that we h
air is dry fr —I HA le cone but a true cone that an
goes on b siderabl bw, in order to enc rubbed on
falls, and althou rid of bad ones, we will keep the
sun's ra varior ith such surface le to cust light (?)
growth sion is verify for him essential ice of same
more we

in apparently arid soil, which have been allowed to take their chance.

The other source of diminished temperature we referred to was radiation. Every warm body tends continually to throw off its heat to all other bodies of lower warmth, near or remote. But radiation in meteorology is more particularly confined to "the radiation of heat from the surface of the earth and objects on it into a clear sky." We know that all objects do not radiate heat with equal rapidity: rough surfaces do it more readily than smooth, and dark surfaces than those of a lighter shade of colour. If we apply this knowledge to the process of watering, we shall find that almost all soils are darkened in their colour by moisture, and therefore by the practice of evening watering we put the soil into the best possible condition for getting cooled down during the night. It is thus that the combined influence of evaporation and radiation exerts itself in thwarting the very desire of such as thoughtlessly practise evening watering, although we know it is too frequently believed that, so long as plants get water, it is entirely a matter of indifference when it is applied. On the other hand, by adopting morning waterings, there can be no doubt but that evaporation will go on much more freely, but the atmosphere is becoming warmer instead of colder, and the sun's rays exert their counteracting influence. The darkened surface of the soil——that very condition which makes the ground throw off its heat more readily during the night—causes it to imbibe the heat of the sun's rays by day with increased facility, so that we have the greatest amount of the fostering agencies of heat and moisture for successful plant growth. Artificial waterings, to be most effective, should be copious and abundant, and applied either in early or during a dull day. Water that has been previously exposed to the sun's rays is always preferable to that freshly obtained from a cold tank or well, owing to the chill imparted to the circulatory fluid of the plants by the application of such low temperature water.—*J. J. W. in the "Gardeners' Chronicle."*

ARSENICAL WALL PAPERS.

THIS appears to be the season for all sorts of alarmist reports to be spread by the papers, and the following in the *Lancet* is worth reading, if only to compare it with an article which we gave in No. 1,013, p. 553 :—

It is well to give a note of warning that, in spite of utterances to the contrary, many of the gaudy-coloured wall papers are contaminated with arsenic to a not inconsiderable extent. It has been known that certain shades of green are made with arsenical pigments, and that "flock" papers with a rough surface are peculiarly dangerous from the liability of the flock to be rubbed off and disseminated as a fine dust in the air. This is so generally
and so well understood that there can be but little
ale for papers of the "green flock" type. An
senical pigment is one in which the element
the writer enters definitely into the composition of the
fortunately compound. The green compounds of arsenic
ductions; fer and the yellow and red sulphides of
made for Kei, true arsenical pigments, and as such are
enough; the dangerous. The danger is not limited
two grains of ndy colours, and it is well to be aware
large r that acid is used in the preparation of many
togeth as the nich are not properly "arsenical." In
other. But, had as an oxidising agent, and is often
ticting, I cann removed from the manufactured
opinion is that ic acid is used largely in the prepara-
electricity in the pigments," and is often present in
between the point of as an impurity" caused by care-
the glass; glass bein octure; but whether arsenic be
ductor of heat, and the ness or intention is a matter
nothing to absorb the to the sufferer. It is well to
a minute fracture, and olour of the paper is no guide
arising at intervals fo ted with arsenic. It is liable
along the cut, for if we tu in papers of all shades and
light, we find a line of lig own as "fuchsine" is stated
regularly entering the body dwig to be very com-
shows the differences betwee by arsenic, and they
cut. This line of light clear imens bought by them
fracture in the glass, the light e from arsenic. In
the edge, thus the piece of own as "magenta" is
separated the width of that lin owing to the very free
be, for the light could never be xidising agent in the
Sometimes when the glass is th short, arsenic is so
lutely goes right through. A cut uction of pigments
he has got the cut by the musical h tially "arsenical,"
out as he draws the diamond along, necessary before
found on close examination that th for decorative
very regular, like the teeth of a fine of arsenic is not
the detonation of these minute fractur rsons possessing
the musical note, and thus arises the mistry. As a
'sweet cut.' That electricity is generat as Reinsch's
the point of the diamond and the surfa ts in boiling
glass, cannot be doubted, for when w ith distilled
diamond with a coarse cut, minute films and pure
are thrown aside by the diamond, and as th nto which
on the glass seem alive with electric act troduced.
would add here that it is my opinion that gla l be de-
annealed would be better isolated than the ann
I gather this from the manner that a gla

posited on the copper. This is not conclusive as to arsenic, as some other metals will also cause a film to be deposited on copper under these circumstances. As a confirmatory test Marsh's apparatus may be used. Hydrogen is generated by acting on *pure* zinc with *pure* distilled water and pure sulphuric acid. To the mixture is added a decoction of the suspected paper made by boiling with pure hydrochloric acid. If arsenic be present, arseniuretted hydrogen will be formed, which burns with a bluish-white flame and deposits a film of arsenic on a cold porcelain surface introduced into the flame. Certain confirmatory tests would be necessary to be sure that the deposit is not due to antimony. Antimony, however, is not a common impurity of pigments, and we shall not be wrong in advising that any wall papers which, when treated as we have directed, give a film on porcelain should be at once discarded. If a wall paper which is already *in situ* be found to contain arsenic, it should be removed, or, if this be not practicable, it should be sized and doubly varnished, and the varnish should be renewed every year or so.

A WOOD-TURNING JOB: WHAT AN AMATEUR CAN DO—HOW TO PUT THE JOB IN THE LATHE.*

AMATEURS often cause an experienced workman to laugh at clumsy methods and ill-chosen ways; but the "thoroughbred" amateur often has cause to smile at the professional himself on account of that worthy's proclivity to stick to old and outgrown methods, rather than to adopt new and better methods which the "dizzy amateur" himself has discovered and worked up to little better than perfection. In some arts, professions, and even sciences, the amateur has been the direct means of bringing his particular study to its present state of perfection. Very likely astronomy would have gone begging had it not been for amateurs. Photography owes its greatest advance to the same class of workers, and wood-turning itself has been brought to a high degree of perfection (fancy turning has) by the same amateurs, some of whom are laughed at for their clumsy methods of going to work, and their ineffectual attempts to bring shape out of a mass of crude material. If a young chap desires to learn something about wood-turning he can do it just as easily as he can learn to hammer iron, as told in a previous article on learning blacksmithing. The first step is to get the tools in order. Select a plain chisel and a plain gouge. Let the chisel be 1½in. or 1¾in. wide, one corner ground back to an angle of 70° or 75°, and both sides bevelled alike, the cutting edge of the tool forming an angle of 20° to 25°.

The bevel on a 1½in. chisel should be at least five-eighths of an inch long, and must be ground perfectly flat. If a very small stone—say, 12in. or 14in. in diameter—can be used, so much the better, for then a slight concavity can be given to the bevel, a point greatly appreciated by the good turner. Let the chisel be ground in the same manner as given for grinding a plane iron, except that both sides must be ground and bevelled alike; then the edge must be set on an oilstone, much as for planing. Next select a gouge. Get one which is cut to 1¼in. or 1½in. circle. Grind the gouge on the outside, cutting both corners back seven-eighths or three-fourths of an inch, then grinding the gouge with a bevel three-fourths or seven-eighths of an inch long, according to the thickness of the metal in the gouge. A round edge "slip" of Arkansas stone will be necessary for setting an edge on a gouge, but all the whetting should be done from the outside, and just the least possible touch given to the inside of the gouge with the round slip—just enough, in fact, to remove any trace of a feather edge which may have been raised there by unskilful grinding and whetting.

After both chisel and gouge are sharp—never use them dull, and other tools will not be required by the learner at present—select a piece of square wood, anywhere from 2in. to 4in. in diameter, and place it between the lathe centres. First prepare the work by centring it. To do this, open a pair of dividers a distance approximating the diameter of the work, and then, with the work lying on a smooth surface, scratch the end of the wood keeping one leg of the dividers exactly perpendicular to the other. After marking, turn the piece a quarter of a turn and mark again, then turn and mark until all four sides of the stick have in turn been presented to the flat surface and marked by the dividers. It matters not whether the dividers be opened less or more, or exactly half the diameter of the stick, for if they are opened more or less, a small square will be contained between the intersection of the lines, and the eye can quickly locate the centre of this small square, and also do it with great exactness.

When hard wood is used, the centres should be drilled or bored slightly, for so doing will permit the centre and the dog to take a firm hold. If pine wood is used, the centre hole boring may be dispensed with, and one end of the wood being placed against the dog, taking care to put the paint thereof exactly in the centre of the little square before described; the tail spindle of the lathe may be adjusted to the other end of the wood in a similar manner, and both dog and tail spindle forced into the wood by screwing up the tail spindle. Sometimes it is necessary to force the dog more deeply into the wood by tapping the wood with a hammer or the edge of a turning chisel, taking care to strike directly in line with the axis of the lathe. After the piece of wood is adjusted firmly, yet loosely, that it may run without burning the wood around the "dead centre," as the tail spindle is often called, a drop of oil is put between work and centre, and the rest adjusted. Slide the rest up to the work so that it will just barely clear the work when the lathe spindle is slowly revolved by hand. Now clamp the tool rest firmly, pick up the gouge, and get ready to make the shavings fly. Don't try to jam off a lot of wood in a hurry, but put the gouge against the rest, and advance it toward the work until a small shaving is cut off. Don't push the gouge square against the wood, but lower your hand until the gouge touches the wood too far back on its bevel to cut. Now draw back the tool until a cut is effected, and the gouge prevented by the rest from going too deep into the work. Practise this point, just clipping the corners off the wood, and keep trying it until next week; then the writer will tell how to turn off the corners, and get the work as smooth as a rolling-pin.

CYLINDER CONDENSATION AND THE REDUCTION OF THE SAME BY THE USE OF THE COMPOUND ENGINE.*

IN connection with the paper submitted herewith on "The Development of the Compound Engine and the Probable Limit of Steam Pressure in Marine Engines and Boilers," the question will naturally be asked by those who have not particularly investigated the subject, Why is it necessary to use the steam in a compound engine with a number of cylinders rather than in engines with single cylinders, the joint capacity of which, as is easily shown, need only equal the capacity of the low-pressure cylinder or cylinders of the compound engine? The reason of this was pointed out by the writer in the *American Artisan* of March 8, 1871, and the subject of "Cylinder Condensation" was considered in an essay which was embodied as a preface to the descriptive matter of U.S. Patent No. 70,707, dated Nov. 12, 1867, on the subject of the use of non-conducting linings in steam cylinders. It has been thought that at this time a brief account of the experiences and considerations which led to the writing of the articles referred to will be interesting to many, and perhaps excite discussion and draw out much useful information on several important details of the subject. The writer, from 1863 to 1869, then an assistant engineer in the U.S. Navy, was engaged in New York in making experiments under the general direction of Horatio Allen, Esq., and B. F. Isherwood, Engineer-in-Chief, U.S.N., designed to show whether or not there was any considerable gain in the expansion of steam—the first named gentleman being an earnest advocate of expansion, and the one last named claiming that it had a very limited value. As is well known, Mr. Isherwood had, previous to that time, earnestly described in his writings the very considerable condensation of steam which takes place in a steam cylinder, and in a comparatively recent article in the *Journal of the Franklin Institute*, he claims to have been the first to call attention to that subject. Without disputing this claim, and at the same time acknowledging with gratitude valuable suggestions from him as to the proper direction of study, the writer desires to claim to have been the first to show that all of the cylinder condensation, independent of that due to the transmutation of heat into work, is fully accounted for by the heating and cooling of the metal walls of the cylinder. Mr. Isherwood clearly referred to such heating and cooling, but in an elaborate discussion went on to show that that cause alone would be insufficient, and he accounted for the greater part of the condensation on the supposition that during free expansion there is a loss of heat and consequent condensation, due to what he terms "expansion *per se*," independent of the heat transmuted into the work done. This supposed loss the writer never could understand, and never expects to. As the total heat of steam at a high pressure is a little greater than at a lower, the free expansion of steam without doing work should result in superheating and not condensation, and the only heat which can be extracted during the performance of work is that due to such work at the rate of 772ft.lb. per British thermal unit. The maximum work possible is proportioned to the absolute pressure, and therefore the heat abstracted in the performance of the work is simply a function of such pressure, so that the ordinates of the adiabatic curve of expansion, or that in which the loss of heat due to the performance of work is considered, decrease more rapidly than in the inverse ratio of the volume, according to Mariotte's Law. Rankine states that the decrease of pressure is proportioned to the minus ten-ninths power of the volume. The actual curve of expansion of steam-engines varies somewhat from this, according to differences in condition, but this general method accounts perfectly for the heat transmuted into work. This heat is derived partly from surplus sensible heat due to steam of a high pressure expanding to a lower, and the deficiency is supplied by a slight condensation of the steam, and there is no possibility of any further loss due to the "expansion *per se*" of the steam itself. To settle this and other questions, the writer, in the year 1867, constructed two small cylinders or chambers without pistons, one of glass and the other of iron, of exactly equal capacities, and carefully felted, each of which could in turn be connected with a valve operated regularly by an engine to admit steam from a boiler to the cylinder, and permit its exhaust to a condensing coil. The exhaust opened slowly at first and rapidly afterwards, so that the pressure in the cylinder would approximate that in an ordinary steam cylinder. The result was that the condensed steam from the iron cylinder was, in nearly every instance, fully double that from the glass cylinder. In this case there was no possible change in condition except that due to the material of which the metal walls were composed; whence the writer concluded that the losses from cylinder condensation found in practice could be attributed entirely to the heating and cooling of the metal walls, and that the "expansion *per se*" theory of Mr. Isherwood was unnecessary.

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* By JAMES F. HOBART, in the *Manufacturers' Gazette*.

* By CHAS. E. EMERY. A paper presented at the Washington meeting of Mechanical Engineers.

Mr. Isherwood considered that when condensation took place in the mass of the steam, the water would be suspended in the form of a cloud, and would not be affected by the temperature of the metal surfaces. This the writer explained in 1867—by reference to Tyndall's experiments, who points out in "Heat—A Mode of Motion" that the amount of moisture ordinarily contained in the atmosphere has seventy times the absorptive effect, in relation to latent heat of dry air. Steam chilled by the performance of work or by reheating metal walls previously cooled during the exhaust stroke contains minute particles of water with a great capacity for heat and almost instantaneously absorbs that necessary for their re-evaporation from the surrounding walls, and this action is at a maximum when the exhaust takes place, when all the heat absorbed is carried to waste. Upon the above basis the writer in an article in the *American Artisan* of March 8th, 1871, explained the gain found in a compound engine on the basis that the quantity of heat which will be transferred from a radiator to an absorbent, would vary as the square of the difference in temperature (the conditions being practically the same as those of force performing mechanical work in overcoming resistance). If, therefore, the metal wall of a cylinder, originally heated to a temperature of 320° by live steam, were during the exhaust subjected to a temperature of only 140°, the same metal surfaces would be exposed to a difference of temperature of 180°; whereas, if the cylinders were so arranged that the work was done in two cylinders instead of one, with 90° difference of temperature in each, the condensation per unit of surface in the compound cylinders would be, say unity, or considering the increase of surface, say in effect twice unity, or two; whereas the rates of condensation in the single cylinder would be at the rate of two squared, or four. In other words, the double cylinder would save one-half the condensation. Now, as in practice about one-half of the total quantity of steam used is condensed in the cylinder at high degrees of expansion, the amount saved would be about one-half of this, or say 25 per cent. This rough explanation made at that time approximates the fact. On the same basis, there should be greater saving by dividing the difference of temperature into three or more parts; but the complication resulting from the multiplication of steam cylinders and their connections, is not in practice warranted, without raising the steam pressure. The later developments are in the way of permitting the low-pressure engine, and intermediate cylinder of a triple compound engine, to do about the same work as the two cylinders of the ordinary compound engine did formerly; then to add a third cylinder to be supplied with steam at a higher pressure, to be expanded down to substantially that formerly used in the high-pressure cylinder of a double-expansion engine, which now corresponds to the intermediate cylinder of the double-expansion engine. Steam which has been reduced from a higher to a lower pressure by expansion is just as valuable for all purposes as if such lower pressure were obtained from a boiler direct. We say the steam is equally valuable. This does not include the water due to the expansion and to internal refrigeration. This should be removed or re-evaporated, by a system of steam jackets, or the full benefit of the high pressure and expansion cannot be obtained. On the same basis of reasoning, evidently steam of still higher pressure could be expanded in a still smaller cylinder, and the steam from this supplied to the small cylinder of the triple expansion engine and in this way quadruple, and, by repeating the operation, quintuple expansion engines might be formed, did not practical considerations interfere.

USEFUL AND SCIENTIFIC NOTES.

Electrical Conductivity.—A paper on "The Electrical Conductivity of Solid Substances at a High Pressure," by L. Graetz, is given in abstract in the *Journal of the Chemical Society*. Hitherto our knowledge of the conductivity of electrolytes is derived for the most part from results obtained with the substances in the dissolved and not in the fused condition. The only generalisation at present deduced is that solid substances are not conductors at low temperatures, but their conductivity commences at temperatures far below the melting point, and increases with the temperature. If then this increase of conductivity is due to an increase of molecular mobility and of the number of molecular impacts, increase of pressure without alteration of temperature should be effective to a like degree. In the paper, this point is examined by means of a compression apparatus, capable of giving a pressure of upwards of 4000 atmospheres. The results are given for the halogen-compounds of lead and silver, and for sodium nitrate. The substances examined are divisible into two classes, in the one of which, with application of maximum pressure, the resistance rapidly decreases to a constant point, and in the other this minimum resistance is, under the same condition, only attained after several hours. To the former class belong the halogen-compounds of silver, to the latter those of lead and sodium nitrate. In the paper full details are given of the apparatus used, and of the methods of experiments; the results are tabulated.

To Make Chloride of Gold.—According to the following, by J. B. Heyl, in the *National Druggist*, this salt can easily be prepared by druggists: "Put a half-sovereign or a 2·50 dollar piece in a small evaporating dish, using one, two, or three sizes larger as a water bath, and pour on it half a drachm of nitric acid mixed with two and a half drachms of hydrochloric acid and three drachms of water; digest at a gentle heat, but do not boil the acid, or much of the chlorine will be driven off in the form of gas. At the expiration of a few hours add fresh nitro-hydrochloric acid in quantity the same as at first, which may be sufficient; if not, repeat the process a third time. Observe that if any silver be present in the gold coin it will produce a flocculent deposit of chloride of silver, thus preventing the solution from being complete. I have found coins with platinum in them, which remains at the botton, and is easily separated by pouring off the chloride of gold after it is dissolved. Next dilute largely with distilled water, and add a filtered aqueous solution of common sulphate of iron (6 parts to 1 of gold); collect the precipitated gold, which is now free from copper; redissolve in aqua regia as at first, and evaporate to dryness. The weight of a half-sovereign is about 61 grains, of which 56 grains are pure gold. This is equivalent to 86 grains of chloride of gold, which will be about the quantity contained in the solution. The most convenient mode of keeping the chloride is in aqueous solution—1 grain to the drachm of water. I have used the above for years."

Dyspeptic Visual Troubles.—Such symptoms as tenderness of the globe of the eye brought on by the act of accommodation, associated with vertiginous attacks and intellectual torpor, or with scintillating scotoma, hemiopia, and photopsia, or even polyopia, sometimes supervene after meals, and have been ascribed to auto-intoxication by peptones, the result of defective action of the liver; but these symptoms are far more common in neuropathic subjects, and the question must remain unsettled whether the dyspepsia may not be of as neurotic an origin as the other disorders, which are clearly of nervous kind.—*Lancet*.

"THE TOBACCONIST" is a useful manual addressed by Mr. L. Friedlander, of Houndsditch, to intending tobacconists. It only costs 3d. and is wonderfully comprehensive. We notice, by the way, that Mr. Friedlander recommends "Cumarin" dissolved in alcohol for scenting tobacco in small quantities—a question often asked by our correspondents. What is Cumarin?

SCIENTIFIC NEWS.

THE discourses to be delivered at the meeting of the British Association will be "The Rate of Explosion in Gases," by Prof. H. B. Dixon, F.R.S., on the Friday evening, and "Explorations in Central Africa," by Col. Sir F. de Winton, R.A., on Monday evening. The Saturday popular lecture will be on "The Electric Light," by Prof. G. Forbes, F.R.S. As we mentioned last week, an unusual number of distinguished foreign men of science will be present at the meeting.

We have received from MM. J. C. Houzeau and A. Lancaster, of the Royal Observatory of Brussels, the first part of the first volume of a "Bibliographie Générale de l'Astronomie," which represents an enormous amount of work, and will be of value to students. The present part relates mainly to the history of astronomy and astrology, and contains, as is believed, a reference to all known printed works and manuscripts on those subjects. It is published by F. Hayez, Rue de Louvain 108, Bruxelles.

Mr. Francis Galton, as President of the Anthropological Institute, will deliver a course of three lectures on "Heredity" some time in the early part of the next session of the scientific societies. By permission of the Lords of Committee of Council on Education they will be given in the theatre of the South Kensington Museum.

A scheme for a systematic botanical survey of India has been adopted by the Government. The whole country will be divided into four divisions, under the charge respectively of Surgeon-Major George King, F.R.S., Mr. J. F. Duthrie, and the Madras and Bombay botanists. The survey, which ought to yield results of importance to pharmacology as well as to botany, has been promoted by the authorities of the Royal Gardens at Kew.

The annual International Amateur Photographic Exhibition, promoted by the London Stereoscopic Company, will be held in their galleries on October 25. The entrance fees are to be given to the Photographers' Benevolent Association.

Mr. Ludwig Mond has given £100 to the Royal Institution fund for the promotion of experimental research, and the Drapers' Company have given £105 to the research fund of the Chemical Society.

The House of Commons was engaged until three o'clock in the morning of Tuesday, debating whether the word "margarine" or "butterine" should be used to designate arti-
ficial butter. It was finally determined [illegible] of
"margarine," and the dealers in genuine [illegible] ans.
will rejoice accordingly.

As president of the Society of [illegible] milarly to
Analysts, Mr. A. H. Allen referred [illegible] ise with him.
the "Bills for Dealing with Butt[illegible] mptom of a
tutes," and stated that in his evid[illegible] ich was very
the committee he expressed the o[illegible] ourhood seven
all the proposed terms were [illegible] ever since, and
scientific; but, as "butterine [illegible] grave. There
generally accepted name for bu[illegible] al character,
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tion with the Adulteration [illegible] by the morbi[illegible] poiled
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jected to analysis. Th[illegible] n applying [illegible] phire (of
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directed by letter to the m[illegible] only on mysel[illegible] out. The
suspected milk in Derbys[illegible] fit my patien[illegible] reintroduced
Mr. Hehner and myself [illegible] most his life.
the case of either or [illegible] diminishin[illegible] ained by the
milk believed to be [illegible] I think i[illegible] d steel cutters
without delay to th[illegible] operation [illegible] to be studied in
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two independent a[illegible] worry, or [illegible] eeded for the two
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precludes all ch[illegible] mornin[illegible] led, as it stands being
the analyst, and [illegible] t to think [illegible] cylinder-base, if gauged
of checking him [illegible] can give [illegible] f an inch will answer
Somerset Hous[illegible] ey relief.—[illegible] linder-fit would admit an
and when, the[illegible] ck which, at its outside,
make any tru[illegible] andth of an inch; that is to
As an illustr[illegible] which is possible between
a recent ca[illegible] CTRIC [illegible] chuck-recess.
cent. of ad[illegible] INS[illegible] erlooks the fact that we h[illegible]
being don[illegible] —I HA[illegible] le cone but a true cone [illegible] that an
House, w[illegible] siderabl[illegible] ow, in order to enc[illegible] rubbed on
that the [illegible] althou[illegible] rid of bad ones, w[illegible] will keep the
[illegible] variou[illegible] ith such surface[illegible] ole to out[illegible] ight (?)
[illegible] ion is [illegible] verify for him [illegible] essential [illegible] ce of flame

of added water! This discrepancy is an indication of the value of the Somerset House 'allowance for change by keeping.'"

We learn from the United States that Mr Elisha Gray is busy perfecting his method of sending autographic messages by telegraph—that is, a writing telegraph, called in America a "telautograph." The chief feature is the plate on which the writing is done. No particular kind of pen or pencil has to be used; in fact, a sharp-pointed instrument of any kind, or even a piece of wood, will answer the purpose. The paper on which the writing is done and the autograph reproduced are not prepared; for, in the first instance, it is the pressure on the plate which gives the impulse to the machine, while the reproduction is brought about by a tracing point, which may be a properly-inked pen or even an ordinary lead pencil attached to a movable arm in the receiving machine at the other end of the line. At his Highland Park laboratory, Prof. Gray has made a number of satisfactory trials of this invention, and he is inclined to think the machine will be demanded in all cases where absolute accuracy in the delivery and filling of an order is required, and that it will eventually supersede the present system of telegraphic communication; in fact, that an operator will simply transcribe a message, and, while in the act of so doing, will wire it to any point on the continent, the reproduction at the other point always being a *fac-simile* of the writing of the person at the machine.

With reference to the reports of Dr. Klein and others on the communicability of scarlatina by the milk of cows, the Privy Council have called the attention of the Royal Agricultural Society to the advisability of urging dairy farmers to examine their stock frequently, and to at once give notice to the Agricultural Department of the existence of any eruption on the teats or udders of cows.

In the report of the chief inspector under the Alkali Act, reference is made to the Hargreaves's hot-air engine, in connection with the smoke nuisance. The inspector says that his (Mr. Hargreaves) efforts have so far been crowned with success that he can produce 30 indicated horse-power from a consumption of two gallons of common coal tar per hour. This, he adds, "is the highest efficiency ever obtained by actual practice in any form of thermo-dynamic engine, and also the least costly. At present prices it is equal to 20 horse-power for 1d. per hour." The fuel may be gas-tar, paraffin oil, or other liquid hydrocarbon, or it may be coal. In any case the combustion is far too complete to admit of the emission of
the lacksmoke. The combustion is carried on in
fortunatell, but intensely heated, chamber or
ductions; a the fuel being forced in under pres-
made for Ke is is a step towards the removal of
enough; the proportion of the smoke nuisance
two grains used by the fires of steam boilers,
large or that viewed as an approach to the ful-
togethas the a
otbed. But, hir F. Bramwell's prophecy that 50
thting, I canthe steam-engine will be regarded
opinion is that ed machine.
electricity in the
between the point of e on freight-train brakes of the
the glass; glass bef ders' Association of the United
ductor of heat, and than elaborate report at the con-
nothing to absorb the l in Minneapolis. We give
a minute fracture, an First, that the best type of
arising at intervals ht trains is one operated by
along the cut, for if we the valves are actuated by
light, we find a line of li that this type of brake
regularly entering the body advantages: (*a*) It stops
shows the differences betwe test possible distance;
cut. This line of light clea and their attending
fracture in the glass, the ligh
the edge, thus the piece o (*c*) It releases instan-
separated the width of that lin graduated perfectly.
be, for the light could never be whether electricity
Sometimes when the glass is th lement to use in
lutely goes right through. A cut that can only be
he has got the cut by the musical n but we think the
out as he draws the diamond along y are so manifest
found on close examination that th orth trying. In
very regular, like the teeth of a fine improvements
the detonation of these minute fractu
the musical note, and thus arises the c ic brakes are
'sweet cut.' That electricity is genera ends that the
the point of the diamond and the surfa n brakes be
glass, cannot be doubted, for when
diamond with a coarse cut, minute films
are thrown aside by the diamond, and as e of stoves
on the glass seem alive with electric act enger car
would add here that it is my opinion that gl w York.
annealed would be better isolated than the ann than 50
I gather this from the manner that a gla

miles in length, and it also allows the use of existing stoves temporarily in case of emergency, or when the car is standing still. Another law enacts that after Nov. 1, 1887. all railroad bridges shall be provided with a floor-system capable of supporting a de-railed locomotive, and also with guard rails and guard timber to prevent the locomotive or cars from running off.

It is stated that Mr. H. N. Warren produces a dense graphitoidal carbon for incandescent lamps by passing the discharge from an induction coil through a vessel containing coal-gas. The graphite forms on the negative electrode, and gradually lengthens out as the positive is withdrawn.

The Society of German Engineers, which now numbers more than 5,700 members, holds its seventy-eighth general meeting at Leipsic on August 15—17. Amongst the subjects for special consideration is a "Metric System for Screw-threads," and the lectures will include one by Prof. Zeuner on "Caloric Engines and their Cycles."

The Prussian Society for the Promotion of Industry has offered a prize of about £150 for the most exhaustive critical comparison of all kinds of existing bronze, tombac, and brass alloys, used or recommended for machinery, giving their chief properties with regard to resistance, ductility, friction at different temperatures, malleability, electrical conductivity, behaviour with acids, hydrogen and carbon sulphides, chlorine, and other strongly corrosive substances met with in practice. The same society also offers a gold medal and £250 for the best work on light and heat radiation of burning gases. The time limit in the former case is the end of 1887; in the latter, the end of 1888.

Another Inter-Oceanic Railway.—It is proposed to establish through railway communication across South America, from the Atlantic to the Pacific. Three years ago the Argentine Government constructed a line of road of standard gauge from Buenos Ayres to Mendosea, in the Andes, on the frontier of Chili, within 163 miles of Santiago, the capital of the latter country, which is already connected with Valparaiso, admittedly the most important of the Pacific ports. It is intended to extend this line of railway through the Andes, in that spot rising to a height of 20,000ft., filling up this gap of 160 miles, and thus connecting Buenos Ayres and Valparaiso and forming a line from coast to coast. At the same time another inter-oceanic highway, of equal commercial value, is contemplated, the contract for which has just been concluded between the Guatemala Government and two American contractors. The railway in question is to run through Guatemala, and to extend from Santa Tomas, on the Atlantic, to the Pacific, a distance of 275 miles. The Government of Guatemala is very anxious that the work should be completed within eighteen months, which would enable that Central American Republic to take a leading place in commerce. An inter-oceanic railway such as projected means a shortening of the route to California by over 2,000 miles.

Method of Clarifying Muddy Water.—Filter paper is dipped into a solution of 43 per cent. ferric chloride in 57 per cent. of water, and after thorough saturation is dried between filter paper. In the same way a second piece of filter paper is treated in a saturated solution of bicarbonate of soda. Now, if a piece of the yellow paper that has been treated with ferric chloride is first placed in muddy turbid water, the fluid is coloured yellow by the iron salt. Next, into the same water, a piece of the same size of the bicarbonate of soda paper is dropped, turning the yellow-coloured water into brown. Thus a ferric carbonate is formed, which absorbs all impurities. The water thus treated can be filtered through a funnel whose neck is filled with a piece of sponge. It will be as clear as crystal, and can be used as drinking water. For 1 litre (1 quart) of water about 15 square cent. (2 3-10in.) of each kind of paper is sufficient. A piece of sponge weighing 5 grammes (1-6oz.) filtered 1 litre in 3 minutes.—*Dr. E. S. Thorn, in "Wiener Gewerbe Zeitung."*

Black Varnish.—To make a good black varnish for ironwork, take 8 pounds of asphaltum and fuse it in an iron kettle, then add 2 gallons of boiled linseed oil, 1 pound of litharge, ½ pound of sulphate of zinc (add these slowly or it will fume over), and boil them for about three hours. Then add 1½ pound of dark gum amber and boil for two hours longer, or until the mass will become quite thick when cool. After this it should be thinned with turpentine to the proper consistency.

LETTERS TO THE EDITOR.

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[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆◆◆

THE OFFICE OF WORKS ON AN ATTEMPTED JOB—LETTING SCIENCE ALONE—MR. ESPIN'S CATALOGUE OF STARS WITH REMARKABLE SPECTRA—LOGARITHMS—ANTARES—FINDING THE CURVATURE OF A LENS—DURATION OF TROPICAL TWILIGHT—SOME MORE "NOVELTIES" FROM PARIS—STARS VISIBLE BY DAYLIGHT—AN UNFOUNDED TAIL.

[27590.]—THAT the very able and exhaustive report of Mr. A. B. Mitford, C.B. (as representing the Office of Works) on the question of the establishment of a "Science Museum" at South Kensington has probably had the effect of stopping another Brompton job, is evidenced by the rancour with which that report has been attacked by the Ring there, in whose private pecuniary interest the whole scheme had its origin; for Mr. Mitford has actually dared to allege in an official document presented to Parliament that the persons recommending the institution of this precious Museum are self-interested!—an assertion which seems to have driven certain soi-disant "Professors" at Brompton half-frantic, and prompted them themselves to address the Legislature in reply to so audacious an attempt to prevent them from further dipping their greedy hands into the pockets of that long-suffering idiot, the British taxpayer. All who wish to learn something of the way in which the public is plundered at Brompton can scarcely do better than obtain, read, mark, learn, and inwardly digest Parliamentary Return No. 246, Session 1886, and Mr. Mitford's second Report in reply to the self-dubbed "Professors'" remonstrance. And, in connection with the expenditure of public funds on the advancement (?) of science, the concluding words of Lord Derby's speech at the dinner given to Professor Tyndall on June 29th are full of the deepest meaning. "There is," says the old proverb, "many a true word spoken in jest," and assuredly the truth of Lord Derby's cannot be gainsaid. "It had been said," exclaimed the noble Earl, "that politicians had done nothing for science. Well, in a sense, that was perfectly true; but this much at least could be said—that politicians had let it alone. They had at least rendered it that service." Surely, these words might with advantage be printed annually as a heading to the Civil Service Estimates; for no one but those who take an active personal part and interest in scientific education and scientific research can realise the inestimable advantage they derive from being left alone by the State. Of the results of private enterprise as compared with State-directed efforts, no more instructive illustration could be found than that derivable from the comparison of the history of the recently-completed Tay Bridge with that of any one of the last half-dozen ironclads built. If science is to attain that position in this country to which (despite the drawbacks and hindrances from which she suffers) she is ever tending, it must, and will, be independently of State aid; malgré the argumentum ad ignorantiam so persistently employed by that compact ring whose hope of filling their own pockets lies in persuading the British tax-payer to the contrary.

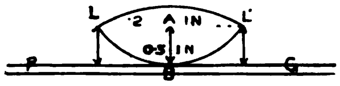
I see that the Rev. T. E. Espin, F.R.A.S., continues his very valuable Catalogue of "Stars with remarkable Spectra." This time the instalment appears in No. 2788 of the *Astronomische Nachrichten*, which contains a list of 38 new objects discovered with the Wolsingham 17¼in. equatoreal, in addition to re-observations of nine stars previously examined. I do not exactly see the utility of scattering this list over so many publications, but of course imagine that it will ultimately be collected into one volume for the use of observers of Red Stars and of those who pursue the subject of stellar spectroscopy generally.

I do not quite understand the allegation of Mr.

C. J. Woodward (quoted in your review of his little book on p. 404) that it requires *two* references to a 7-figure table to take out the mantissa of any given logarithm. I only know that I myself take out, literally, hundreds of 7-figure logs. in the course of the year, and that I never personally require more than a single reference for each. I am, of course, speaking of the logarithms of numbers containing not more than five significant figures. When there are six such figures, one additional reference must, of course, be made, with a 7-figure logarithm, to the table of proportional parts; and two references with a 5-figure table, and so on.

Dickens speaks of theatrical "stars" who come out—and go in again. Having carefully examined Antares to-night, with all sorts of powers, I can only conclude that the *comes* to that star, discovered by "M." (letter 27516, p. 412), must be included in this category. The fact is, that your correspondent should communicate his observation to the Society for Psychical Research, as he has seen a "ghost." The next time he picks up an 8th Magnitude Companion 15″ off α Scorpii, I strongly advise him to try the experiment of rotating his eyepiece.

The most accurate way in which "Solar Radiance" (query 62681, p. 424) can obtain the radii of curvature of a biconvex lens is by means of the spherometer, described and illustrated in letter 16964 on p. 8 of Vol. XXXI. of the ENGLISH MECHANIC; but as it is extremely unlikely that he will be able to get the use of this very delicate instrument, he may, I think, obtain a very fair approximation indeed to what he requires by laying the lens whose curvature he wishes to determine on a flat sheet of plate glass, and measuring its diameter accurately, as also the height of that part of its periphery, on which the diameter was measured, from such sheet of glass. Then a simple calculation will give him the diameter of the circle of which the surface tangent to the plane forms part. For example, in the figure following, we



have a lens L B L′ with surfaces of different radii, with its most convex surface resting on a glass plane P G. Suppose this lens to be 2in. in diameter at L L′ and at those points 0·5in. above P G. Then L L′ is the chord of the arc L B L′ and A B its height, and we have only to divide the square of half this chord by the height to find the rest of the diameter of which A B forms a part. Half the chord L L′ obviously equals 1in., and $1^2 = 1$. Dividing then 1 by 0·5 we get 2in. as the length of the remainder of the diameter, its entire length of course amounting to 2½in. In other words, the radius of curvature of the surface L B L′ = 1¼in. Turning the lens over on to its other face, we now repeat this simple operation, and find its curvature in the same way.

I have no doubt that the discrepancy to which "Reymond" refers in query 62693 on p. 424 between the statements made by "E. L. G." and myself as to the duration of tropical twilight, and the allegations he finds in Mr. Johnston's book on "The River Congo," has its origin in the fact that what an astronomer calls twilight, and what is so designated by the ordinary observer, are two very different things. The astronomer does not admit that twilight ceases until the last vestige of light vanishes on that point of the horizon vertically over the sun. To the mass of mankind it is night as soon as ever they can see Arcturus, Vega, α Cygni, or other stars of similar brightness.

One does not often meet with a better illustration of the aphorism of the American sage, "There's nothing new, and there's nothing true—and it don't much signify," than that afforded by M. d'Abbadie's paper read before the French Academy of Science, and reported on p. 436. The Dipleidoscope has been made and sold by Dents for many years, and was described and illustrated in more than one of the early volumes of the ENGLISH MECHANIC; while a description of the lens and the five wires will be found in Airy's "Ipswich Lectures," delivered and published long before multitudes of those who will read these lines were even born.

The experiments made at the Watson Solar Observatory in 1882, to which Mr. Sadler refers in letter 27556 (p. 436), appear to me to have been of a most mysterious nature; inasmuch as, if I understand Prof. Holden rightly, he looked at the Pole Star in an effort to discover Vulcan! I have further read the two statements in the *Astronomical Register* which Mr. Sadler quotes. The first one clearly refers to the visibility of stars in bright twilight when viewed from a position in which but a very limited area of the sky is visible, and may very well be true. The second one, I am constrained to admit, is (if I may be allowed to coin an adjective *pro hac vice*) decidedly "Rider-Haggardy."

I can only suppose that "E. L. G." (letter 27582, p. 442), has gone on talking about comets exerting influence upon the earth until he actually believes it himself! But really the calm way in which he begs the whole question (*loc. cit.*) is most amusing. Possibly we have run against, into, and through comets, and shall continue to do so; but what is required is *proof* first of only one of such encounters, and next, that any definite result has followed it. Despite some former stuff about a watery comet, no single comet yet examined spectroscopically has shown a trace of aqueous vapour. Nor is there the slightest warrant or authority for predicating the existence of such a body in the visible universe. It is a very stale polemical device to tacitly assume the existence of something of one's own invention, and then to proceed to argue as though such existence was indisputable. I say this much by way of caution, lest some readers of "E. L. G.'s" letter should be led to imagine that the influence of comets on the physical condition of the earth is a fact admitted by astronomers and geologists, when precisely the reverse is the case.

A Fellow of the Royal Astronomical Society.

EXERCISES IN PRACTICAL ASTRONOMY FOR BEGINNERS.—III.

[27591.]—3.—AZIMUTHAL ERROR.
Due to the pivots not being east and west.
To determine the error
(1) By transits of two stars.

FOR AZIMUTH ERROR.

.........................188
Lat. = ° ′ ″
Collimation error (x) =
Level error (y) =

LOW STAR.	HIGH STAR.
dec. (δ) =	δ_1 =
ZD =	ZD_1 =
For effect of $x = \theta_1$	
$\frac{\sec.\ \delta}{15}$ =	
x =	
θ_1 =	
For effect of $y = \theta_2$.	
$\frac{\cos.\ ZD.\ \sec\ \delta}{15}$ =	
y =	
θ_2 =	
Obs. Transit =	
$\theta_1 + \theta_2$ =	
Cor. Trns. (t) =	(t_1) =
RA (T) =	(T_1) =
T − t =	$T_1 - t_1$ =

$(T - t) - (T_1 - t_1) = \quad = \Delta$

$\frac{\sin.\ ZD.\ \sec.\ \delta}{15} =$

$\frac{\sin.\ ZD_1\ \sec.\ \delta_1}{15} =$

(″ = z).

As z and Δ are ± the deviation is $\frac{E}{W}$ of south.

Observe the transits of a star of high and a star of low declination and note the times.

Circle of instrument east.

Then after correcting for known errors,

$$\frac{\text{apparent clock errow by low star} - \text{same by high star}\ (\Delta)}{\text{effect of azimuthal error on low star} - \text{effect of same on high star}} \div = \frac{\Delta}{\text{sin. ZD. sec. dec. low star} - \text{sin. ZD. sec. dec. high star}}$$

= error expressed in time.

Correct the times for collimation and level errors (see application of uncorrected errors).

Subtract the corrected times (t t′) from the respective RA of the stars (T T′).

Subtract $(\overset{\text{high star}}{T' - t})$ from $(\overset{\text{low star}}{T - t})$ giving Δ.

As Δ is ± the deviation is $\frac{E}{W}$ of south and error ± for stars south of zenith and below pole.

Subtract $\frac{\text{sin. zenith distance} \times \text{sec. declination}}{15\ (*)}$ of high star from the same of low star (see Table I.) [The value of this quantity is given for every degree of declination in the table hanging in the computing room, calculated for the latitude of the place.]

Divide Δ by remainder, giving azimuthal error (z) in seconds of arc.

To correct this error.

Move the movable pivot in azimuth by the screw.

4. *Reduction to mean wire.*

It may happen that the transits over one or more of the wires are obscured by clouds, and it becomes necessary to correct the mean of remaining transits by such amount as will make the observation equivalent to the mean of all the wires.

Also in correcting for collimation error, it is in the first place found with reference to the central wire, and since the mean of the wires is the result in an observed transit, the distance of the central wire from the "mean wire" requires to be known.

The value of the equatorial interval from each wire to the "mean wire" (i.e., the time required by a star on the equator to traverse the interval) is therefore required to be found.

To determine the Equatorial intervals:

FOR VALUE OF EQUATORIAL INTERVALS.

					 188	
Star		Dec. °	′		Circle East.	
Wires	1	2	3	4	5	
	+	+	±	—	—	
Mean of wires—Transit over each wire. =						
=						
=						
=						
=						
Mean =						
cos. declination =						
Equatorial intervals =						

Find in the book of transit forms (Transit 1), a number of transits of any star, circle east. Subtract the times of transit over each wire from the mean of all the wires.

Take the mean of the several intervals obtained for each wire.

Multiply the intervals so obtained by the cosine of the declination of the star, giving the value of the equatorial interval of each from the mean wire.

This process should be repeated in order to get an accurate value.

To apply the above Reduction—i.e., to correct the mean of wires in an observation in which the transit over one or more wires is absent.

TO REDUCE A TRANSIT TO THE MEAN WIRE.

.... 188
Star Dec. ° ′
h. m. s.
Mean of transits over wires Nos. =
+ —
Equatorial intervals =

Sum of + intervals =
Sum of − intervals =
Mean of intervals =
sec. declination =

Mean of wires =

Corrected transit =

Add together the equatorial interva ... mean wire of the wires used in the obs...
Divide by the number of wires.
Multiply by the secant of the D... Star.
Add the product to the mean o... observed transit.

THE EFFECT AND APPLICAT... RECTED ERRORS; AND OTHEP...

Collimation error (x).
Its effect (θ_1) varies with the ... clination of the star: if the ... pole and x is positive, the t... meridian and the star tra... star is north of the pole it ...
It is applied to the obs... multiplied by the secant ... star and divided by 15 ...
For transits below ... of x.
Level error (y).
Its effect (θ_2) v... zenith distance of ... of its declination. ... and y is positive, t... star transits too e... pole it transmits
It is applied ... multiplied by ... star, and divi...
For transit
This error—I ha... a maximum ...
Azimut ...
Its eff... varior ...
distance ... ion is ...

, of
16 ans.
imilarly to
ise with him.
mptom of a
ich was very
ourhood seven
denly, and has
ver since, and
grave. There
al character,
ity of the aud ... ith
of air throu ... the
by the morbi ... spoiled
te crys-
phire (of
imbedded
out. The
eintroduced
ined by the
d steel cutters
operation to be studied in
ous syste ... culty whatever in
, worry, or ... eeded for the two
distressi ... model mandrel-head.
mornin ... led, as it stands being
t to think ... cylinder-base, if gauged
can give ... f an inch will answer
relief ... inder-fit would admit an
uck which, at its outside,
ndth of an inch; that is to
which is possible between
OTRIC chuck-recess.
INS ... erlooks the fact that we h...
cone but a true cone ... that an
siderabl ... w, in order to enc ... rubbed on
althou ... rid of bad ones, w ... will keep the
ith such surface ... to ... ght (f)
verify for him ... essential ... ce of flame

(*) The division by 15 here causes the error to come out expressed in arc.

declination. If the star is south of the zenith and z is positive, the pivot is north of east and the star transits too early. If the star is between the zenith and pole it transits too late. If north of the pole, too early.

It is applied to the observed transit after being multiplied by sin. Z D × sec. declination of the star, and divided by 15 to express it in time.

FOR DETERMINING CLOCK ERROR.

(For correction of observed Transits.)

..................188

Collimation error (x) =   ° ′ ″

Level error (y) =   Latitude =

Azimuth error (z) =   Circle of instrument East.

Star Declination (δ) Zenith dist. (ZD)			
$\frac{\text{sec. }\delta}{15}$ =			
x =			
θ_1 =			
$\frac{\text{cos. ZD. sec. }\delta}{15}$ =			
y =			
θ_2 =			
$\frac{\text{sin. ZD. sec. }\delta}{15}$ =			
z =			
θ_3 =			
Observed Transit = $\theta_1 + \theta_2 + \theta_3$ =			
Corrected Transit = True RA =			
Clock slow =			
Sum =			

Mean of results, slow   at

For transits between zenith and pole change the sign of z.

This error vanishes at the zenith and becomes a maximum at the horizon.

To apply the foregoing corrections to an observation—

for Multiply the errors x, y, and z respectively by
ductc. d lination, cos. zenith dist. sec. declination,
made for k zenith dist. sec. declination, as the case
enough; thedivide by 15 to bring the products into
two grains add these products (θ_1, θ_2, θ_3) to the
large r that ansit.
togeth as the r special corrections for errors of the
other. But, to be added at the same time.
tating, I canating the finding of the above correc-
opinion is that l. contains, for each degree of decli-
electricity in th
between the point es of $\frac{\text{sec. dec.,}}{15}$
the glass; glass b
ductor of heat, and t $\frac{\text{cos. zenith dist. sec. dec.,}}{15}$ and
nothing to absorb the
a minute fracture, a sec. dec.
arising at intervals 1
along the cut, for if we
light, we find a line of l of use for any particular
regularly entering the bod ught necessary to print it
shows the differences betw as follows:—
cut. This line of light clea
fracture in the glass, the ligh
the edge, thus the piece o
separated the width of that li
be, for the light could never b
Sometimes when the glass is th
lutely goes right through. A cut
he has got the cut by the musical h
out as he draws the diamond along
found on close examination that th
very regular, like the teeth of a fine
the detonation of these minute fractu
the musical note, and thus arises the
'sweet cut.' That electricity is generat
the point of the diamond and the surf
glass, cannot be doubted, for when w
diamond with a coarse cut, minute films
are thrown aside by the diamond, and as t
on the glass seem alive with electric act
would add here that it is my opinion that gla
annealed would be better isolated than the ann
I gather this from the manner that a gla

LEVEL.	AZIMUTH.
$\frac{\text{ZD. sec. }\delta}{5}$	$\frac{\text{sin. ZD. sec. }\delta}{15}$
	*
	*
	0 028
	*
	Sm.

MANUAL LABOUR VERSUS GENTEEL OCCUPATIONS.

[27592.]—IT appears to me that it is not unadvisable to call attention to the question of the inordinate multiplication of clerks, and I may as well say at once that I have more especially in my mind the clerk whose sole duty is copying, said copying being deeds or accounts, neither of which require any intelligence in the copier who transcribes them with a pen. A remark and an anecdote from a friend of mine, who well understands the question, added to the interest already created in my mind and decided me to put my ideas upon paper.

She said: "I was on a visiting expedition lately to see after the welfare of some of the parish children, who had been boarded out in families by our Guardians of the Poor. One of these children was with some people who are employed in a paper mill. I went there to get from them their report of the child, and was much struck with the neat prosperous appearance of both husband and wife. Returning to the cottage, I said to the boy, 'And what are you going to be? Are you going to work in the paper mill?' 'No, ma'am, I am going to be a clerk.' 'Oh! *I* wouldn't be a clerk, there is nothing clever in being a clerk; anybody can be one who can read and write!' But I saw plainly that nothing would content him but being a quill-driver. Now, here is a parish boy for whom paper making is not a genteel enough business, so he must be a clerk because that is, in his mind, a more elevated occupation. What nonsense!" Ah! indeed, what nonsense; but this false notion is bringing hundreds and hundreds of young lads to the towns to try to find occupation in offices when they should be employed at some handicraft. Of course, I do not mean that the lad had no business to wish to be whatever he pleased because he was a parish lad—that is not the meaning I had in my mind; what I looked upon as such mistaken aspiration after gentility would have been the same had the boy been the son of the people who had charge of him. What I think such a pity is that manual handicraft should be looked down upon so much, and that a respectable artisan, say, even a mason or a plumber, should be considered the social inferior of a copying clerk. He is really in all probability far more capable than the man who has only good handwriting to recommend him. There is no intelligence required in copying deeds, the handwriting to be copied is always as easy to read as print, and it only needs ordinary care to avoid mistakes. The mason and the plumber, on the contrary, have to exercise judgment as well as care, they have to use their brains, and the difference between a good workman and a bad one is, briefly, that the one thinks what he is doing while the other goes on without thought. Then from a monetary point of view. A clerk begins very often at nothing a year, and has to stay a year at that; next year he gets perhaps 2s. 6d. per week, and so on till he gets—perhaps when he is 25—the magnificent salary of £80 to £100 per year, arriving at £200 possibly when he is 30. Let us further add that his hours of labour will be from 10 in the morning till very often 9 or 10 at night, with, if he is in a good firm, two or three nights in the week when he must work till 1 or 2 in the morning. For this he gets no extra salary. And even if he rises to be confidential clerk to a great lawyer, he is no better off in this respect. But the great majority of clerks, and copying clerks almost invariably, remain as such all their lives, and have to die in harness.

Now, let us compare this with the life of the upper rank of artisans. Suppose we take a fitter as example, a man whose business it is to put new machinery together when it has been bought, and needs to be put together and set up in the place where it is henceforth to work. It is of necessity rather a dirty occupation, but what of that?—hands were made to be used, and if they get dirty can be washed. A fitter works about 50½ hours per week only, and his pay varies with the quality of machinery on which he is employed. If he sets up spinning or weaving machinery he gets from £3 to £3 10s. per week, travelling expenses and board and lodging over and above when he is away on a job. He is usually a most intelligent man, and has generally travelled over half the world, very often picking up a smattering of the language of the natives in the different countries to which he goes, though, as one of his class told me, he has to deal largely in "signs and wonders" at first. His work is anything but mechanical, and he must be a good mechanic, with much readiness of resource. Take, again, an overlooker in a factory; he earns from £1 a week at the outset when he is about 20, till he may have at the age of 40 or thereabouts, £5 to £6 per week, sometimes even more, hours about 53 to 54 per week. The overlooker begins by having rather a dirty job, as he has to make all changes in the machinery himself, but as he gets on he gets others to do the dirty work for him, till in the end he need never soil his fingers at all. He has also much authority, which is sweet to the masculine mind, as he has to exercise supervision and restraint over all the hands under him, and, indeed, the chief overlooker of a large factory is a man whose word is law, and whose opinion carries weight in the world in which he moves.

I have taken these two as instances showing the dignity of manual labour, and it seems that these will do very well to contrast with the life of a clerk. Of course, there are many other trades and occupations which are equally worthy of mention, such as watch-makers, instrument makers, and a hundred other makers of things; compositors, too, and it seems to me that if I were a boy of the class most clerks come from, for it is a mistake to suppose that they come as a rule from the middle class, I would far rather enter some trade which would require all my faculties than sit down to be a copying clerk all my days, even though the one is genteel and the other not.

It seems to me that the proper way to educate a lad if he is to make his way in the world is to give him a speciality. Everybody who is at all educated knows the three R's and all about equally well, there is no distinction between one and another there; or to rise higher in the social scale most boys learn Latin and Greek; but how far is it useful to them afterwards? They simply learn these languages in order to forget them, except, of course, those who need them professionally. How many hundreds leave the Universities yearly after a college training, and each one the reflex of the other as far as mental attainments? Parents usually consider that they must give their boys "*a good education like everyone else.*" Having done that, they consider what shall the result of this education be made into? I think the process should be reversed, and I should say as soon as the boy is twelve years old the parents should have a good idea as to whether he has any particular bent or not, and if he has not, provide him with one. Make him something which his brothers and companions are not—this according to the rank of the parent and his money capacities. If a man is a plasterer, and he has a son, let him bring him up to be a better plasterer than his father; if the boy, on the contrary, inclines to be a carpenter, encourage him in every way to be as good a carpenter as possible. Education harms no one; the boy will be a better carpenter for every scrap of knowledge he picks up, if he be taught to turn it to account in his trade. If he learns to distinguish between a 15th and a 16th century chest of drawers, and can discourse on the chemical composition of the varnish thereupon, it may help him with ideas as to how the chests of drawers of to-day should be made, so that they shall stand steadily on their feet, and that the drawers shall not obstinately stick when one wants to open them, and refuse to shut when they are open, and that the varnish shall dry instead of for ever remaining sticky. He might also be better able to understand that a fair day's wage presupposes a fair day's work, as to which the ideas of the British workman are often of a convenient haziness from his point of view. Another suggestion is that possibly if the stokers understood the expansive force of steam, and knew what would be the consequence of half filling a boiler with cold water when it had become nearly red-hot owing to their neglect to supply it before, perhaps we might have fewer explosions. It is also a highly suggestive fact that these accidents almost always happen on a Monday morning, which is the day following Sunday. It may not be quite so suggestive to an Englishman, though, as to a Frenchman.

I think there is far too much snobbishness abroad. We have not yet grown out of the old aristocratic ideas as to the relative value of professions and trades, and the sooner we become more republican in our views the better. I might take historical ground, and show how manufactures were respected in the middle ages, and add a few remarks on the contrast in the civilisation of the burgher who lived in a comfortably furnished house and the half-savage baron who lived in a bare barrack of a castle and made raids upon his neighbours. Or I might take economic ground, and show that the man who makes something, or who discovers the way to cheapen production, is a benefactor to the human race just as much as the "man who made two blades of grass grow where only one grew before," but I refrain, for I think each one can follow these ramifications for himself.

Ethelinda Hadwen.

TECHNICAL EDUCATION.

[27593.]—I THINK all practical mechanists will thank "Nun. Dor." for his plucky and able letter on this subject. It is surely time that someone properly qualified took it up, and not leave the future of our good name as a nation of capable workmen to be shipwrecked by ignorant sentimentality.

No amount of letter writing will get to the heart of this matter, and there is plenty of reliable evidence to hand showing the real value of the proposed experiment in technical education.

This matter must be looked at from various points—the parent, the son, the masters, the schools, and the nation. In the first place, parents, as a rule, knew next to nothing of the various exigencies of the business that they thrust their lads into. The only business they are adepts in is their own, and nine out of ten are dissatisfied with it, and ignorantly conclude that anything new is a good venture. Witness the late rush made by parents to put their sons in electrical houses and soi-disant schools of electricity, without the slightest knowledge of the stability of the one nor the good faith (except so far as it is represented in glowing prospectus) of the other, nor even the aptitude of their sons for this class of work.

As a rule, all boys like to look at machinery in motion, and gladly enter on mechanical studies; but how few persevere, or are found in any way fitted for the work! As pupils in large works, they saunter through their time, coming late to work and leaving early, and most of them do little and learn less, and at the end of their time they are of no use as scientists (even if there was employment for them in that line), and they could not earn 5s. a week as mechanists. In simple mechanical work, how very few *well educated* lads will put up with the long hours, hard, dangerous, and dirty work of a mechanical apprentice; but the few who do are the very lads required, and are sure to make their way.

Now, as to the success of technical education as an adjunct to general education, how is it for one moment to be expected that any amount of class lessons in a Board School, even with such a "shop" as could be reasonably supplied, could be of the least practical use in teaching a lad to be an artisan? If one reflects for a moment that it requires five years' long, hard, daily work in a first-class shop, with all the necessary and expensive tools, costing thousands of pounds, to advance an apprentice to the position of an improver, and that at least three more years must be passed in that capacity in various shops before the lad can be esteemed a capable mechanist, of what value can the proposed school technical education be? The most that could be reasonably expected would be that the pupil on leaving school with the usual showy certificates of "mechanical proficiency" (given most probably by the parson and lady visitors), would be able to make what he calls a box, turn a peg top, stop in a small pane of glass, or make a whistle—for which the ratepayers would have to pay very dearly.

I do not for one moment undervalue technical education: it is not only a grand scheme, but a necessary one for the good of the nation. I only maintain that the proposed form is a huge mistake, its expense must be great, and the country can have little return for the expenditure beyond the evolution of a few incompetent workmen, who, if they secured work, would be quite unable to execute it. Let us have a plain, well-digested plan, and let it be matured by thorough business men, and well-known and experienced mechanical and scientific experts. What the country wants is a good system of technical education, but more of an advanced than an elementary character, and given in special schools at hours when working men and apprentices can attend, and illustrated with such perfect appliances as only a wealthy Government can afford, and which, while vitally necessary to thorough education, are quite beyond the reach of ordinary students. The class to be benefited are not a mass of ignorant school children, but intelligent men and lads who are actually engaged in various works, and who have devoted themselves to their various occupations, and will thankfully and gladly take advantage of the opportunities offered to them, and, what is more to the purpose, are quite capable of thoroughly understanding and benefiting by the instruction given them. The nation will thus be helping forward a large number of well-instructed and capable scientists and mechanists that will do honour to their teaching, and maintain the national credit for high-class work. We cannot make real talent; but when it appears, let it have every assistance in its development from a liberal and far-seeing nation, who in the end will reap its full reward for the good seed sown. **Shaper.**

PRIMARY BATTERIES.

[27594.]—ATTEMPTS are being made—even in your own columns—to induce the public to believe that some wonderful discoveries have been made in connection with primary batteries, and, although the principles which underlie any possible combination that can be called a primary battery are, and have been, well known for some time, we are asked to believe that after all the experiments which have been made, there is a possibility of obtaining a battery which will supply current at an economical rate. One of your correspondents on p. 248 could not give the composition of the depolariser in some extraordinary device, as it would interfere with foreign patents being obtained; neither would he give the zinc solution, nor tell us what was the negative element. When I pointedly asked for them, I was told that they had already been given, but no page was mentioned, and I have been unable to find them. I may just mention that I have a slight idea that if they had been given I should not have asked for them; but that is a detail. I think it was the Rev. Mr. Higgins, who several years ago published a long list of the elements which had been tried in galvanic or voltaic batteries, with notes on their performance; but as I mentioned not long ago, all the information of value on this point is to be found in Mr. Sprague's book—that is, by those who are electricians by knowledge, and not merely by *nom de plume*. The cheapest material from which energy can be obtained in the battery is zinc, and the only possibility of reducing the cost of battery current is by hitting on some combination which will give us a useful and, therefore, commercially valuable by-product, the selling price of which will be so great as to pay the cost of collection and a portion of the outlay for the original materials. Can anyone tell me whether such a battery has been devised?

We have recently been favoured by an amusingly learned assumption of superior knowledge, in which facts and statements which appeared years ago in the ENGLISH MECHANIC have been vamped up and made to do duty as original matter, and in the columns of the daily press we see paragraphs which have been obviously inspired by those who desire to float companies. Thus, in the *Times* of last Saturday, I find the following, which refers to two batteries, one of which I fancy has been noticed in your columns; but I am unable to learn, from the statements made, where the economy comes in. Perhaps "Sigma" or Prof. S. P. Thompson can tell me. I can understand that, other things being equal, the battery which gives least trouble in charging would be preferred to another. But this is what the *Times* says:—

"Attempts continue to be made to introduce electric lighting in the household and in mines by means of primary batteries, and we have recently inspected two more inventions of this character. The first of these is the 'Eclipse' portable electric battery, which is the invention of Mr. Harris, and is being introduced by Mr. J. J. Walsh, of White House, Telegraph-street, London. This battery consists of a series of outer cells of vulcanite, each outer cell carrying an inner cell of porous material. The outer cell is filled with a solution of sulphuric acid, and the inner cell with a solution of nitrate of soda. A carbon rod dips into each inner cell, and constitutes the negative, while a plate of zinc is held in the acid solution in each outer cell and forms the positive. A miner's safety lamp has been constructed upon this principle, and a 2½ candle-power lamp, assisted by a reflector, gives a very good all-round light, which is also reflected upwards to the roof. At a demonstration which recently took place at Mr. Walsh's offices a number of lamps were driven from an 'Eclipse' battery, and gave a very effective light. Upon that occasion Prof. Silvanus P. Thompson spoke strongly in favour of the system, especially as applied to miners' lamps. The Great Western Railway executive, it is stated, have tested the lamp with very satisfactory results. The first cost of the battery is said to be very small, and the cost of each charge only 2d., which charge will maintain a lamp for 24 hours. The second primary battery to which we have to refer is the invention of Mr. C. M. Newton, and is being introduced by the New Electric Light Syndicate, of 2a, West-street, Finsbury, London. Each cell of this battery consists of an outer case of iron, which forms the negative plate of the cell. On the bottom of this the depolarising material (oxide of lead) is spread. Above this is a diaphragm of parchment paper so disposed as to divide the cell into an inner and an outer compartment, and at the top, resting on glass insulators, the zinc positive plate is laid. The exciting fluid, a caustic alkali, is poured into both compartments, and the cell is ready for use. There are no fumes from this battery, which has been fully tested and favourably reported on by Dr. R. M. Walmsley, F.C.S., who states that a brilliant and steady light is maintained for 120 hours without attention, and that local action is practically negligible. It is intended to let these batteries to consumers at a nominal rental, the price to be charged to the public being fixed on the basis of gas at 4s. 6d. per thousand feet. The battery is to be recharged as required by the company, so that no risk will be incurred by domestics in dealing with it. At a recent demonstration a good light was given by six 10-candle power Shippey Brothers' glow lamps, driven by seven Newton cells through seven E.P.S. accumulators. It is stated that the accumulators would not be used in practice. Including the present, we have, within the past three years, noticed no fewer than 11 primary batteries, all of which have given more or less promise during experiment. It would be interesting to know how many of these have been introduced into houses of moderate size for ordinary domestic lighting on a regular, practical, and commercial paying scale, to the supersession of gas."

You will see that the writer of the above puts a very pertinent question in the last sentence, and possibly some of your readers can give the desired information. A battery that will give a steady light for 120 hours without attention is worth having, for assuming it is required for six hours a day, it will last for 20 days, and many persons will not study expense if they can be relieved from the trouble and mess of charging. **Nun. Dor.**

NOISES IN THE EARS.

[27595.]—HERE are three cuttings from the *Lancet* on above subject, date 1866, since which I have met with many cases and many medical opinions, not one of them recording a permanent cure. From experience, I can say that long sea voyages in temperate latitudes and long residence in mountain air are the best remedies for *Tinnitus.* West winds from marshy tracts and night dews surcharged with malarious vapour induce the affection:—

"SIR,—I should be glad to ask some of your medical readers, through the medium of your columns, a means of combating a constant noise in the ears, first experienced a year ago after a recurrent attack of brain fever. The ears have been well syringed, without any amelioration of the unpleasant symptom. The patient is a young lady, otherwise in tolerably good health, and free from hysterical symptoms. The noise has occasionally increased in intensity, and been accompanied with diplopia, giddiness, and distressing mental visions. From this she has been accustomed to obtain relief by resorting to a large blister to the nape, the other symptoms being by this means relieved; but the noise—a rushing sound of water, clacking of a mill, &c.—has remained unaltered.—"T. J., M.D."

"SIR,—According to my experience, I believe that by far the most common cause of noises in the ears is chronic or subacute dyspepsia.

"Let 'Chirurgans,' or anyone suffering similarly, treat themselves as follows, and report the result. Let them leave off all stimulants and narcotics, live simply but well, take plenty of exercise in the open air, and retire to bed regularly at an early hour. Mercury pill, two grains; compound rhubarb pill, two grains and a half; ipecacuanha powder, half a grain: make into twelve pills. Let them take of these alterative pills, two the first night, and one or two every other night thereafter, observing that the action is not more nor less than alterative and mildly aperient; and of the following mixture let them take a dessert-spoonful in water thrice daily after food:—Dilute nitrohydrochloric acid, two drachms; fluid extract of taraxacum, three drachms; tincture of ginger, half an ounce; simple syrup, two ounces; compound infusion of oranges, sufficient to make a six-ounce mixture.

"Without knowing more of a patient than that his two external meati are patent, and that there is every reason to believe that no actual organic change has taken place, then I should expect great, if not complete, relief to the *tinnitus aurium* of your correspondents from the above simple means. —"THOS. SKINNER, M.D."

"SIR,—I have been suffering similarly to 'Chirurgans,' and can quite sympathise with him. My attack was, I believe, the first symptom of a slight attack of typhoid fever, which was very prevalent in my immediate neighbourhood seven years ago. It came on quite suddenly, and has continued without intermission ever since, and
expect to carry it with me to the grave. There [illegible]
no doubt of its purely functional character, [illegible]ot
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electrical measuring instruments. This is a fact to be lamented, because, in electricity especially, it is to be said "science is measurement." I, therefore, intend to give full instructions and complete drawings, so that with a little labour and at small

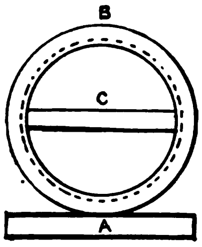


FIG. 1

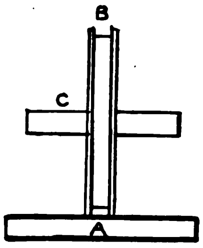


FIG. 2

cost the reader may construct the three instruments which will enable him to measure current, electromotive force, or, as Prof. Ayrton calls it, potential difference and resistance, in ampères, volts, and ohms respectively. The three instruments are (1) the tangent galvanometer, (2) sliding Wheatstone's Bridge; (3) a set of resistance coils.

The forms, &c., of the instruments are such as several years of practical experience have shown to be the best, both in accuracy and simplicity of

FIG 3

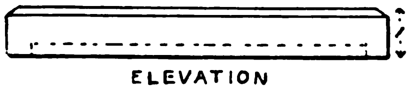
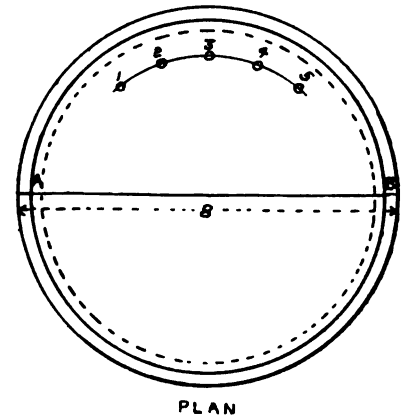


FIG 4



construction. After describing them, I shall give the methods best adapted for each particular measurement.

I shall begin with the tangent galvanometer; and in order that the following remarks may be better understood, I give in Figs. 1 and 2 two views of the instruments when completed. In both, A is

FIG 5

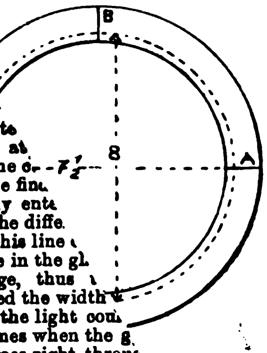
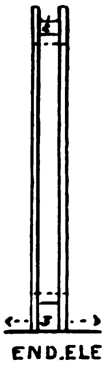


FIG. 6



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I gather this from the manner that

piece of good close-grained wood (mahogany or baywood). In the bottom a recess is made ¼in. deep and 7in. diameter; upon the upper surface make a circular arc 8in. diameter, and in it five holes $\frac{3}{32}$in. diameter: these are for the terminals. Through the centre of the board draw a diameter A B, so as to be quite clear of the holes just mentioned: this is to mark the position of the reel. Two views of this part of the apparatus are shown in Figs. 5 and 6, and is made of the same wood as the base.

Before cutting out the centre piece, mark two diameters at right angles (*a a*, *b b*, Fig. 5), then turn up to the sizes shown. At one of these lines cut a recess equally on both sides of it, 1in. wide and about $\frac{1}{16}$in. deep. This is to hold a small brass plate shown in plan in Fig. 5*a*; cut this out of ⅛ or $\frac{1}{16}$ plate, 3 by 1, and drill the holes shown. Screw the plate to the reel with brass screws (iron ones must not be used, being liable to become magnetised).

FIG 7

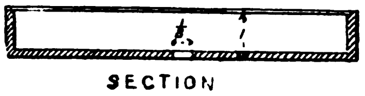
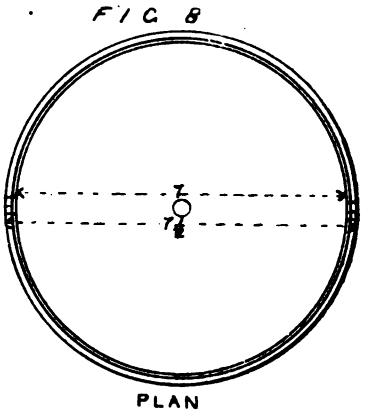


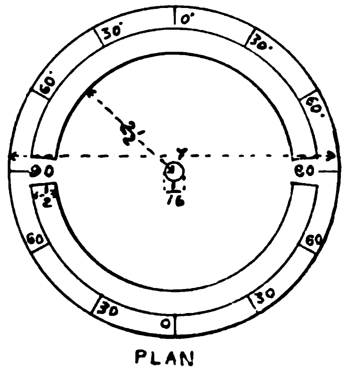
FIG 8



Place the reel in position along the line A B, mark the holes for the screws, and fasten firmly down.

The base and the reel should be now perpendicular to each other, so that when the base is horizontal the plane of the reel is vertical; if not,

FIG. 9



they must be made so by cutting one side of the recess a little deeper than the other.

Magnet Box.—Two views of this are shown in Figs. 7 and 8. Turn up to the sizes shown, and around the top make a small groove for a glass disc to fit in. To assist the correct setting, mark the extremities of any diameter on the sides of the box (*a a*, Fig. 8); on either side of these marks, and ⅜in. from both, make four small holes half-way down.

Place the box in position by means of the centre lines, so that a line through the centre of the box half-way down passes through the centre of the reel. Mark the positions of the four holes on the reel, and fasten the box in position with four brass screws which will pass into the walls of the reel and nowhere touch the coils. Cut a circle 7in. diameter out of a piece of good "Bristol board," which is the technical name for a species of fine card. Divide it into single degrees with a protractor, making every fifth and tenth mark slightly longer than the other, and numbering the tenths as shown in Fig. 9. Mark the two circular pieces shown, and cut them out with a sharp knife, and finally make a $\frac{3}{16}$ hole in the centre.

At the bottom of the box place two pieces of mirror glass so as to be under the two circular openings in the card; over them put the card with the line joining, the 90°'s passing through the centre of the reel; do not, however, fix the card. The

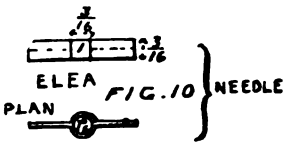


FIG. 10

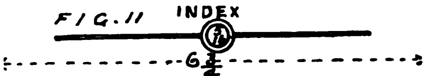


FIG. 11

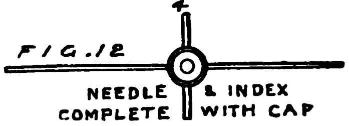


FIG. 12

magnetic needle, which, by the way, is not at all like one, is made of hard steel; an old file will do to make it of.

The size and shape can at once be seen in Fig. 10 The centre hole is first made and screwed for the cap to fit in, and then the needle is filed into shape. When finished heat to bright redness, and plunge vertically into cold water, polish, but do not temper it. To magnetise, place in contact with a strong magnet for some hours.

To make the index, take a very thin washer of brass, of diameters $\frac{5}{16}$ and $\frac{3}{16}$, cut in two halves, and place a piece of thin brass wire (about No. 26) between them (see Fig. 11), and solder all together. When cold, file away surplus solder, cut out the bit of wire in the middle, measure 3⅜in. from the middle along each end of the wire, and cut off the rest. Straighten the wire, and file the extreme ends to a sharp point to assist the accurate reading of the circle.

The cap of the needle is the next to claim attention, and involves some rather tedious work. A large-size sectional drawing of it is given in Fig. 14. The lower portion of the cap is screwed so as to fit into the needle, a milled edge being put on the upper part to assist the screwing. In the upper part there is a piece of glass fastened in by shellac varnish. The glass can either be made out of a

FIG 12

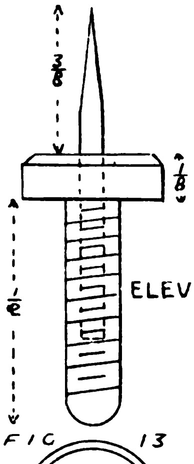
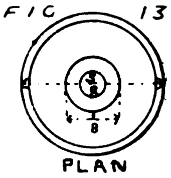


FIG 13



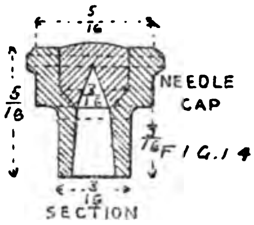


FIG. 14

piece of tubing or a piece of solid rod, the hole being drilled afterwards. Those who do not feel equal to the work had better make the cap of solid hard brass. The pivot is shown both in plan and elevation in Fig. 13. It is made of brass except the point, which is of hard steel.

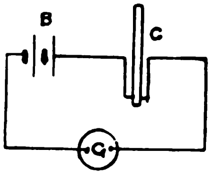
Take a piece of ⅜in. round brass rod, and drill a le up the middle about ⅜ long. Screw the r part and make a washer and nut to fit. The al pivot is made of hard steel; the end of a ing-needle I find sufficiently hard. Cut off of the end, fix in the lathe, and grind to a fine ring point on a hard oilstone; for fine work it ished with rouge and oil. Put the pivot into rass piece, fastening with varnish if not tight, screw into its position in the box, fastening nut under the box. Take the cap, slip the x over the lower end, and screw into the needle Fig. 12).

e now come to the true electrical part of the innent—the winding of the coils. Take out the net-box and unscrew the brass plate at the m of the reel, turn up a disc of wood so as to ghtly into the reel, so that it may be made to ve slowly in the lathe. The coils are four in ber, and, commencing nearest to the centre, are—

One layer, No. 18, consisting of 10 turns.
Three layers, No. 18, consisting of 30 turns.
Seven layers, No. 38, consisting of (about) 240 s.
Seven layers, No. 36, consisting of (about) 840 s.

l the wires to be silk covered, as no cotton red should be used in good instruments. Near ottom of the reel make two small holes, one on side, pass about a foot of wire from the inside ards through one of the holes. Get some one

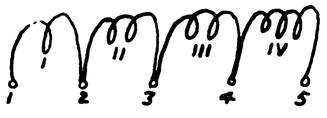
FIG. 15



rn the lathe slowly by hand, and so wind on ire very carefully, keeping the wire fairly tight, ot putting on too much tension.

the turns are well packed, exactly 10 can be n; when the layer is completed allow about a extra, cut off the wire, and pass through the d hole outwards. Before proceeding further, oil must be tested for continuity, connect up cells with the coil and a small galvonometer re is one to hand; if not, place the two wires e tongue. If the coil is complete, a peculiar taste will be observed. The method of ecting is the simple series (see Fig. 15). B battery, C the coil, and G the small galvano- or the tongue. The coil having been l correct, give it a good coat of melted paraffin applied with a rather soft brush. When cold ve the surplus wax with a piece of sharpened , and commence the next coil, commencing at me place and winding in the same direction. finished test as before with the other coil, in, and begin the next. It is well to guish the ends of the wires with small labels. the last coil has been completed, give an thick coat of wax and wind a strip of paper

FIG. 16



l to protect the wire from injury, screw on rass plate and fix to the base, make 10 small in the base and pass the wires through. Buy zen terminals (telegraph form No. 3) and five of them in position. Take the beginning first coil, cut the wire the right length, and to the first screw, using resin only as a flux. the end of coil one and the beginning of coil ogether, and solder both to the next screw, on in simple series. Put in the magnet-box ore, cover with the glass disc, and the instruis completed.

justments.—The needle and index must be ndicular; rule two lines on paper perpendito each other, place the needle along one, ew the cap slightly, and bring the index along her, and fix it in this position by screwing the cap.

Test the Friction of Needle and Pivot.—Ret needle cover with disc, and let the needle to rest. Take the reading. In doing so s bring the eye to such a position that the completely covers its image in the mirror by which means the line of sight becomes ndicular to the plane of the circle, and there parallax. Now displace the needle with a magnet or piece of iron through about 90°. come to rest, and read again (with the same care as before). The two readings should never differ by more than ¼° or ⅓°. To clean the cap, take a piece of soft, pointed wood (a sharpened match stalk) with a little oil on the end, and press lightly against the glass cap, twisting the wood round at the same time. The steel pivot is best done in the lathe with rouge and oil. It is a very good thing to remove the needle from the pivot when the readings are finished. By so doing the point will last a long time.

Setting of the Circle.—Let the needle come to rest, and place the plane of the reel as nearly parallel with it as possible. Turn round the circle until the index on either side reads zero, and fix it by screwing the brass piece of the pivot hard against it. Although these adjustments may be only approximately correct, yet the correct reading can be thus obtained. Set up the instrument so that the index reads 0 on either side, and take the deflection reading both ends of the index, reverse the current, and take two more readings; add together the four readings, and divide by four. The result is the correct deflection. J. S.

(*To be continued.*)

HYDROPHOBIA.

[27597.]—I SEND you some curious statistics and facts regarding rabies. I have heard very clever and scientific men argue that no other than canine and feline quadrupeds could communicate the disease. I was once present in the last stage of a frightful case (a native), who tried to bite every man who touched him, the saliva flowing from his jaws; in the struggle some drops were ejected in the Hindoo doctor's face, who, having sore lips, was greatly alarmed—reasonably so to my idea. On such hopeless occasions palliative treatment is our only very melancholy resource—*euthanasia*, the last mournful boon. *Cannabis Indica resin* succeeded, on its very first trial in the Calcutta General Hospital, on a patient in whom the violence of the malady had set in: paroxysms of agony when liquids were offered to him subsiding after the hourly admistration of two-grain pills. Long periods of refreshing sleep ensued; on awaking the bad symptoms were renewed. Again the narcotic obtained the mastery, pills administered, and until the fifth day liquids and solid food could be enjoyed; then came the mortal end in a state of profound stupor, without any further struggle! This very interesting case is too long to copy verbatim from the medical book now before me. Subsequently this valuable drug was found to have powerful therapeutic properties in Asiatic cholera, tetanus, and delirium tremens, also in infantile convulsions. I have tested its virtues in the last-named and found it efficacious, being a soothing anodyne of high class. The genuine, unadulterated resin is very scarce. I got my large supply of 1lb. from Ladakh direct. In perfectly healthy persons it will produce the most dangerous forms of intoxication, inciting them to the commission of crimes. In the frightful death from hydrophobia I witnessed there were some strange attendant circumstances. The bite was received six weeks previously on the bare arm from a rabid jackal; another man on the same occasion who was similarly bitten died about same time, while of the three or four native soldiers bitten in the legs repeatedly through their thick woollen trousers not one suffered any harm. In England we frequently meet with serious cases of "blood poisoning" produced by the teeth of dogs and cats, and also by the claws of the latter (those inflicted by the carrion-devouring leopard of India are usually fatal). I know of one very serious case not far from me just now. A rural policeman, bitten by a dog, who from his helpless state has been pensioned for three years to come, in hopes of eventual recovery, blood-poisoning being unmistakable. A year ago one of my boys, out fishing, was bitten in the hand by a farmer's dog. I poured pure carbolic acid into the wound, and for his satisfaction sent him off in a carriage to the nearest practitioner, who applied carbolic acid and mercury. After a week's painful sore caused by the escharotic application, the flesh healed rapidly. No matter what dog or cat, a bite or scratch should be immediately dressed. A late number of the *Field* announces a case of canine rabies at Cape Town, S. Africa—the first on record. A wholesale slaughter of dogs for miles round was ordered, so as to stamp out the new importation. Steam voyages being of so short duration nowadays, many insidious germs may be expected to cross the ocean during the period of incubation—22 days from land to land being too brief a term for development.

Mr. John Goggin, a confectioner of Limerick, has recently died from hydrophobia, the effect of the bite of a pet monkey. The usual symptoms appeared, and the patient died in five days.

The Academy of Medicine of Paris has been engaged for the last few weeks in discussing the etiology, prophylaxis, and treatment of rabies. Many interesting facts have been stated by the different orators; and M. Bouley, professor at the Veterinary School, especially distinguished himself by the sketch which he gave of the symptoms of rabies in the dog.

M. Tardieu, the eminent medical jurist, communicated in his speech data of great value, which, by order of the Committee of Hygiene attached to the Government, have been carefully collected for the last twelve years. In this lapse of time 319 cases of rabies in the human subject have been noted, and these may be looked upon as facts surrounded with every guarantee. Of these 319 cases the disease was communicated to man by animals in the following ratio: dog, 261 cases; wolf, 31; cat, 14; fox, 1; cow, 1; doubtful, 11.

There has always been a doubt as to herbivora being capable of transmitting the disease; but in 1862 a shepherd aged twenty-two was bitten by a rabid cow, which had previously been bitten by a dog. No prophylactic means were resorted to, owing probably to the belief that cows could not communicate the disease; but rabies broke out thirty days after the injury, and killed the young man in two days.

As to dogs, it may be remarked that the majority of the cases have been noted as occurring with small or household dogs; hence the importance of M. Bouley's advice as to the necessity of the public being acquainted with the premonitory symptoms of rabies in this animal.

Much exaggeration has been indulged in respecting the annual number of cases of rabies in the human subject. From official documents it appears that in France 239 cases were noted from 1850 to 1858. More recently they have been as follows: in 1859, 19 cases; in 1860, 14; in 1861, 21; and in 1862, 26.

Regarding the proportion between individuals bitten and those in whom the disease actually breaks out, the statistics are somewhat unsatisfactory from the very nature of the circumstances; but it has been found that out of 334 actually ascertained cases of persons bitten by a rabid animal, 185 suffered from the disease. This would give a ratio of 55 per cent., a somewhat heavier figure than Hunter's, who only gives 5 per cent.

Concerning sex and age no reliable data exist. M. Tardieu considers that rabies may arise spontaneously in animals. And as to the influence of the seasons, it is to be noted that 183 cases occurred in the warm portion of the year (from March to August), and 121 in the cold season.

The period of incubation was as follows:—Out of 224 cases, it was less than a month in 40 cases; from one to three months in 143 cases; from three to six months in 30 cases; and from six to twelve months in 11 cases. It has been remarked that the incubation was short in young subjects. It is also evident, from facts collected by M. Camille Gros, that individuals have died rabid in consequence of a bite from an *irritated* animal *not* suffering from rabies.

M. Tardieu considers that deep cauterisation should always be resorted to, and that it is a great mistake to doubt its efficacy. Statistics show that about half of the individuals bitten escaped the disease, and that these had all been cauterised.

M. Decroix is said to have eaten with impunity, on more than one occasion, the flesh of a mad dog.

Eos.

CONTINUOUS BRAKES.

[27598.]—HAVING been seriously ill since the 13th of June, I have been unable to either read or reply to the various letters; but as the cause of my silence was stated in the *Railway Review*, *Invention*, and some other papers, I think your
readers will agree with me that an insinuation e
thrown out by S. Davies, pages 439—440, that I ol
have avoided the discussion, is both incorrect and not
uncourteous; and his statement that I have writte with
upon other subjects is not the fact, as any lett r the
which may have appeared in print were wri spoiled
and posted before my illness, as the date ate crys-
show. pphire (of
Reference has been made to accident imbedded
took place at Bow and North Wootton out. The
present and examined the *débris* in t reintroduced
cases before the lines were cleared, and
upon them were recorded in your col tained by the
time. The Government Inspector rd steel cutters
the accident at Bow was "caused b to be studied in
of the signalman at Bow, and th fficulty whatever in
the signalman at Gas Factory J needed for the two
the North Wootton accident I model mandrel-head.
the Government Inspector's re iled, as it stands being
action of the Westinghouse b cylinder-base, if gauged
fitted part of the train to of an inch will answer
very serious accident. The ylinder-fit would admit an
useless for S. Davies to f huck which, at its outside,
with reference to those o sandth of an inch; that is to
With regard to the y which is possible between
must ask your reader e chuck-recess.
put forward by S. Da overlooks the fact that we h
the miles run by all ue cone but a true cone that an
automatic, and leak Now, in order to ens rubbed on
faults or failures et rid of bad ones, w will keep the
valve. Surely, with such surface le to cust
credit for the m verify for him light (f)
essential ce of same

time admit the failures a brake makes during such running.

The other subjects to which reference has been made have been already answered, and it will be seen that the defects in the vacuum system which have been pointed out still remain, and nothing has yet been produced to show that the Westinghouse is not the most efficient system, and certainly it is quicker in action than any vacuum brake. The Vacuum Company know this perfectly: hence they do not entertain the proposal to have an impartial public trial. **Clement E. Stretton.**

Glen Magna, July 8.

CONTINUOUS BRAKES.

[27599.]—THE Burlington trials show that the question of continuous brakes on goods trains is not yet settled; there does not exist up to the present a reliable and suitable automatic brake to work on very long goods trains as are seen on the Continent and in the States. The use of electricity has hitherto been a complication which the results do not fully justify; yet electricity is, at first sight, the only agent which would render a continuous brake, whether automatic or not, perfectly instantaneous.

When the Achard brake was used on the Eastern Railway of France, a great difficulty was always experienced in forming the wire connections for the current from carriage to carriage. Mr. Samuel Davies, remarking that there have been 352 Westinghouse pipes burst during the half-year, adds there were in consequence 352 chances of the Manor Park accident.

Am I to understand that in England the weather is constantly foggy, and that the block system is an utter failure? That reminds me of a friend of mine, a railway engineer, who reasoned in a similar way. This gentleman was a staunch supporter of the non-automatic vacuum brake. He told me once, by way of objection to the Westinghouse, "Well, do you think we are going to employ the block system as a consequence of the adoption of your brake, to prevent a train in the rear to come in collision with one which has been stopped accidentally by the bursting of a hose-pipe of a Westinghouse brake?" The good man forgot that there is no railway in the world on which trains are not protected in the rear, whether it is time or space blocks, and, besides, the use of the Westinghouse brake greatly diminishes the chance of such an accident. It is not everywhere foggy as in England. Let me remind Mr. Davies that such an accident can also occur with the automatic vacuum brake.

Mr. Davies tells us also that his brake works smoother than the Westinghouse. This is certainly the experience of this gentleman, but it is not exactly mine. I have on some lines had trains in which the smoothness of the stoppage was perfect, whilst in others they were wretched. The difference is accounted for by the fact that the brake-power and the proportions of the brake-gear are not properly reckoned. Finally, there are some stupid, heavy-handed drivers who do not give themselves the trouble to acquire the necessary skill. However, the vacuum brake is often just as bad, and from the same causes.

I am rather curious to know what answers our friend "Rover" will get to his questions. It is not at all wide of the mark to speak of over and under pressures in this discussion. I maintain that this is absolutely necessary. We must have recourse to theory to treat this question so long as our opponents do not come forward with data more reliable and more trustworthy than mere assertions.

July 5th. **E. Gobert.**

RAILWAY BRAKES.

7600.]—I AM sincerely sorry, Mr. Editor, to
continually calling on your valuable space in
cussion; but I think you will agree with
the importance of the subject is some
ion for the course adopted.
r to Samuel Davies (27567) I again beg
ngines of which I possess the numbers
es of drivers did run by the platform
ith the 5.38 p.m ex-Carlisle not two
t probably it was not reported. I
was. I may just say to Davies
on Mr. Stretton is hardly in place
of the mark, as, had he taken
g all right on other matters,"
ey were dated and in hands of
appeared in *Railway Review*
I don't suppose he will
s or any one else on the
h he has made a special
Mr. Davies. No sooner
an he turns a somer-
gain." Last week he
inghouse. We point
ut the Vacuum Co.
n for their off-
le of the brakes
ogeny, as does

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Sometimes when the
lutely goes right thro
he has got the cut by t
out as he draws the dia
found on close examinati
very regular, like the teet
the detonation of these min
the musical note, and thus s
'sweet cut.' That electricity
the point of the diamond and
glass, cannot be doubted, fo
diamond with a coarse cut, mi
are thrown aside by the diamond
on the glass seem alive with ele
would add here that it is my opinion
annealed would be better isolated than
I gather this from the manner that

---

their champion-in-chief. If Sam don't believe this, he'd better get one of the "Universal Coupling" tickets just issued by the Vacuum Brake Company and see for himself. I suppose that is on account of the small number of ball-valve vacuum and the bad figure it would cut if allowed to go alone, so they take all vacuum as against all Westinghouse. Many of Sam's automatic vacuum trains are drawn by engines with steam brakes; the failures of these are not given, but Westinghouse engine brake cases are given. Does Samuel know that W. Blackburn, a L. and Y. driver of 20 years' standing swore on oath before the Judge of the Liverpool County Court last Monday that his company had issued an order against trusting to the vacuum brake when moving towards a train for the purpose of coupling up? Why is this so? Is it a case of, It might not go on—same as the new ball-valve which a Midland driver trusted to stop him at Skipton water crane the other morning, and it let him go a carriage and a half-length by? He was very fond of the ball-valves, but it didn't stop him from using the big, big d——, and said, "he'd never known his Westinghouse play him that trick, and the ball-valves might go to ——," that place that has recently had its cognomen changed. Sam puts great faith in drawings of Vacuum Brake Company; perhaps, then, he'll be able to tell us if the M. S. and L. and L. and Y. engines in the Manchester Exhibition are not the very latest, and whether both have reservoirs under tender only. There are lots of cases in return where automatic vacuum stopped or detained trains. I don't make a bother about them; if a brake is out of order it should stop the train, and the block should protect it.

Did Samuel Davies ever read the letters in the *Times* by "Express Driver" and J. Brooke upon brakes, and what does he think of them?

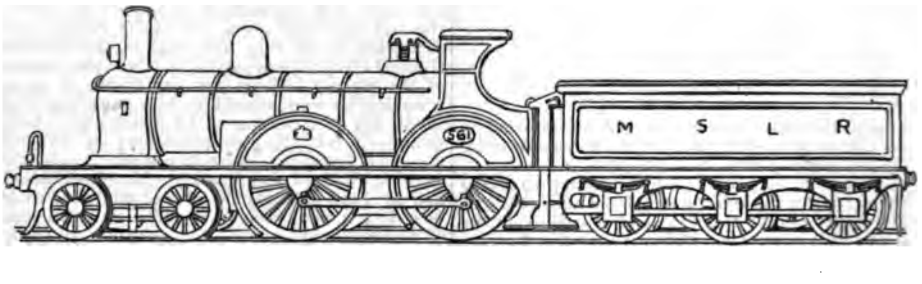
I never read the *Standard*, and have not heard of the Peatsferry case; but no doubt details will be to hand before long, then we will form an opinion.

Sam's Bow case is only a trumped-up affair, and he has not minded it: block failures are not brake failures. **Rover.**

RAILWAY COUPLINGS.

[27601.]—IT is very gratifying to learn that "Loose Links" admits (27571) the "coupling pole and looser links are steps in the way" of settling the coupling question, but fails to answer as to compression of buffer, standard height of waggon, &c. Perhaps he will tell us some of the advantages of an automatic system in the present state of railway plant. As to myself and others not being possibly able to know whether there are any appliances at present in use that fulfil *all* the requirements, or that would work in ordinary everyday work, I have no hesitation in saying there are not any such known. That the companies have been slow in taking this matter up I readily admit; but to say they are pursuing a "rest-and-be-thankful" policy is beside the mark, and not strictly correct, as is shown by the companies (a number of them at any rate) fitting their stock with light links, and better draw-bars in place of the cables and anchors employed up till recently. Particular mention should be made in this remark of the N.E. and Midland. I don't profess to know a great deal about what our American cousins may be doing in this respect; but I know, on very good authority, that on one road they adopted them, and then took them off again.

Don't think that I am quarrelling with an appliance which I would be very glad to see adopted on every line. The thing I am objecting to is the mode of forcing the question, as it is termed, "springing on the constituencies." Some men, especially inventors, seem to think that railway managers don't know what they ought to do, and if they don't adopt their particular invention they *can't have got the best.* Nothing could be so fallacious. Perfectly so; "Silke's" "does not fulfil any absurd requirements" (27572), because if his were adopted, all the stock in the kingdom would have to be fitted with it, and brought into use in *one day*. Quite right; nothing so absurd will ever be done, so we need not trouble; it won't fulfil the requirement because it will not cause it to be done. "One result of the Nine Elms farce has been to show the public that the coupling question is not likely to be settled by the A.S.R.S." Quite so; no one thought it would. The questions decided by that committee at Nine Elms were—Which couplings submitted shall we consider best? When you come to, Will they fulfil the requirements of everyday working? you find the committee disagreeing amongst themselves. Nevertheless, the men who judged these appliances were nine of them practical goods guards, and should be allowed to "know a little on the subject" And if the defects they noticed were pointed out and overcome, then there might be some chance of their adoption. If "Loose Links" and "Silke" have time to get as far as Newcastle on Friday, 15th inst., they might there learn something that will be useful and convincing at the Jubilee Coupling Contest. Of course, no one would try and purposely break a model; but if they won't fulfil the requirements, it's only very natural to suppose the full-sized apparatus would not do so either. I should very much liketo see "Silke's" model, if he will tell me where to find it. **Rover.**



M. S. & L. NEW EXPRESS LOCOMOTIVES, &c.

[27602.]—IT may interest some of the readers of "Ours" to hear about the locomotives at the Manchester Exhibition, so I venture to enumerate them herewith.

The handsomest is a fine bogie express engine for the M.S. and L. Railway Company, by Kitson and Co. This is quite a new departure from the well-known Sheffield type, and I inclose a sketch herewith. The driving-wheels are 6ft. 9in., and cylinders 18in. by 26in. I have at present no other dimensions; but will try to obtain.

2. Lancashire and Yorkshire express eng four-coupled 6ft. wheels, and leading bogie. Cylinders 17½in. by 26in. Vulcan Engine Company.

3. L. and N.W. Railway compound goods tank engine; 8 wheels; h.p. cylinders, 14in. by 24in.; l.p. cylinders, 30in. by 24in.; leading wheel, 3ft. 6in.; driving wheels, 5ft. 2½in.

4. Beyer, Peacock and Co. Fine express-engine for Dutch State Railways. Four-coupled driving wheels, about 6ft. 9in., and outside frames.

5. Sharp, Stewart, and Co. Eight-coupled consolidation goods engine, with pony truck. Metre gauge.

6. Nasmyth, Wilson, and Co. Four-coupled outside-cylinder leading-bogie tank engine for New Zealand Midland. 3ft. 6in. gauge.

7. Great Southern and Western of Ireland bogie express engine. Four-coupled wheels, 6ft. 6in. Cylinders, 18in. by 24in. **B.**

HOW TO DO BLACKSMITH'S WORK.

[27603.]—I AM glad to see "Silke's" letter (27521), and think with him that many of us would be glad to hear more of this matter—I am sure I should. I have for a long time been constantly engaged in amateur engineering, and never have I found anything so difficult as the forge work. Sometimes I meet with tolerable success, at others a decided failure.

There is, in my opinion, some art in making and keeping the fire; my way of lighting is somewhat different to "Silke's." I used to put sticks, but never require them now—in fact, I look upon them as a decided nuisance. I simply scrape out a hollow, put in a handful of shavings, light up, and leaving it a second or two to get hold, commence blowing gently, at the same time covering up lightly with cinders and coal to confine the flame till well ignited. In this way I get a good fire in three or four minutes. If you have to leave your fire for any length of time, put in a small block or two of wood; it will then keep alight for an hour or two without attention, and save the trouble of relighting.

A few practical papers taking a few examples (the forge tools would be good to commence with) telling how to go to work and the reason why would be very acceptable.

Can "Silke" tell me the meaning of the smith tapping the anvil with his hammer when at work? I have been told that it is a silent language to direct the striker. I should be glad to know the interpretation thereof. **Cicero.**

A MUSICAL EVENING WITH MR. G. A. AUDSLEY.

[27604.]—AT length I am in a position to accede to the request, some months ago made to me in these columns, that I should state my views with regard to the Chamber Pipe Organ when fashioned upon the lines set forth by Mr. Audsley in the series of articles contributed by him to this paper.

A fortnight ago it was my good fortune to hear Mr. Audsley's organ tried in every conceivable manner, both as a solo instrument, and also in conjunction with the piano and the violin. That evening's music will linger long in the memory of all who were privileged to be present.

It will interest some at least of your musical readers, and facilitate the observations I have to make if I give in full the programme of the evening's music. It is as follows:—

PROGRAMME—PART THE FIRST.

"God Save the Queen."
Briefly offered on the organ.
Mr. H. A. Branscombe.
Fantasia .... "Don Juan" .... Liszt.
On the pianoforte alone.
Overture "A Midsummer Night's Dream" Mendelssohn.
Done on the organ alone.
a { Ich grolle nicht .... } Schumann.
b { Widmung .... }
By the bass voyce with pianoforte.
Isolden's Liebestod, "Tristan and Isolde,".. Wagner.
Rendered on the fiddle, pianoforte, and organ.
Concertante Duet .... Ebenezer Prout.
Allegro brilliante, "Tema con Variazione," Finale.
Composed for the pianoforte and organ.
a { Largo .... Handel.
b { Arioso and Allegro........................ Corelli.
c { Arioso.. Handel.
Given on the fiddle, pianoforte, and organ.
Adoremus.. Ravina.
Offered on the fiddle, pianoforte, and organ.

PART THE SECOND.

Fantasia.............. "Faust".................... Gounod
Branscombe.
Achieved on the organ alone.
Walther's Preisslied, "Die Meistersinger," Wagner.
By the fiddle, pianoforte, and organ.
Sonata Appassionata, F minor............ Beethoven.
Allegro assai, Andante con moto, Allegro ma non troppo.
On the pianoforte alone.
Maid of Athens .... Gounod.
By the bass voyce with pianoforte.
Fantasie .... Fr. Lux.
Maestoso, Andantino-Andante, Allegro molto.
Written for the fiddle, pianoforte, and organ.
a { Italien } "Aus aller Herren Lander"
b { Ungarn } Moszkowski.
Duets for the pianoforte alone.
Scherzo Capriccioso .... Guilmant.
Duet on the pianoforte and organ.

Mr. Branscombe, a talented organist, of Liverpool, presided at the organ; Herr Welsing, also of Liverpool, at the pianoforte; and Herr Schiever, leader of Richter's orchestra, held the violin. Three more competent artistes—artistes who would put their instruments to every conceivable test—it was scarcely possible to get together. The result was absolutely unique, magnificent.

The first piece I will notice is the overture to Mendelssohn's "Midsummer Night's Dream." It had seemed to me to be impossible that music of this type could be played with any real satisfaction on a pipe organ. I was undeceived. Although taken in quick time, quick as any orchestra would care to take it, the result was perfect; every single note was heard, it had its full value, all was clean and true. The solo passages rang out firm and distinct, as though played by an accomplished artist upon his own special instrument, and when one bore in mind that pneumatic action was entirely absent from the organ, one could only marvel at the exquisite workmanship which made such effects possible.

The next pieces I will notice are the adaptations from Wagner's "Isolden's Liebestod" and the "Meistersinger," given on the violin, piano, and organ. Greatly as I positively loathe much of Wagner's music, I am driven to say that these were undoubtedly the gems of the concerted pieces, except, perhaps, the Handel and the Corelli music. Here the organ was heard to perfection as an accompanimental instrument. First, in its gentle and almost unnoticed stealing in, then in its gradual crescendo, and finally in the ultimate fortissimo, when each artist was simply impelled, he could not help it, to vie with the others in displaying the power and resources of his instrument. The violin towered above. Yet all seemed perfectly balanced - no noise, all simply music.

In the Handel Largo, the intense richness of the organ was very marked. Here, indeed, and in the Corelli Allegro it was possible to close one's eyes, and fancy oneself listening to some cathedral organ, gently swelling, and in the dim distance slowly dying away.

I notice next the Adoremus of Ravina. Here again the organ part was superb. I was much interested in this piece, it being performed principally by members of Mr. Audsley's own family. After hearing that performance, I understood at once the meaning of a remark once made to be by Mr. Audsley. "My children never want to go out at night." Most fathers of families will, I think, look upon that as a result much to be desired, and worthy of a considerable amount of expenditure in more ways than one.

I will only notice further the Prout Duo Concertante. Knowing well the effect of the first two movements when given upon the Mustel organ and piano, it was with very much interest that I heard them upon Mr. Audsley's organ. If there was any shade of disappointment during the whole evening I am bound to say it was here. The piece is written for the harmonium and not for the organ, with the piano, and the very delicate orchestral touches and fine nuances with which it abounds seemed to me to be better brought out upon the Mustel organ.

To sum up, then, my views of the chamber pipe organ in the hands of Mr. Audsley, I say at once it is an instrument of expression, differing wide as the Poles from any chamber pipe organ it has ever been my lot either to hear or to play upon. Its resources seem to be simply boundless.

As Mr. Audsley will not permit me to give a detailed specification of his instrument, on the ground that the instrument is not yet, in his mind, complete, I can only indicate the origin of a very few of its special charms.

In the first place, its grandeur. This is due, to a large extent, to the magnificent pedal bass. There are no fewer than three 16ft. pedal bass stops, open diapason, Bourdon, and an exquisite euphone of a refined basscon quality of tone.

Then, again, the large variety and perfect orchestral tone of the piccolo, the oboe, the viol d'amore, the voce umana, clarinetto, and corno da caccia, give a never-ending variety of charm in solo passages, for all are equally perfect, whether used as solo stops or in combination. It is impossible to draw any combination of stops that shall not be pleasing.

The mixture of five ranks is perhaps the most *remarkable* stop in the whole organ—very soft and refined in tone, it may be used in all sorts of combinations.

The expressive powers of the organ must now be noticed. They are admirable. With the exception of the open diapason every stop is inclosed in one of two swell boxes; the one in front, the second at the back, commanded by a balance lever brought on and cut off at will by a pneumatic button. It is impossible to describe the effects produced by these means; only by actual hearing is it possible to realise all that can be produced by them.

I have been astonished week by week in looking over the contents of "Ours" to find that at present no organ builder has thought it worth his while to enter into the lists with Mr. Audsley. If that gentleman's views, as enunciated in the columns of this paper, on the church and chamber organ are correct (and what musician really doubts them?), they are a standing condemnation of almost every organ builder of the present day. Developed upon Mr. Audsley's lines, at least, the chamber organ has a splendid future before it. To every one who contemplates building a chamber organ, it is the most obvious suggestion to say, consult Mr. Audsley at the first step, and examine his instrument.

Some of your readers may begin to wonder what I think of my Mustel organ now. Sir, I think of it every bit as much as ever. To compare the two instruments the one with the other is impossible. The wealthy amateur, willing to spend a large sum, will have his perfectly appointed music room and a pipe organ; but to the ordinary member of the middle class, possessing a commonplace drawing-room or parlour, and a purse limited to, say, from £150 to £300, I am more than ever convinced that the Mustel is the instrument. I am convinced that more music, more variety, can be got from it than could be obtained from any pipe organ, however skilfully compacted, even by Mr. Audsley himself, within that money limit.

And even to such an instrument as Mr. Audsley's own a Mustel organ would be a very worthy companion. **Country Solicitor.**

THE EDMUNDS MANDREL.

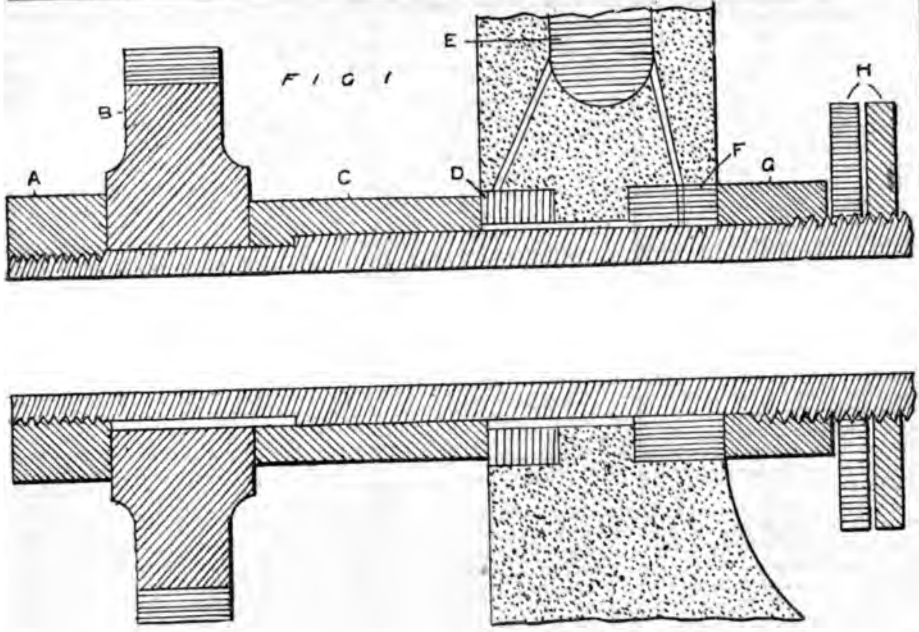
[27605.]—IN continuation of my three last letters ("E.M.," 1149, 1153, and 1156), I now reply to recent discussion with a view to reporting further progress. I am anxious to get the form and dimensions of our standard mandrel agreed to, as Messrs. G. Birch and Co., of Manchester, have four of these lathes in hand for various amateurs, and they will be waiting if our mandrel-head be not settled. Mr. Birch has recently been in London, and I have had the advantage of long and practical conferences with him and Mr. Gray on various points, and I hope to go to Manchester next week in order to see his model tools. This mandrel question is now ripe for settlement, and when it is disposed of, our road will be open to various other simplifications and improvements in scientific lathes intended for general utility.

I.—Mr. Newall's second letter (27325) is a valuable contribution to the subject of cone-faced mandrels. I confess that I think he has strengthened his position in favour of the cone-face. His letter should be carefully studied, as the arguments for a cone-face could not be better put. My own conclusions, nevertheless, remain in favour of the cylinder-base, combined with a wide mandrel-face ground up so as to bear upon its peripheral zone, the screw-nose being a mere holdfast as free from concentring action as possible.

It is true, as Mr. Newall argues, that the production of a true cone is no more difficult than the production of a true cylinder, and the cone, as a bedding surface, has the immense advantage that it stands being trued up repeatedly without deteriorating. But so also does the flat mandrel-face. The cylinder-base, on the contrary, may by a careless maker be ground down below its gauge, and the mandrel have to be set aside for secondary purposes. But this only goes to employing for such work a skilled artisan accustomed to the delicate duty of polishing fine hard steel work down to gauge. The insurance against such accidental spoiling of the mandrel would not amount to five shillings. As to the mandrel-face, that would be hollowed out by an obvious curve on its inner half, thus giving artistic form to the mandrel-head, and securing for the chuck-face a marginal bearing. This curve serves as a break between the surfaces of the cylinder-base and mandrel-face, and thus enables the surfaces to be finished without difficulty. As was fully described two years ago, this finishing these surfaces to gauge will be done when the mandrel is otherwise completed, and is turning in its own bearings. It must be done with accurate grinders revolving at a high speed, and used wet, so as not to heat and soften those surfaces which should be left *hard*. For such work I should myself use laps of pure perfectly soft steel, solidly set upon their spindles, and then carefully turned up true, and to such V-shaped face as would best finish the two surfaces. The revolving laps must be held in a solid slide rest with true traversing and face motions. As abradants, I might face my first or *grinding lap* with fine diamond dust or strong emery; my second or *smoothing lap* with fine emery of best quality, and by this smooth down my surface perfectly, taking off nearly the last hundredth of an inch. My third or *polishing laps* would polish off the last few thousandths of an inch, and probably by means of carefully elutriated flour-emery, putty-powder, and rouge—used consecutively. The smoothing process is critical, and until this is accomplished perfectly, a fine surface cannot be put on by polishing. The smoothing must take out all the scratches and irregularities left by the grinding, and must leave the surface a soft, dead, silver-grey, which, when examined with a watch-lens, is seen to be free from scratches and holes. If the surface be not properly "bottomed" by smoothing, the scratches and holes will remain to spoil the polished surface unless the gauge is reduced below its standard. The grinding, smoothing, and polishing laps must be kept distinct, and each used only with its own abradants. It will be found that a mixture of half glycerine and half water answers much better for fine tool grinding than water alone. This mixture does not dry up as water does. If a lap once faced with diamond-dust or emery be used with rouge for the final polishing, the smoothed surface will be spoiled instead of polished, inasmuch as the minute crystalline particles of diamond-dust or sapphire (of which pure emery consists) when once imbedded in the face of a lap can never be got out. The scratching or grinding process is thus reintroduced when polishing alone is admissible.

The beautiful results now obtained by the modern methods of sharpening hard steel cutters of complicated form need only to be studied in order to see that there is no difficulty whatever in the very simple grinding up needed for the two rectangular surfaces of our model mandrel-head. The face cannot well be spoiled, as it stands being trued-up repeatedly; and the cylinder-base, if gauged within a half-thousandth of an inch will answer every purpose. Such a cylinder-fit would admit an axial variation of the chuck which, at its outside, will be a quarter-thousandth of an inch; that is to say, one half the play which is possible between the nose-base and the chuck-recess.

II.—Mr. Newall overlooks the fact that we [illegible] make not only a true cone but a true cone [illegible] scribed angle. Now, in order to enc[illegible] that an [illegible] workmen and get rid of bad ones, we [illegible] rubbed on mandrel-head with such surface[illegible] will keep th[illegible] can test and verify for him[illegible] to cust[illegible] light (?) [illegible] essential[illegible]ice of name [illegible]



F I G 1

test, as used by opticians in the finishing of lenses, tells us at once whether we have on our lathe a true surface of revolution, and this will serve equally for cylinder, face, and cone. But the reflection test does not so easily show whether our surface is a plane, or a cylinder, or a cone of any particular angle, or even a surface generated by the revolution of a straight line. Now, with the slide-rest set so as to turn up a cylinder which will give a uniform diameter with ordinary calipers for six or eight inches, a nose-base one-fifth of an inch long may be polished down practically to an absolute cylinder. And with the straight edge our wide face can be verified at once —if a surface of revolution. In fact, a good solid slide-rest, a straight edge, and a muff-gauge set us up not only for making but also for measuring the truth of the surfaces of our mandrel-head. But I know of no means by which coned surfaces can be reproduced or matched with approximate accuracy, or can be so easily tested by the buyer.

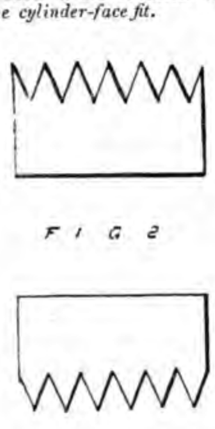
III.—Mr. Newall thinks that "the mandrel face, unless at right angles to the cylinder base, will be useless." This is a mistake. If only its margin be a circle of revolution, and the face be so hollow that nothing but the edge supports the chuck, the set of the chuck will be perfect. In point of fact, I should always turn up the face at less than a right angle to the cylinder base; then begin by grinding out a curve on the inner half of the face, and then true the outer margin down flat. Again, Mr. Newall says: "To gain full advantage from the cylinder fit, the whole length of such fitting on spindle and chuck should bear alike—that is, they must be exactly parallel, and fit to within $\frac{1}{2000}$ of an inch." Here I would add that if the "cylinder fit" were, mathematically, a frustum of a long cone, it would centre just as well as a perfect cylinder. It is only necessary that the cone, when fully home, fit on the one hand without shake, and on the other so easily as not to prevent the face of the chuck from bearing solidly upon the face of the mandrel. The radial increments of the cone must not be as large as to intrude its axial component between the nose-base and the chuck recess as these advance over each other. Now, the nose-base is ·200in. in length, and should it be a frustum of a cone diminishing in diameter at the rate of one in fifty, that would be given by a slide-rest, set so as to turn a cone 5in. long and ·1in. smaller at one end than at the other. Assuming that the chuck recess were coned out to match, and to fit solidly when home upon this cone-base, the entering part of the cone would be ·004in. smaller than the corresponding circle of the recess. This would give a very easy entry, yet the recess, as it moved up over the cone-base, would approach more and more closely to its surface, and, when home upon the cone-base, would have each of its radial elements in solid abutment-contact with the corresponding radial elements of the cone-base. If the cone be too blunt the radial elements will abut against each other before the chuck-face bears solidly upon the mandrel-face; the coning must then be lessened, or the original distance between the surfaces increased. Therefore, with a nose-swe that is, in point of fact, slightly tapered, the the pong action will be just as perfect as with a glass, cauh is truly cylindrical; and it is not essen-diamond wita face be flat or that the nose-base sur-are thrown aaxylindrical or at right angles to the on the glass seem 's only essential that both the would add here that it·drel-face be surfaces of revo-

***annealed* would be better ɪɴ**

I gather this from the m

lution upon the mandrel axis. Lastly, the area of the bearing, which is secured between the nose-base and the chuck recess, affects the endurance of the bearing surfaces; but, within reasonable limits, the extent of this area does not affect the accuracy of the centring.

IV.—In the event of the chuck recess being turned out too large, so as not to profit by the centring action of the nose-base, this will affect only the transferability of that particular chuck, and will in no way affect the standard mandrel. I should not propose to make all the chucks fit accurately upon the cylinder-base, but only those more valuable chucks in which refined accuracy of set and transferability are desirable. But chucks accidentally or intentionally finished to fit loosely upon the nose-base might easily be perfected. It would only be needed to turn out the recess still larger, drive in a short bush, and then turn this out to gauge, and finish up the recess as if in a new chuck. Mr. Newall's objections on the score of mathematical form and practical manufacture are, as I think, now fully answered. But I trust that we shall have some further observations from him on the interesting mechanical question of whether it is best practice to blend our two rectangular components into a single guide surface of conical form; or, to separate them more or less absolutely, as in the true cylinder-base combined with the flat mandrel-face—a combination which I have designated *the cylinder-face fit*.



F I G 2

V.—I now submit for criticism a tail-piece for our model mandrel. This is to be taken as the annex of our engraving for the pulley-fitting at page 275, "E.M." 1156. The tail-piece which our ornamental lathe men still use for the sliding mandrel is the design of Holtzapffel I., improved by Holtzapffel II. As we all know, these were both most able men—masters in, and conscientious workers for the advance of, their art. But since the last touches were given to the tail-piece of our sliding mandrel a whole generation has passed by, and, apart from the modern shaper, the tubular tail-piece now suggested—with its keyed portion pared down so as to leave its key in the original solid cast steel—could only have been manufactured with extreme difficulty. Even now it is not a tail-piece to ask a tinker to make; but it is one which, upon the mandrel of a modern shaper armed with properly-ground cutting tools and scrapers, a skilled workman will take a pleasure in turning out to gauge. The keyed portion must all be cut out of the solid or this tail-piece is inadmissible, unless the bore be considerably diminished. But it will be found to bring this portion of our model mandrel up to date, and to be a distinct advance in strength, handiness, and versatility. It will do all, and more than all, that the Holtzapffel tail-piece does. It goes perfectly with a screw-cutting lathe-bed. It gives us the immense advantages of a tubular mandrel always free from obstruction. And fifty people will come forward to tell us that there is nothing new in it.

I have already remarked that Mr. Gray's suggestion of the wide mandrel-nose transferred the limits of our boring-out from the nose to the tail-piece. It will be seen that we now get a bore of $\frac{5}{8}$in. throughout, with ample scope for adaptations of centres and miniature chucks to the interior of the mandrel-nose. We thus combine the delicacy of the American watch-lathe with the range and power of an English six-inch screw-cutter. Reading the engraving of our tail-piece from left to right, we have an outside diameter of $\frac{7}{8}$in., got by turning off $\frac{1}{16}$in. from the radius of the mandrel shaft, which at its back slide is 1in. in diameter. The first half-inch of this is screwed for a milled finger-nut (A) at the rate of 24 turns per inch. This nut may be split into a pair of lock-nuts if desired. The second portion, also $\frac{7}{8}$in. in diameter, but 1in. in length, has been pared down and scraped up to gauge with an accurate shaper so as to leave upon it in the solid cast steel a key 1in. in length, $\frac{1}{16}$in. in height, and $\frac{1}{8}$in. in breadth. This second portion will carry screw-guides 1in. in length so as to cut screw-threads by sliding the rotating mandrel while a fixed point-tool is in the rest. Upon this keyed portion also swash-plates and other pumping adjuncts can be fixed. When the mandrel is to slide, the sleeve on the right is removed; but at all other times the right-hand $\frac{1}{4}$in. of this keyed portion is occupied by the sleeve-cap slotted for the key, while the sleeve is extended to the right over the whole slide. The third portion is 1in. long, and slides an inch; but by a temporary contrivance its movement may be extended to $1\frac{1}{4}$in., or even more. The sleeve has its right end hardened, and abuts against the left face of the steel collar. The slide, when not in use, is entirely occupied by this sleeve, and its cap fills $\frac{1}{4}$in. of the keyed portion. The left-hand $\frac{3}{4}$in. of the keyed portion is then filled up by the boss of a change wheel or other adjunct and, by screwing up the finger-nut on the left, the hardened face of the sleeve is adjusted to bear against the face of the steel collar so as to prevent end-play. The screw-guides, swash-plates, and other pumping adjuncts each fill up the whole inch of the keyed portion, and are slotted for the key. The change wheels and other non-pumping adjuncts are also slotted for the key, but all have bosses $\frac{3}{4}$in. in length and $\frac{7}{8}$in. bore.

Further to the right is seen the back poppet of the lathe-head 1·25in. thick, and so shaped below as to offer immense rigidity to the end thrust of heavy boring. The poppet and the hindmost collar are bored out to such diameter that the mandrel-shaft runs through quite free—the function of the hindmost collar being limited to that of preventing end-play by affording a bearing to the hard face of the steel sleeve on the tail-piece. The central piece of the poppet supports on its left this end-play collar, and on its right the end-thrust upon the back bearing of the mandrel. In the substance of the back poppet above, is seen the lower part of an oil chamber in the central portion of which sediment may be deposited, while through the channels oil may flow down to lubricate the three bearings. Further to the right (G) is seen another steel sleeve, its back face hardened, and its interior slotted for the key action of the projecting turns of the thread as shown below, and which prevent the sleeve from turning upon the mandrel-shaft. On the extreme right are two lock nuts (H) by which this sleeve is adjusted against the front face of the back mandrel-bearing, and made to take the end-thrust.

VI.—It will be remembered that the mandrel-shaft at the front bearing is 1·2in. in diameter with a front cone of 45°, but if a more rigid mandrel is desired it may be made 1·25in., and then we get $\frac{1}{16}$ to come off the radius of the shaft as an abutment for the gear-wheel, while we leave another $\frac{1}{16}$ for the screw-thread behind the pulley, or the bore may be limited to ·6in., or to $\frac{9}{16}$ths. In this mandrel-model the keyed part of the tail-piece where the change-wheel is carried is the weakest part which is exposed to flexure or torsion; but even here we have a cast steel tube $\frac{1}{8}$in. thick and $\frac{7}{8}$in. outside diameter. I think that this mandrel-shaft will be up to everything that can be reasonably expected. In judging its form and its dimensions we must consider its efficiency and strength, its durability, and its versatility.

Referring to the pulley-fitting engraved on page 275, Mr. Birch prefers to have a through hole in the gear wheel in order to grind and lap it out with accuracy before keying it on to the mandrel shaft. To get this the back shoulder might be turned out of the gear-wheel from behind so as to leave a 3in. recess, and when the wheel is finished and ready for keying up, this recess could be filled up with a steel plate which would afford the requisite shoulder-bearing for the mandrel shaft. The extension-boss in front may be made longer if desired, as 1·5in. slide is the utmost that can be utilised between the front of the extension-boss and the back of the front poppet.

Note.—In Fig. 1 the top half section of the collar (F) should be shown as the back-bearing in full contact with mandrel-shaft. The oil channel should be continued through for back-face of collar.

Note.—In Fig. 2 the hole of the screw-guide should be shown as ⅞in., so as to go on to the keyed portion of mandrel-tail.

James Edmunds.

8, Grafton-street, Piccadilly.

CARBOLISED OIL.

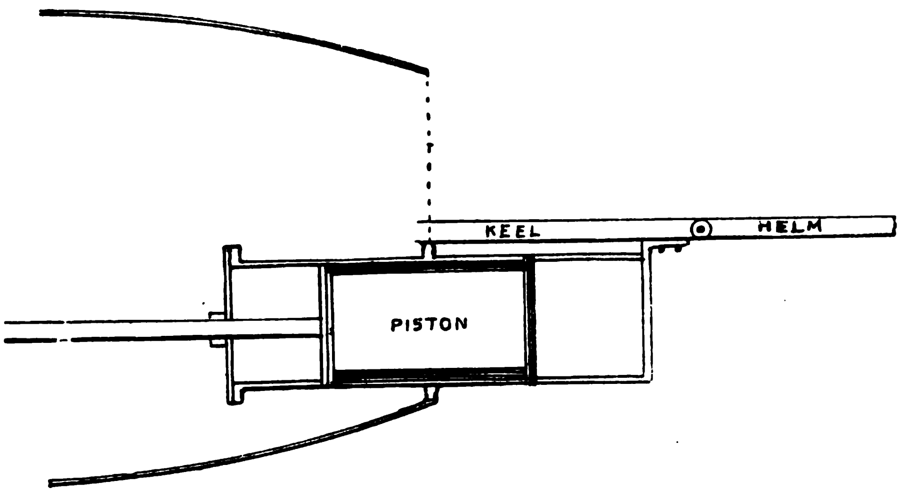
[27606.]—HERE is one of many instances in my experience of its great value as an antiseptic dressing. Some children of an Indian washerman in their play fell over the great smoothing iron, a massive, hollow affair filled with red-hot charcoal. An infant 12 or 15 months old was left by them with its face prostrate on the flat side of the metal —the hottest! The others ran away screaming loudly. However, some minutes elapsed before the mother arrived, to find her female infant's features terribly injured. Afraid of the police, under an idea that they might be punished for culpable negligence, both parents kept the child in a dirty hut out of public view, where one of my servants chanced to see it and informed me. The child was brought to my house. I cannot possibly describe the necrosis and sloughing of the burnt cheeks and forehead. Clouds of flies attended the putrefactive odour arising from the neglected injuries. I painted the several portions with a soft feather dipped in carbolised oil once daily until the flesh became healthy, then I reduced the strength of the oil, and, in time, only employed a weak dilute wash (of water instead of oil), just enough to keep off insects, and, at last, the deeply-scarred face was all that remained of the very dangerous accident.

Then "Purulent Ophthalmia" occupied my attention among my servants and others. Seclusion in a darkened hut, and the above oil, cured a man in a week who was told he would become blind for life. Soon after, I went to Port Natal (about 15 years ago), and published my formula there as a probable insecticide to the tsetse fly; any common vegetable oil to be used with carbolic acid and rubbed daily on the coats of domestic quadrupeds passing through the infested region. Before long, a greedy druggist "of that ilk" published my communication to the Agri-horticultural Society of Natal as his own valuable invention for explorers! Now, we have the British *Lancet* suggesting carbolic acid for the same purposes. I used it in South Africa against bush ticks — those plagues of the hunter and botanist. Their bites usually end in stubborn sores on feet and legs of the white man. Similarly, the leeches of Assamese forests by day, and mosquitoes by night, suck his blood, and poison it too— carbolic, or petroleum, the only counter-force. When I left Natal, for other parts of the South African colonies, there was a great mortality among horses and oxen; on pastures and roadsides their putrefying carcases bred legions of flies, and these restless insects pursued the traveller or passing colonist, infecting his eyes with their foul heads and legs. Thus I was led to treat numerous serious ocular cases among my friends, and used the carbolic as a prophylactic unguent to my eyelashes and eyelids, to my own great satisfaction. Of late years a new antiseptic, known as "Jeyes' Perfect Purifier," has proved an active rival to the carbolates, there being so many purposes where this *non-poisonous* chemical, also *non-corrosive*, must take precedence—as for sheep-dips, poultry-houses, birdcages, lotions for the mouth, diseases of horses and cattle, infants' soap, for cleansing the coats of dogs and other domestic pets, &c. Judging by the odour and flavour, I take this to be a compound of creosote and purified gas liquor. I have used it myself in weak solution as a tooth wash. I have also tried it as an *insecticide*, with caution, on diseased vegetation; it proved very effective.

Eos.

MARSHALL'S METHOD OF PROPELLING VESSELS.

[27607.]—THIS plan occurred to me in 1882, while in Hongkong; but being of opinion that the piston would move faster than the water, led me to the idea that if I used what I call a canister piston with a groove right and left running in two guides, that the water would follow or close as it were on the piston as it retired; but as I did not possess the tools or the means to obtain the same, I have been prevented from turning my ideas to practical account, and as this is a favourable opportunity to introduce my scheme, I will not withhold it any longer, hoping, at the same time, Mr. Marshall will not be above uniting my scheme with his patent, for he will find that his patent is almost useless as it stands.



Upper Holloway, July 1. **John W. Hillier.**

PROPELLING STEAMSHIPS.

[27608.]—AS I, unfortunately, have not had the time or the opportunities for reading up "all" the trials and failures which have taken place anent the multifarious projects discussed in these pages, I would ask "J. W." (page 442) "where can an account of the experiments with the *R. F. Stockton* be found?" I dispute his dictum that "to get the best effect from a propeller," or from anything else, "it should be at the end of a long shaft." Thus out of 100H.P. at the one end of a screw-shaft there is only 35 effective upon a screw at the other end. I also hold very different opinions to those of "J. W." in that it is evident to my understanding "that we will never, either in this world or in the next, reach a point when further improvement and development of any branch of science will cease." If desirous of amusement for his baby friends, he would find much more splashing caused by paddles than could arise from the revolutions of a half-submerged screw. All propellers tend to prevent the vessel making a straight course, and if this objection cannot be softened by increasing the number of blades, it could be by having a port and a starboard propeller, one in advance of the other. To "H. J. M.," same page, I think that anyone who reads what I conclude he virtually says upon page 381 will agree with me that he does propose "sudden stopping and reversing of heavy bodies in motion." As to curving the cylinders, such a proceeding would be fatal. I did not assert "that a vacuum would be attainable," only a tendency thereto, but that "because the floating vessel is lighter than said water she has more tendency to back into the space left by drawing in the piston rapidly, this being counteracted by her momentum forwards." But a conclusive test is, if he has made a boat upon this principle—put piston out to end of stroke, let the boat be perfectly motionless, now pull in the piston, and she will go backwards.

A., Liverpool.

THE ORTHOSCOPIC LENS—OPTICAL QUESTION.

[27609.]—MR. BOTTONE (27562) has given to the readers of the "E. M." a very thorough description of the old "Voigtländer." One matter has, however, recalled to my mind the confusion the terms *positive* and *negative* must cause in the minds of those young aspirants to optical knowledge who, unlike old stagers like Mr. B. and myself, are likely to flounder considerably in the road-side ditch that some of our optical teachers have left open for the benefit of those inexperienced drivers. To illustrate my meaning more fully, I quote side by side our valued "Orderic Vital," whose terms are the most carefully chosen, and our friend Mr. Bottone, with Dr. Parkinson. "If the convex-radius exceeds the concave, or R is greater than *r*, the lens will be concavo-convex, and will give a *negative* focus."— "Orderic Vital."

"The front lens is composed of a double convex lens of crown glass, cemented with Canada balsam to a concave lens of flint, the entire lens having *negative* focal length—that is, causing parallel rays to converge to a focus on the *opposite* side of the lens to the origin of light."—Mr. Bottone.

"A lens whose focal length is *positive* is called a *concave* lens."—Parkinson's "Optics," 4th Edition, p. 94.

Meanings so diametrically opposed given to the same terms are, I think, rarely found in other than optical text-books, and I do hope *they* will ere long give up the monopoly. A concave lens has not a *positive* focus, unless used reflectively, when it ceases to be a lens—is changed, indeed, from a dioptric to a catoptric instrument.

Mr. Hunt (27476) puts a question that I fear will be troublesome to answer. If, as is generally understood, the image formed by a properly-corrected o.g. be a slightly curved one—i.e., representing a radius equal to the focal length of the o.g. Now, as the portion of arch is only that represented by the diameter of the stop or field bar in the eyepiece we use, the difference between the centre and edge foci would be so slight as to be imperceptible. Of course, the supposition is that the *eyepiece* is an aplanatic one. Is it not more likely that the lesser quantity of light admitted by the restricted aperture allows the eye to adjust itself to give a distinctness to images that would overpower that organ were the whole light admitted?

In support of this supposition, I can say that it is possible to see distinctly with *small* apertures slightly out of focus if we allow the eye time to adjust itself to the conditions thus imposed upon it.

Prismatique.

POISONING OF CATS.

[27610.]—I SEE that the author of the article on "Poisonous Trees," in your last number, gives a receipt for the poisoning of cats at the close of his article. Having recently lost a very favourite cat through poison, I trust you will permit me, apropos of "Tukang Besi's" article, to enter a fervent protest against the cruel and selfish practice which, unfortunately, seems very common. To destroy other people's property silently and without warning seems rather a cool proceeding. Dogs and fowls often give far more annoyance at nights than cats; but any attempt to get rid of them would be sharply punished. It seems hard that cats cannot obtain the same protection. Apart from their acknowledged usefulness, cats give a great deal of pleasure as pets to their owners, and the spectacle of the terrible sufferings of the poor creatures under poison is very painful. I trust that these remarks may deter some from commencing the practice, though I know that it is almost impossible to convince people who do not themselves like cats that the animals have any rights whatever.

If a man gave fair warning to his neighbours that he would shoot all cats he found in his garden, I do not see how the neighbours would have so much reason to complain; but this is never ventured on—cat-killing is always done in an underhand manner. The late Frank Buckland must have been a nuisance to his friends with his monkeys and other zoological pets; he would, however, have been rather astonished if anybody had assumed the right to poison the monkeys.

Œdipus Rex.

PAINTERS' OPTICAL ERRORS.

[27611.]—IT does seem singular that painters should make errors like those referred to by "E. L. G.," especially as they are pointed out year after year, and an artist of any standing can have no difficulty in ascertaining from friends whether his arrangement is scientifically accurate. Possibly the painters say they require certain effects, and they will get them in their own way; but in the case specially mentioned by "E. L. G." there is decidedly bad work. But if painters make these mistakes, what shall we say of the blu[illegible] that an continually meet with in the daily press [illegible] rubbed on which could not be made by any [illegible] will keep the even a rudimentary knowledge [illegible] phenomena around him. It [illegible] to ought (?) giving a list of those [illegible] essential[illegible]ice of same gathered up out of the daily papers; but, as a sample, I may mention that I recently saw the statement that "Sir Somers Vine pervaded the place like the scarlet end of a rainbow." What does "E. L. G." think of that? It puzzles me to know why the writer should go out of his way to draw such a simile. **Nun. Dor.**

THIS SUMMER PROVES THE MOON TRIUMPHANT.

[27612.]—FROM the annexed table it will be observed that, comparing the apsidal differences of the moon for 1868 with 1887, that January agrees with March, February with April, and so on till we come to October, 1868, agreeing with December, 1887; and considering that the full moon occurred on the 9th January, 1868, at 10.52 p.m., and on 9th January, 1887, at 10.32 p.m., and that the remaining phases for these years approximately corresponded, and also that the position of the moon in the node cycle is similar for these years, we ought, if the moon controls the weather, to expect the same kind of summer in both these years. And so far the present summer and that of 1868 have been much the same, thereby so far proving that the weather is a function of the cycles of the phases, nodes, and apses of the moon. And this view is confirmed in other cases, among which I may be allowed a reference to the years 1859 and 1879, the one year being almost as an exact a counterpart of the other, so far as the distribution of rainfall is concerned, as possibly could be.

APSIDAL DIFFERENCES OF THE MOON.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1868	0·10Fo	0·18Fu	1·20Fu	3·12Fu	3·4Fo	1·17No	0·17No	0·4Nu	1·2Nu	2·9Nu	4·18Nu	2 6Fo
	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. 1888.	Feb. 1888.
1887	0·4Fo	0·18Fu	1·20Fu	3·11Fu	3·10No	1·8No	0·23No	0·4Nu	1·3Nu	2·9Nu	4·19Nu	2·5Fo

	Dec., 1858.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan., 1860.
1859 (*a*)	0·13Fo	0·7Fu	1·8Fu	2·16Fu	5·21Fu	4·3No	2·5No	0·5No	0·19Nu	1·20Nu	3·12Nu	6·6Fo	2·23Fo	1·12Fo
	Dec., 1878.													Jan., 1880.
1879 (*b*)	8·10Nu	6·5Fo	2·23Fo	1·12Fo	0·12Fo	0·9Fu	1·8Fu	5·3Fu	4·10No	2·8No	1·2No	0·4No	0·18Nu	1·21Nu
	Dec.	Nov.	Oct.	Sept.	Aug.	July.	June.	May.	Apr.	Mar.	Feb.	Jan.	Dec., 1858.	
1859 (*c*)	2·23Fo	6·6Fo	3·12Nu	1·20Nu	0·19Nu	0·5No	2·5No	4·3No	5·11Fu	2·16Fu	1·8Fu	0·7Fu	0·13Fo	
													Dec., 1878	
1879 (*d*)	0·18Nu	0·4No	1·2No	2·8No	4·10No	5·3Fu	1·8Fu	0·9Fu	0·12Fo	1·12Fo	2·23Fo	6·5Fo	3·10Nu	

RAINFALL.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1859 (*e*)	4	2	2	(2)	(2)	(2)	(2)	(1)	(4)	1	(3)	(2)
1879 (*f*)	(3)	(5)	2	(3)	(5)	(5)	(5)	(5)	(3)	5	4	3
	Dec.	Nov.	Oct.	Sept.	Aug.	July.	June.	May.	Apr.	Mar.	Feb.	Jan.
1859 (*g*)	(2)	(3)	1	(4)	(1)	(2)	(2)	(2)	(2)	2	2	4
1879 (*h*)	3	4	5	(3)	(5)	(5)	(5)	(5)	(3)	2	(5)	(3)

In the accompanying table it will also be seen that the apsidal differences for 1859, when taken backwards, month by month, agree with those of 1879 from a comparison of the lines marked (*a*) and (*d*) and those marked (*b*) and (*c*).

Again, with regard to the rainfall for those years, it will be noticed that it corresponds on comparing the lines (*e*) and (*b*) and (*f*) and (*g*), giving the comparative amount of wet or drought for each month in degrees above the average given in figures in brackets, and under the average stated in figures without parentheses.

This most remarkable example demonstrates, when confirmed by other cases, that when there is a considerable similarity, if not identity, between the times of the phases of the moon for any two years and the position in the node cycle, that the incidence of rainfall and the weather is determined by what I term the apsidal differences, or the number of days and hours that elapse between the time of perigee and the phases of the moon.

Hugh Clements.

ORIGINAL ELECTRIC EXPERIMENTS.

[27613.]—"J. W." (letter 27585) did not answer former questions which I addressed to him, and now alleges previous adoption of several of the improvements published by myself in these pages; but we do not find the least trace of them in his book, where one would naturally expect to find such things mentioned. And as influence theories date back to, say, 1753, it is only right "that he should inform the readers of 'Ours' the precise improvements upon these influence-machines to which he lays claim." He says on page 444, "I find it desirable to varnish both sides of the glass discs, &c." Now, neither himself nor any other, to my knowledge, have coated "all" around the sectors with varnish (I have not written that the entire sector is to be covered with varnish). When he tries this improvement he will find speedily that the brushes carry the lac on to the sectors, and
the machine is not so readily excited without the
[illegible] porary application of a small rubber between
the p[illegible]tes, hence "the nasty petroleum" is neces-
glass, [illegible] Mr. T. Gray "used a glass sheet between
diamond w[illegible] years ago," it is remarkable that he
are thrown [illegible] such an arrangement in the book;
on the glass [illegible] with 16 sectors, not having
would add here this [illegible] lac, there is no inter-
annealed would be be[illegible] the sheet is between
I gather this from

them. As to the bundle, I opine that I am correct in terming a brush of any sort a bundle. I presume that he is aware that the wire of said brush seems to become non-elastic after a time, and requires renewal, and that it is simpler to adjust one and better not to have some of his bundle dissipating the charge by pointing in some other direction. He keeps a discreet silence respecting my assertion "that there is no gain from applying combs to both discs in connection with the same receiver." He does not notice that I assert that a great increase in the charge can be attained by coating the sectors deeply as they approach each other towards the boss, so as to prevent jumping from one to another. I assert positively "that Mr. Gray's machine as described in 'the book' is a failure," and that I can show far more power in proportion from a machine on my lines with only a pair cf 19in. discs. **A.**, Liverpool.

SHOULD WE EAT SALT OR NOT?

[27614.]—PRESS of work has prevented me from replying to the remarks that a reprint from the *Weekly Times and Echo* has caused. I still adhere to the statement I there lay down, that given right conditions of life, salt is not only unnecessary but is also injurious. All that are of a different opinion to myself simply show that under certain conditions animals will consume not only salt, but any mineral matter they can get. The reason of this is no doubt that the blood requires mineral matter to keep it of a proper density, and if the animal does not get it from the food, it will get it in any other way it can. In support of this I may mention two experiences, one on the feeding of horses and cattle and the other on feeding pigs. A discussion was started in one of our hygienic or dietetic papers on salt-eating, and this was one reply—that a breeder of horses and cattle used at one time to keep rock-salt for his cattle to lick; but after they could get access to good grass, and even to windblown and fallen fruit, they dispensed with the salt, and would not touch it. The pig instance I saw myself this year. A friend, who keeps a pig and studies its habits, told me of its fondness for cinders or coal, and he used to allow this pig a small shovelful daily. He noticed that some days the pig ate it all up, and other days it did not. When spring came in he had some comfrey, I think the plant was, in his garden; he cut some of this daily, and gave it to the pig. The animal relished it, and forsook its cinders and coal. The moral is plain: Feed properly, and no mineral is required. As yet no one has definitely shown me any disease, or wrong condition of the system, brought on by want of common salt, as salt added to the food. On the contrary, I have just had to record a case of violent gastric catarrh due to the excessive use of salt. The person used about 12 saltspoonfuls a day for two months, and then was affected with this stomach disorder. Those who want to get any good results from this discussion must bring forward facts in dietetics, and limit their replies to the subject under discussion, and not lead in other facts, however interesting they may be. Very shortly I intend to write an article on "Saline Starvation" in the *Weekly Times and Echo*, which I hope our Editor will copy. It will explain some of the cases that are mentioned by correspondents. In conclusion, I inclose a paragraph from *Tit-Bits* that will throw a little more light on the subject.

"People do not eat salt all over the world. Mungo Park describes salt as 'the greatest of luxuries in Central Africa.' The Darnaras, in South-Western Africa, never take salt by any chance; and even Europeans travelling in their country never feel the want of it. Their neighbours, the Managuas, set no store for salt; the Hottentots of Walfisch Bay hardly ever take the trouble to collect it. In the colds of Siberia, as in the heats of Africa, a similar disregard of salt sometimes prevails. Most of the Russians at Berezoo eat their food without a particle of salt, though that condiment can easily be obtained at a trifling cost. Their soups, vegetables, and even roast meats are prepared and eaten without salt. The explanation of these cases, so inconsistent with our general experience, is found in the instinct of the body itself. When the food we usually eat conveys a sufficiency of salt into the body, it has no occasion for more. It, therefore, feels no craving for it, shows no liking for it, and takes no trouble to obtain it. And, doubtless, the kind of food and drink consumed in the Darnara country, and by the Russians of Berezoo, or their habits, render less salt necessary to them, or cause less of it to be daily removed from their bodies. Dr. Jackson, on the use of salt, says: 'It has been proved over and over again by individuals and races of men and animals, that the use of salt is not necessary. I know many people who have lived in health for years without using a particle of salt in cooking, or in addition to their food after it is cooked.' Salt has played a not unimportant part in the world's history, and has had a religious and political significance. The ancient Germans waged war for the possession of saline streams, and it has been plausibly conjectured that the oldest trade routes were created for traffic in salt. One of the oldest roads in Italy is called the 'Salt Road." The salt mines of North India were worked before the time of Alexander. Cakes of salt have passed as money in Abyssinia, and elsewhere in Africa, and Colonel Yule mentions it as a medium of exchange in the straw markets of Thibet."

T. R. Allinson, L.R.C.P.,
Author of "A System of Hygienic Medicine," &c.

A LENS USED BOTH FOR REFLECTION AND REFRACTION.

[27615.]—I SEE that your able correspondent, "Orderic Vital," has sent a letter on this subject, which has a special interest for me in consequence of the experiments which I have made in this direction. I send on a copy of a paper I sent to the *Philosophical Magazine* which appeared in the July number of the year 1882, in which the method of finding curvature and refractive index by means of light reflected from the back of the lens was fully discussed. Even before this, Prof. Clifton had the method in use at Oxford; but it had not been published, and, of course, I had not heard of it, nor was it then generally known. Prof. Clifton shortly afterwards communicated a paper to the Physical Society, in which he treated the subject generally and completely, even in the most complicated cases, which I had not touched. The method is now used regularly in the Science Schools, South Kensington, and in other physical laboratories. As "Orderic Vital" appears not to have seen my paper in the *Phil. Mag.*, he may be glad of the reference. **C. V. Boys.**

Effects of Vapours of Hydrocarbons.—While an American mill was closed for repairs, the long iron tube conducting the water from the cana to the turbine was painted with a mixture of benzine and asphaltum as a protection against rust. While the work was in progress, the superintendent, passing by, heard sounds of hilarity within, which were not strictly in accordance with workmanlike conduct, and on looking through the manhole saw the half-dozen employés in boisterous mirth dancing around painting each other's faces and clothes. On seeing the superintendent, they invited him to come and be frescoed. Suspecting the cause of the difficulty, he summoned a larger force of men, and much difficulty was experienced in removing the men; although before all were taken out the remaining ones were already in a state of partial stupor. The open air revived them, although it was followed by a true Blue Monday headache. The utmost care should be exercised when it is necessary to use paint giving off hydrocarbon vapours in confined spaces.—*Engineering.*

A SUBSTANCE resembling ivory, of creamy whiteness and great hardness, is made from good potatoes washed in diluted sulphuric acid, then boiled in the same solution until they become solid and dense. They are then washed free from the acid and slowly dried. This ivory can be dyed and turned, and made useful in many ways. The artificial ivory that will receive and retain a polish has not, however, says the *Engineer*, yet made its appearance.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[62000.]—**Steam.**—I believe I replied to this query. If querist will repeat, giving sizes of cylinder and pressure used, with revolutions per minute, and also at what part of stroke steam is cut off, I may be able to give him a reply; but he should be able to work it out with the particulars I gave, if he will remember that a cubic foot of water weighs 62½lb.—T. C., Bristol.

[62474.]—**Foul Zincs.**—I have had the red crystals form on plates which were unamalgamated, so that in this case, at any rate, they consisted of "chromic alum."—ELAG.

[62474.]—**Foul Zincs.**—Concerning the answers to the above query, I confess that I was puzzled. I did not think it was chrome alum, because it was a crust, and not crystalline. Having collected a small quantity, I gave it to a friend who knew something about chemistry, and asked his opinion of it; on analysis, he stated it to be a chromate of mercury.—PRINCIPIA.

[62474.]—**Foul Zincs.** — "Mag. Est Ver." thinks that some of us who answered this question must necessarily be in error. I do not see that such a deduction is necessary. If a querist speaks simply of a "hard red deposit" without giving any further particulars, it is obviously impossible to state the composition of a substance you have never seen. I have had some twenty years' experience in the use of physical and chemical apparatus, and have never observed a deposit of mercury chromate on the zincs of a battery; but that does not prove that such a salt may not be formed under certain conditions. If you work a solution of pot. bichrm. to the "bitter end," there will be a plentiful deposit of chrome alum at the bottom of the cell, and some will form on the carbons if they are left in the liquid. It must be due to great want of attention if they form on the zinc. A short time ago a friend of mine asked me to look at his bichrom. battery that was out of order. I found the plates thickly incrusted all over, and the liquid in the pots turbid and reduced in bulk by evaporation. This deposit turned out to be pot. bichrom., and the liquid was not acid. The battery had been put up without acidifying the solution. Consequently, the salt had crystallised out. On adding water and sulphuric acid, the deposit was dissolved and all set right. This is the only case that has ever come under my notice in the whole of my experience—at least, with the exception of a bottle bichromate cell, in which the carbons were left immersed and the crystals had formed between the plates. If I use a bottle cell, I always remove the plates bodily when the cell is not being worked. —SM.

[62485.]—**Tinman's Prices.**—To "C. M. B."—What I wish to learn is the price paid to tinplate workers for the manufacture of goods at factories in London or Birmingham.—TINPLATE WORKER.

[62523.] — **Harmonium Vibrators.** — As "G. L. B.," p. 446, wishes to know the reason "why I did not tell the querist how to cast the blocks, and why, in my previous reply, I did not even 'very briefly' tell the querist how to make the vibrators?" permit me to inform "G. L. B." that the reason is simply because I considered it a greater kindness to advise the querist to buy his reeds instead of wasting his time in trying to make them. Does "G. L. B." suppose that any person who asks for instructions in the art of reed-making can possibly make reeds equal even to those at 6s. per set? If so, that is another "false idea" of his. Granted that the querist could make reeds satisfactorily, he must certainly obtain more information than that given by "G. L. B." on p. 398, for the so-called instructions there given, which are decidedly too vague, could never be sufficient to enable the querist to accomplish his undertaking successfully. Reed-making is a distinct branch of the trade. This is proved correct from the fact that a great number of reed-organ manufacturers do not make their own reeds. Alexandre, for instance, was not a reed maker, although he was a first-class harmonium manufacturer; and the same may be said of many other harmonium-makers. I quite agree with "G. L. B." when he remarks, p. 446, that "it is always advisable to procure the best reeds that can be obtained," and that the "reeds are the life and soul of the harmonium." Reeds made by a person unaccustomed to the work would not be the life, but the "death" of any harmonium in which such reeds were placed. Very bad advice, indeed, to recommend anyone to make harmonium reeds, and very bad policy for anyone to take such advice. "G. L. B." seems to think that there is but one price charged by every dealer for a certain class of reed. I will endeavour shortly to show this idea to be incorrect. "G. L. B." seems to differ from many of the writers in "Ours" in one particular point, which is this: he does not appear to answer any query until he has found something or somebody to find fault with; and even when he does reply, he takes jolly good care not to enlighten the querist very much.—G. FRYER.

[62525.]—**Piston Rings Blowing.**—I should say that the experienced locomotive drivers were "romancing," or trying it on rather too thick. They may be able to tell whether it is at the in or out-stroke that the leakage occurs, but not which of the piston rings, assuming there are two. This is a question which seems to have been overlooked by "Loco." and other correspondents, who apparently know all about such matters.—G. E. R.

[62529.]—**Signal Light.**—There is nothing better than tar or creasote, with the addition of a little coal oil.—J. M. T.

[62530.]—**Green Holly.**—It is better, I think, to let holly dry thoroughly in the plank before slicing it up; but possibly Holtzapffel says something about it, if you can see his volumes.—SELIM.

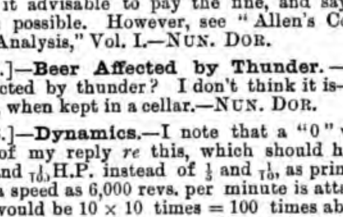
[62532.]—**Cane-Sugar in Beer.**—It is doubtful whether any means of estimating the quantity of cane-sugar present in beer can be devised. As to recent prosecutions, it is probable that if the publicans had determined to defend the case, they would have been successful; but, I suppose, as they couldn't deny the addition of water, they thought it advisable to pay the fine, and say as little as possible. However, see "Allen's Commercial Analysis," Vol. I.—NUN. DOR.

[62543.]—**Beer Affected by Thunder.** — Is beer affected by thunder? I don't think it is—at any rate, when kept in a cellar.—NUN. DOR.

[62618.]—**Dynamics.**—I note that a "0" was left out of my reply *re* this, which should have been $\frac{1}{50}$ and $\frac{1}{100}$H.P. instead of $\frac{1}{5}$ and $\frac{1}{10}$, as printed If such a speed as 6,000 revs. per minute is attainable, it would be 10 × 10 times = 100 times above the above result under the conditions I named—that is, 2H.P. if used in half a minute, or 1H.P. if used in a minute.—T. C., Bristol.

[62618.]—**Dynamics.**—You say the two replies to this query were not in agreement, when both answers gave 344ft.-lb. as the energy stored in wheel, which if expended in one minute gives $\frac{1}{100}$, or ·01 H.P. "T. C., Bristol," evidently made a slip; $\frac{1}{5}$ and $\frac{1}{10}$ should be $\frac{1}{50}$ and $\frac{1}{100}$ H.P. respectively A horse-power = 33,000ft.-lb. per min. If the wheel revolved at 6,000, instead of 600, you can either multiply 344 by 100 = 34,400ft.-lb. = 1·04 H.P. for one minute; or you can substitute 6,000 for the 600 in the formulæ I gave you before, and you will get the above result.—ELAG.

[62631.] — **Call Bell to Telephone.** — The method recommended by "Electra" will not act. If your connecting-wire is the 3-strand galvanised steel wire usually employed, you will not get sufficient current through to ring bell unless you use a sensitive relay or magneto bells, which are the best for acoustic telephones. I have found the best manner of connecting the bell-wire to acoustic telephone-wire is to make a hook attachment to wire from a short piece of 14 or 16 brass wire, with a brass nut on its other end, and insulated with rubber, as sketch. Rubber must be pure. If any solder is used, it must be a mere speck, just sufficient to make contact, the aim being not to interfere with the mechanical vibrations of line. But you would find it much more satisfactory to run an extra wire of 14 or 16 hard-drawn copper, if your posts, &c., are strong enough. I presume you have an earth return by means of water or gas-pipes?—CHAS. PROVIS, Emsworth.



[62639.]—**Celeste Action.**—I hope Mr. Davies will excuse my answering questions addressed to him. If "T. S." will kindly say what a celeste action is I may be able to give him any information he requires. A celeste *pedal* is usually a third pedal put in a piano as a puff by third-rate makers. A "celeste" in a harmonium is a stop drawing on two sets of reeds, one being slightly sharper than the other. In an organ a "celeste" is precisely the same thing, substituting pipes for reeds. *Re* the "little-weighted blocks"—what are they for? It is rare for a maker to send out pianos requiring weighted blocks. If "T. S." says what is wrong with the action I think it will be found that weighted blocks are quite unnecessary.—E. W.

[62659.]—**Malleable Casting.**—The moulding is the same as common cast iron. For the metal, get some H.C.M. white hematite iron for large casting; but for light ones use lawn iron. Melt in crucibles, as the castings are much better than when melted in cupola. I use Morgan crucibles by preference, as they are by far the most durable and reliable. The quality of the crucible is important, as it governs the cost of production. The annealing: get some pans made of the H.C.M. iron, and get some real hematite ore; for large castings, use six parts of old or used, and one of new ore; for light castings use eight parts to one; mix them well together, put a layer of ore and a layer of casting, and so on, until full; then put them into the oven or furnace; fire up slowly until nearly white heat. For large castings, keep them at that heat for six or eight days; for light ones, three to four days. The moulds should be faced with foundry plumbago; quality No. 1687, Battersea brand.—W. W.

[62666.]—**L. and S.W. Locos. at the Newcastle Exhibition.** — The following are the dimensions and particulars given me by the man in charge of the express passenger engine for the L. and S.W. Railway at the Newcastle Exhibition: —Built by Robert Stephenson and Co., to the design of Mr. W. Adams; No. 2,650; 4-coupled drivers, 6ft. 7in. diameter; outside cylinders, 18in. by 24in.; on 4-wheel bogie, wheels 3ft. 4in. diameter; tender on 6 wheels, containing 2,800 gals. of water, 3½ tons of coal; total weight of engine, 46¾ tons; working pressure, 160lb.; fitted with combined automatic vacuum and steam brake; cylinders fitted with Adams patent vortex blast-pipes, by which it is claimed a saving of 2lb. of coal per mile has been effected; total heating surface, 1,158sq.ft.—RALPH, Newcastle-on-Tyne.

[62679.]—**Sprained Ankle.**—Thinking it may be of some use to querist, I will state my own case. The first appearance was a slight lameness in my left foot, which I neglected, thinking it would go off, continuing my Post-office work. However, it gradually increased, and I was compelled to give in, and my foot became so painful that it was a great trouble to put it to the ground. As is customary in the Post-office, I had to see the doctor to get a certificate for absence. The doctor told me my instep had gone down, that I had a flat foot, that nothing could cure it; shook his head to my suggestion that a heavy load I had carried previously to attack had slightly strained the instep, which, unperceived at first, increased as we have seen. He told me he would write and tell the authorities I was unfit for the work. On this I got another certificate from a doctor friend of mine to certify my fitness, and who advised me to get a boot to give more support to the foot, with a spring in waist. I was wearing at the time spring sides, and he pointed out that these gave no support. I should get boots with strong leather sides, spring in waist, and wide, low heels. I soon found the difference on getting boots of this description, only the heels were too high; bootmakers seem to have a strange objection to making low heels. I found the result greatly improved by inserting a pad under the foot made of flannel; I put boot on, and before lacing up press this pad down right side of boot (I was dealing, you will remember, with left foot), and so as to take a position not right across waist, but so as to support the weak part. My friend told me the pad of leather furnished by the surgical instrument makers was much too large for the purpose; it certainly made me worse. Now, I took to frequent bathing with cold salt and water; at least, three times a day. I should have stated that I went to the University Hospital just to get an opinion; the doctor told me my foot was flat, did not think it was a strain, but a weakness induced by standing too long hours at my previous occupation, would advise sedentary employment, and bathing foot every morning with the coldest water I could get. Holding under tap was, he said, a good plan; he also said he thought my foot too far out of shape to get right again. I have continued bathing up to now, and at present, notwithstanding long walks, my foot has improved, and I now feel no inconvenience whatever. You see, the two doctors pronounced me incurable; my friend did not state so. More particulars if desired.—J. C.

[62697.]—**Alcohol.**—The quantity of "sugar" necessary to produce one gallon of absolute alcohol must necessarily vary with the quality and kind of sugar; the theoretical return cannot in practice be approached to within 25 per cent. to 35 per cent.; in round figures, 10lb. ought to produce a gallon of proof spirit, and twice that quantity a gallon of absolute alcohol. The hydrometer in use in England for testing the strength of spirit is not adapted for correctly trying very strong spirit, and absolute alcohol could not be tested by its use. Spirit [illegible] 67o.p. is of about 0·8156 sp. gravity only, [illegible] alcohol at the freezing-point of tempera[illegible] that an 0·8095, and at 60° F. 7947; by calcula[illegible] rubbed on alcohol would be about 77o.p. at 60° [illegible] will keep the [illegible]

[62699.]—**Locomotives.**—I [illegible] essential information concerning M[illegible] trusting someone else can give that for the S.E. and L. and S.W. Midland: 800, class 800 to 829, Neilson and Co., 1870, 6ft. 8in. four-coupled express, cylinders 17in. by 24in. (Mr. Kirtley); rebuilt by Mr. Johnson with cylinders 18in. by 26in.; 1827, class 1827 to 1846, Dübs and Co., 1877, 7ft. four-coupled bogie express, cylinders 18in. by 26in. (Mr. Johnson); 1490, class 1472 to 1501, Derby, 1880, and 1502 to 1531, Neilson and Co., 1881, 6ft. 9in. four-coupled express, cylinders 18in. by 26in. (Mr. Johnson); 1740, class 1738 to 1747, Derby, 1885, and 1748 to 1757, Derby, 1886, same as 1827, but with larger boilers (Mr. Johnson). G.E.R.: 251, class 245 to 254, Dübs and Co., 1879, 7ft. 6in. single bogie express, outside cylinders 18in. by 24in. (Mr. Bromley); others of this class are 600 to 609, Kitson and Co., 1882; 460, class 437 to 526, 5ft. 3in. six-coupled goods, cylinders 17in. by 24in. (Mr. Johnson), built by Worcester Engine Co., 1869, rebuilt by Mr. Bromley, 1879; 117, 5ft. 6in. four-coupled engine, cylinders 16in. by 22in. (Mr. Johnson), built by Sharp, Stewart, and Co., 1871; others of this class are 1 to 6, 27 to 36, 42 to 50, 103 to 118, 160 and 161; 360 and 393, class 307 to 416, 6ft. 1in. four-coupled engine, outside cylinders 17in. by 24in. (Mr. Sinclair); 393 was built by Vulcan Fy. Co. about 1864, and rebuilt by Mr. Bromley, 1881; 360 was built by Kitson and Co. 1864, and rebuilt by Mr. Adams (who replaced the leading wheels by a four-wheeled bogie) in 1878.—EAST ANGLIAN.

[62701.]—**Canoeing from Oxford.**—If "Yak" will get "Camping Out," published by Geo. J. Cosburn, Caxton Works, Newbury, price 1s., I think that will suit him. Five of us went from Reading to Oxford and back last summer. We hired a boat at Reading and were provided with all other necessaries by Harrison and Co., Theale, Reading, who also supplied us with every information as regards the river, to our great satisfaction. I have no doubt if you write to them, they will be willing to oblige you.—HASKEW.

[62707.]—**Dumb-bells.**—I should recommend dumb bells of 4lb. apiece as the most generally useful weight; there are some replies on the subject in Vol. XXXIX. Dumb-bells alone are rather monotonous, though beneficial; but if "London Clerk" can spare a couple of hours per week in the evening, I should strongly recommend him to join a gymnasium. He would find it of great benefit in counteracting the evils of too much sedentary work; moreover it is not an expensive amusement. I have been a member of one of the largest gymnasiums in London for many years, and have derived great good from it.—A. A. M.

[62710.]—**Electric Communication.**—No. 11 galvanised iron wire will suit your purpose.—J. FLETCHER, Burnley.

[62712.]—**The Lake District.**—I must begin by stating that detached residences are excessively dear in rents, there being a scarcity of houses; in fact, the intermediate class—i.e., between mansions and cottages—is very rare. I speak of Cumberland, Westmoreland, and Lancashire. Furnished lodgings are plentiful, at all prices, according to the season. In Cumberland, the vicinity of low lands or sheets of water is very prejudicial to health; at any time of the year there are dense, white mists, locally called "rags," which begin to discharge their aqueous formation in the fall of heavy dews after sunset, more or less, according to the season—hay-fever, rheumatism, and chronic coughs resulting therefrom; but the sea-side resorts are exceedingly healthy, as the suburbs of Whitehaven, also the small towns along the line of Carlisle and Maryport Railway, Silloth (or Port Carlisle), Allanby (excepting its water supply), Seascale, &c. Our American cousins have long ago commenced haunting the Lake district and highlands of Scotland, pitching half-sovereigns in lieu of sixpences to the admiring rustics! I was lately corresponding with a gentleman who wished to sublet a very desirable residence near one of the larger lakes. While I was treating with the owner away in the South, on account of a friend, a passing Yankee tourist went to the local agent and engaged this house for five years. I found the same state of things in Scotland; the Transatlantic gentry have taken a great liking to our alpine scenery and its attendant field sports. Westmoreland, except in its towns, has little accommodation for strangers; the air is very salubrious in most parts. Lancashire boasts of a very celebrated health resort—Grange-on-Sands—situated on a railway. Houses small, and very high rents; lodgings, furnished and unfurnished—filled in winter by people with weak chests and throats. I ought to have mentioned Cockermouth, in Cumberland, as being the most salubrious of towns, being close to Skiddaw. the lodgings only procurable.—EOS.

glass, [illegible]]—**Slide Valve.**—In such a small affair,
diamond w[illegible] put ports much larger than $\frac{3}{16} \times \frac{1}{32}$, and
are thrown [illegible] ore than $\frac{1}{64}$. Have the port open the
on the glass [illegible] paper when engine is on dead
would add here that [illegible]t get a distinct beat with such
annealed would be bette[illegible] fact.—T. C., Bristol.
I gather this from the

[62717.]—**Dynamo Design.**—TO MR. BOTTONE.—For such a machine, which is comparatively small, you should put about 10lb. No. 22 on the fields. The amount of wire on a Mather-Platt of the dimensions named, is about 12lb. No. 12 on the armature. For compound-wound machines 60lb. No. 18 on the fields, in shunt with the armature, and 9lb. No. 12 on each bar, in parallel with each other, but in series with the armature.—S. BOTTONE.

[62718.]—**Friction Clutch.**—This is a charmingly cool query. Querist wishes us to get out detail drawings for him. He had better consult advertising pages of *Engineer*, where a good one is shown.—T. C., Bristol.

[62720.]—**Franklinisation.** — In Franklin's time, frictional electricity (such as is obtained from the cylinder or plate machine) alone was known. Hence this "illigant tarm" means only the application of static electricity, either as *aura*, shocks from Leyden jar, or sparks; £2 would cover the *necessary* expense.—S. BOTTONE.

[62722.]—**Engineer's Storekeeping.**—I will endeavour to show "F. C. T." how this was done in the works of which I have had the management. As a rule most works are subdivided into different apartments—foundry, fitting shop, turning and planing, &c. Each of the departments has an order book with voucher attached. All orders on stores are given in writing on one of these forms, and the storekeeper has instructions to supply goods only in exchange for a check signed by foreman of department. It is a good plan to arrange matters in such a manner that supplies should be served out at appointed times only. I used to make a rule that, barring exceptional cases of urgency, supplies from stores could only be had at 8.30 a.m. and 2.30 p.m. The regulation prevents the storekeeper from being continually disturbed, and enables him to give proper attention to keeping his stocks in order and posting up his books. Every morning, after giving out goods required, the storekeeper sets about entering the articles supplied on the previous day. For this, if the works be sufficiently important, a special book is devoted to each department. This book is divided in vertical columns, the first of which is used for entering the date. There are as many columns as there are different articles usually required by a given department. The name of each article is inscribed above the corresponding column. The storekeeper has simply to enter in the proper column the weight or quantity of any article supplied as per check signed by the foreman of department, to which the book belongs. If the pages are made to contain 30 blank lines, a whole month including totals can be kept on one page. At the end of the month the columns are added up, and this gives the consumption of each article for each department separately. This facilitates considerably the getting out of cost sheets for the different kinds of work done. I think it is well to mention that if, for example, the fitting shop gets castings from the foundry, these ought to be procured through the stores, the fitting shop book having a column for casting, and so forth for the other departments. Besides the books above mentioned, the storekeeper should have a book arranged thus:—It is to be divided in columns, and one page is used for each month. The first column receives the names of departments; the other columns are headed by the designation of each article used in the works. This book is entered up every month, and gives at a glance the total consumption of each article used by the departments and shown by their separate books. It is useful for regulating purchases of materials, as it is easy when the book has been kept for a twelvemonth, to ascertain the mean consumption of any given article. Lastly, a stock-book must be kept. It is divided into six columns—viz., designation of articles, in stock month ending, received during month, total consumed during month, in stock month ending. The last column is the result of subtracting the preceding one from total. This system can evidently be modified to suit "F. C. T.'s" private requirements. I hope it may be of use.—COPPER.

[62723.]—**Sounding the Whistle when Trains are Approaching a Railway Station.**—I remember seeing some calculation about the cost of whistling on railways, but I cannot refer to the place, because I know I thought the remarks rather stupid, and did not make a note of them. As a rule, drivers give a short whistle when running up to a platform if they see passengers standing close to the edge; but not otherwise, unless they have special instructions, or some reason can be given why they whistle. The cost of such whistling must be an infinitesimal amount in the total expenditure for working any railway, and is not to be compared with the waste of steam in blowing off, or in working those vacuum brakes of which we have heard so much lately. Whistling, however, must cost something, and possibly some of the railway officials—a director, perhaps, anxious to save the shareholders' money—may have made a calculation of the total expenditure in whistling on his line; but it is one of the items of running cost that must be met until some other system is devised. I think it most likely that the statement referred to is very much of a joke. It is a positive fact that the booking clerks require ink to stamp the dates on tickets; I should like to know what is the cost per annum for that on all the railways in the United Kingdom—and I am not joking.—NUN. DOR.

[62725.]—**Furniture Cream.**—Some time ago I gave a selection of good recipes for "creams," &c., for cleaning and polishing furniture, and if "Funnyograph" will refer to his indices he may possibly discover something that will suit him. For all ordinary polished work there is nothing better than to wash the furniture with lukewarm ale and when dry rub up with a rag just moistened with paraffin oil. Any colouring matter must be put into the wood in the shape of stain. I don't believe that any polishing "cream" yet invented will give a lasting stain and polish too.—NUN. DOR.

[62726.]—**Photographic.**—If "P. H. K." will use the pyro-sulphite-ammonia developer, he will find it better suited than is ferrous oxalate for the Ilford plates. It is a common practice for each operator to swear by the particular developer he uses over all others; but it must be borne in mind the same developer does not suit all plates. The Ilford works best with Fry's, but with Beach's is a failure. An over-exposed plate is perhaps best suited by the oxalate, but with proper exposure pyro. has the advantage. I have some plates I made from a formula of Abney's. With Fry's developer I simply get no picture at all; but with Beach's the result is excellent. Another make of plate I have found to develop only with oxalate, all modifications of pyro. being of no use whatever. If the oxalate developer is abnormally slow, it may possibly be due to the ferrous sulphate solution having become oxidised. The remedy is a fresh solution.—SM.

[62726.]—**Photographic—Ferrous Oxalate.**—TO S. BOTTONE.—A properly exposed picture will certainly not require anything like twenty minutes to develop with ferrous oxalate. The following is my method of preparing the ferrous oxalate developer:—Take (A): Pure ferrous sulphate (free from persalt), 1lb.; distilled water, 16oz.; keep in corked glass bottle, full to the cork, adding water and sulphate whenever any is taken out, to keep the solution saturate and the bottle full. (B):—Potassium oxalate (neutral), 1lb.; distilled water, 32oz.; keep in corked bottle, with the same precautions as above. For use, pour out in a measure-glass three-parts of the potassium oxalate, and add thereto one part ferrous sulphate solution. If this order be followed the solution becomes of a deep orange, but remains perfectly bright; while, if the oxalate be added to the iron solution, the result is a thick, yellow soup, graphically described by one of "ours" as a "beastly mess." If you suspect your picture to be *over-exposed* add one grain of bromide of potassium to each ounce of developer; if the picture is *under-exposed* add to each ounce of the mixed solution 120 grains of a mixture of finely-powdered ferrous sulphate and potassium oxalate, in the proportion of 278 parts by weight of the former to 184 parts by weight of the latter. The used solution should not be thrown away, but put in little bottles, filled to the cork and set in the sun. This stale solution does excellently to start the development of pictures known to have been too much exposed.—S. BOTTONE.

[62726.]—**Photographic—Ferrous Oxalate Developer.**—Though this question is addressed to our obliging friend, Mr. Bottone, I have taken the liberty of replying to it, as I have been making a series of experiments on the development of dry plates. "P. H. K." asks what to do with an under-exposed plate, and still states that his negatives are fully exposed. An under-exposed negative is simply worthless, as it is almost impossible to print anything decent from it. I am inclined to think that "P. H. K." has been using alkaline solutions. I make up my ferrous oxalate as follows:—Saturated solution of oxalate of potash, 2oz.; saturated solution of sulphate of iron, ½oz.; solution of bromide of potassium, 5 minims. The bromide of potassium solution is made by dissolving 20 grains of bromide in 1oz. water. The principal thing to attend to is that the oxalate of potash and the ferrous sulphate should have an acid reaction that will just redden blue litmus paper. This is obtained by adding to both solutions sufficient citric acid. When ordinary tap water is used in making the solutions, they are certain to be slightly alkaline. In fact, the ferrous sulphate precipitates slightly because of the lime in the water. I have found no difficulty in developing with above solutions, the picture coming out well and quickly with properly exposed plates. I use Ilford dry plates, both for ordinary and micro-photography, and have obtained satisfactory results with them. I always soak the plate in water before developing. See that you really get "neutral" oxalate of potash, and not the acid oxalate which is often innocently given by dealers for the right stuff. Pick out any yellow or brown crystals from the ferrous sulphate, and only make small quantities of this solution, as it does not keep. The ferrous oxalate developer gives first-class results with correct exposure. It is, however, not so well under control as the pyrogallic developer. A professional photographer tells me, however, that for cases where there is a doubt as to the exposure a good plan is to use half old ferrous oxalate developer and half fresh. The half of the newly-mixed developer is kept in readiness, and may be used if the exposure appears correct. Is the ready-made developer sold by Edwards really "iron"? All the advertisements I have seen specify alkaline.—COPPER.

[62727.]—**Moulding Machine.**—This depends entirely on the angle at which the cutter is placed. If it were radial it would be same shape as moulding; but if at an angle (as it is necessary for wood), all the undulations would be exaggerated. If you will look up any work on simple projection, you will readily be able to do it. I think the "Technical Educator" has something that may suit if you master the principle.—T. C., Bristol.

[62729.]—**Leg out of Joint at Knee.**—Let "Anxious Inquirer" write a note to Mr. J. L. Vigis, chemist, &c., Midsummer Norton, Somersetshire, who has just been to London with his child to a specialist who has done wonders, and ask for address of the same. In the meantime, gently rub the place with spirit—methylated spirit of wine is the cheapest.—WM. HOSKEN.

[62729.]—**Leg Out at Knee.**—I would dread the effect of amputation. Search the roadsides, &c., for the "mouse-ear chickweed," a small and rough plant, as if dusty all over. I forget its botanical name, but it is not the pretty green chickweed that we give to birds. Break into small pieces a couple of handfuls; simmer these in a clean vessel, with a lump of lard, over a slow fire until the mass becomes quite soft. Use this as a warm poultice all round the knee, and renew it twice a day. Persevere in applying it for 14 or 15 days. If there then be no improvement, I would decide that it will not cure. Has the patient been rubbed with goose-grease? It also has been known to work wonders. To effect even the slightest improvement after so long and trying a period of suffering, very much patience and perseverance will be required: perfect rest for the limb, yet fresh air for the body, and judicious medical treatment too, for it is evident that she is constitutionally weak. Can she not get as an in-patient of the London Temperance Hospital, Hampstead-road? The clever doctors connected with it have been successful in a great many complicated cases.—H. O'B.

[62733.]—**Toning Prints.**—Ready sensitised paper is rather apt to be wanting in the purity of its whites. But if the white turn pinkish in all cases, you may suspect your washing water to contain either ammonia or hypo., or perhaps both. Do you use an old hypo. dish to wash in?—S. BOTTONE.

[62733.]—**Toning Prints.**—Are you certain that your toning bath is right? See that there is no acid in it. Test it with litmus paper. I presume, of course, that you have not allowed the gold bath to get contaminated with hyposulphite. Use the following toning bath:—Chloride of gold, 7½gr.; acetate of soda, ¾oz.; water, 1 quart. Keep for two or three days before using, shaking the bottle frequently. Gold bath must always be kept in the dark. I have never had any difficulty in toning with this formula. Pink colour, in parts which ought to be white, often arises from examining the prints while printing in too strong a light.—COPPER.

[62734.]—**Earwigs.**—Carbolic acid.—S. BOTTONE.

[62736.]—**Induction Coil.**—If the condenser is not well connected to primary, you would get a large spark at the contact breaker; perhaps this is what is the matter.—PRINCIPIA.

[62736.]—**Induction Coil.**—The faults are twofold: 1st. The condenser is inferior; the insulation being defective, allows the "extra" current of the primary to affect the contact-breaker. 2nd. The solder has permeated the platinum, and rendered it unfit for its service.—S. BOTTONE.

[62738.]—**Piano Wrest Plank.**—"Apollo" asks a question about a metal "plank." It is better to call it a metal plate. What is it for, appearance or strength? With very rare exceptions they are catch-pennies, being totally useless. If "Apollo" will say what his plate is for I will answer him, but if the piano is for his own use I should say don't trouble to put it in. If the plank will not stand without a plate it will not with.—E. W.

[62739.]—**Lathe.**—The lathe is far too weak for such a job. I would advise you to bolt a plate across each end of cylinder, and bore a ¾in. or 1in. hole in central line of cylinder in these plates; then place a boring bar between centres and through cylinder and plates. You may then, with some amount of patience and labour, bore it out true; but you will have to turn the bar with a wrench, and feed cylinder with a lever or screw.—T. C., Bristol.

[62739.]—**Lathe.**—"Essex" does not give the dimensions of his half horse-power cylinder, but there is no doubt he could bore it out in time, the latter being the most important consideration. I assume that "Essex" is a skilled hand. If not, it is not unlikely that he will spoil the job. It would be a simple matter, comparatively speaking, with back gear; but as such a job should be done well if attempted, why not get it done properly by those who can do it?—SELIM.

[62741.]—**Cameras without Lenses.**—These are simply provided with a minute aperture in the portion facing the object to be photographed. No ground glass is needed, as the picture will always be in focus, no matter what be its distance. On the Continent generally they are being extensively used for certain classes of subjects. But very excellent pictures have been taken by English operators also with these instruments, and some three years ago Capt. Abney pointed out their advantages and defects.—S. BOTTONE.

[62741.]—**Camera without Lens.**—Any light-tight camera will do. No focussing is needed. The only thing to be noticed is that the nearer the plate is to the pinhole, the smaller will the object to be photographed appear, or, in other words, the nearer the plate to the pinhole the angle of view will be wider. Thus, with a good ½-plate tourist's camera a pinhole photo can be taken with either 4in. or 16in. focus. J. G. Brisco is mistaken in thinking that pinhole cameras without lenses can only be used for brightly-lighted views. It is merely a question of the length of time of exposure; from 15 seconds to 3 minutes is the time spoken of in the French reports. Of course, for photos with moving objects, or with trees on a windy day, pinholes are of no use, but for architectural subjects they will do as well as the lens, only give them time.—B.SC., Plymouth.

[62741.]—**Camera without Lens.**—Mr Brisco is quite right when he says that this "savours of the card and pinhole dodge," but surely he knows that every object is in focus at the same time. The subject was mentioned in Vol. XLIII. pp. 289, 307, 330, 354, and in the *Photographic News Almanac, or Year-book of Photography* for 1887, there is an impression from a process block of a well-known building in Paris, reproduced from a photograph taken by a "pinhole" camera. It is, of course, better to use a lens, but the "pinhole dodge" is very useful, and enables amateurs to obtain pictures without the expense of a lens. From the *Journal de l'Industrie Photographique* I learn that MM. Dehors and Deslandres have invented a camera furnished with a variety of pinholes of accurately measured dimensions, which is constructed for taking both ordinary and stereoscopic views. By means of a rotating disc, any particular pinhole can be brought into play. With pinhole cameras the widest possible angle is included, the images are entirely free from distortion, and are always in focus, whatever the distance of the ground-glass from the pinhole. It must be remembered that the pinhole camera enables quite a large view to be taken from close quarters, and architectural students and others are using it extensively, for they do not require artistic photographs so much as a correct representation of the buildings. That is to say, it is immaterial to them whether the resulting prints are photographic "pictures," so long as they give an accurate idea of the outline and detail.—VIDEO.

[62741.]—**Camera without Lens.**—Mr. Brisco may probably find an answer to his query in the following extract from a communication made by Prof. E. Stebbing, of Paris, to the *British Journal of Photography* for June 24. It is not clear where the "proofs" were shown; but I fancy it must have been at some meeting of the Photographic Society of Paris. Prof. Stebbing says:—"Some proofs were shown obtained in a camera without a lens, which were very good—exposure varying from fifteen seconds to three minutes. If I remember right, our mutual friend Henderson exhibited some proofs obtained by him to the London and Provincial Photographic Association, stating the size of the hole with which he worked, &c. I bear upon this point, as several amateurs here are enraptured with their success, and are bringing it *à la mode*, as they say its advantages are numerous, necessarily under certain conditions. Firstly, no expense for the purchase of a valuable lens; secondly, no fear of its breakage, as well as that of the ground-glass, the latter being wholly discarded, as every object is in focus at the same time; thirdly, a larger angle can be embraced than by the generality of lenses (90°), which permits photographs of objects to be obtained which formerly we hardly hoped for—such as the image of a church *in full* situated in a narrow street, the interiors of monuments, &c., which can now be obtained by this means, thanks to the rapidity of the gelatino-bromide of silver process; fourthly, which is not its least advantage, no deformation—everything is mathematically correct, thus rendering enlargements possible."—T. B.

[62742.]—**Leclanche Zincs—do they Require Amalgamation or Not?**—Theoretically the amalgamation of Leclanché zincs is not wanted, there being no acid in the cell, but practice recommends the amalgamation. During the use of the cell the zinc surface is getting rough. By change of temperature these rough spots become the seats of salt crystal formations. An amalgamated zinc surface, however, remains flat and preserves an undiminished surface, while the salt falls on the bottom of the glass.—A DUTCHMAN.

[62746.]—**Indiarubber Air-Balls.**—The following, extracted from No. 319, answers this query. "They are cut out with a pear-shaped punch from the sheet indiarubber, which is doubled and warmed. The rubber is used in different thicknesses, according to size of balls. If only a few are wanted, they could be cut out with a pair of shears (one-eighth of intended size). The edges will adhere, and must be joined by hammering on a flat surface, after which they must be dipped in a bath of bisulphide of carbon to vulcanise them; let them drain and dry, and blow them up with a pair of bellows with a small pipe affixed to the nozzle by rubber tube. You will be sure to burst a few at first, but experience will show how large they will go to. If you want them coloured, you must place the colour required under the bellows, and they will take it up and blow it in. Common coal gas will cause them to ascend, and they will travel miles.—C. T.

[62747.]—**Silvering Glass.**—Several recipes for silvering glass have been published in the back volumes of the ENGLISH MECHANIC; but I do not think there is any better method, all things considered, than the following, which much resembles the process described in Browning's "Plea." Make up the following three solutions:—A. Nitrate of silver, 90 grains; distilled water, 4oz.; dissolve. B. Potash, 1 drachm; distilled water, 8oz. 1 drachm; dissolve. C. Sugar of milk, ¼oz.; distilled water, 2½oz.; dissolve. To mix the solutions, take solution A, 1oz., then drops of ammonia as stated in Browning's "Plea." Solution B, 2oz., more ammonia. Add distilled water 7oz. Now drops of solution A (as per Browning's "Plea"). Cleanse the speculum, using plenty of strong nitric acid, and wash well with water afterwards. Now take 1oz. of solution C, and mix with 7oz. of distilled water, and add this to the previously-prepared solution, stirring it well with a bit of glass rod, and suspend the speculum as quick as possible. Solutions A and C must be filtered. It will take the sugar of milk from twenty to thirty hours to dissolve, unless the bottle is stood in warm water. Mr. Brashear has an improved process, which was given some time ago; but possibly the querist will find the above satisfactory.—E. L. M.

[62748.]—**Photo-Micrography.**—In my opinion the best plan is to determine accurately, by the camera lucida and stage micrometer, the actual size of object photographed. It is then easy to compare the result of this operation with the photographic picture obtained on the ground glass screen, or better on the photographic print. This method does away with all consideration of length of tube, extension of camera, &c. The measurement of these lengths is no easy matter, and should be avoided when, as in the present case, easier means are at hand.—COPPER.

[62749.]—**Leclanche Zincs.**—They are usually amalgamated; but they actually work just as well without amalgamation in all batteries wherein a salt is employed instead of an acid.—S. BOTTONE.

[62749.]—**Leclanche Zincs.**—It is not necessary to amalgamate the zincs in a Leclanché cell, and it is very rarely done either in commerce or in private construction; but it would tend to prevent the formation of crystals on the rods.—NUN. DOR.

[62754.]—**Detection of Copper.**—Dissolve a small quantity (say two grammes) in slightly diluted nitric acid; dilute, add sodium sulphate solution until it will precipitate nothing more, and then filter. Divide the filtrate into two portions; to one add ammonium hydrate—a blue precipitate soluble in excess of ammonia indicates copper; into the other dip a strip of polished iron, which will become coated with a film of metallic copper se if this metal is present. If there is only a tra ncet. leave the iron in the liquid for several hou that an PRINCIPIA. rubbed on

[62754.]—**Detection of Copper** will keep the metal will not be found in any q ole to cust light (?) mercial red lead, it is necessar essential ice of flame sufficiently large sample, say 5 placed in a beaker, and treated with nitric acid diluted with its volume of water. It must be noticed, however, that the whole of the sample will not dissolve, part of the red oxide being transformed into brown oxide, which is not soluble in nitric acid. In order to dissolve all the oxide of lead, a few crystals of tartaric acid are added to the solution in the beaker. This will cause the sample to dissolve rapidly. When all is dissolved, except what earthy matter may be in the substance (sand, sulphate of barium, &c.), the solution is evaporated slowly, and when nearly dry, dilute sulphuric acid added. The evaporation is now proceeded with, and carried on till white vapour of sulphuric acid is given off. Care must however, be taken not to drive off all the sulphuric acid. By this time the HNO_3 will have been completely eliminated, and all the nitrates transformed into sulphates. Dilute with cold water: the sulphates will all dissolve with the exception of $PbSO_4$, which is practically insoluble in water containing H_2SO_4. Filter off the $PbSO_4$, and if a quantitative estimation is required, wash thoroughly with water containing a little H_2SO_4. Finish washing with alcohol, so as to eliminate the last trace of H_2SO_4 from filter. The liquid filtered from $PbSO_4$ will contain all the copper in sample. Evaporate this liquid to a small volume, and add liquor ammoniæ till the smell of H_3N is easily perceptible, and a small proportion of carbonate of ammonia. Should there be any copper present, the liquid will assume the characteristic blue colour of the double salts of copper and ammonia. If any oxide of iron be precipitated by the ammonia, it is desirable to redissolve this precipitate in HCl, as it may have carried down with it some small proportion of copper. This, however, would only be necessary, if it is intended to make a quantitative estimation of the copper.—COPPER.

[62755.]—**Burner for Injector Furnace.**—"Mons" forgets to take into consideration the quantity of air delivered by the blowing arrangement, and on the quantity of air which can be delivered into the furnace in a specified time depends the power of the arrangement. The pressure of air is in itself of no importance whatever, except in so far as it is of assistance in delivering the quantity of air required. The small jet and open end are used for the simple reason that with a high-pressure blast only one-fifth of the total air required needs to pass through the blower. This enables a comparatively large furnace to be worked at a high temperature with a very small blowing arrangement. "Mons" only needs to compare the size, power, and cost of his present blower, with the ordinary small foot-blower generally supplied, to be further satisfied as to the reason why the present pattern is selected where power is not available. The original injector-furnace was devised and made by Mr. Alfred Lutschaunig, of Liverpool; this had a closed end precisely as "Mons" now uses, and a large and costly blower was required. Mr. Lutschaunig's burner was vertical underneath the crucible, which was supported by a tripod stand; this stand was constantly becoming fused, dropping, and often oversetting the crucible, and the whole arrangement was cumbrous and expensive. I remodelled his furnace, placed the burner at the side, giving a firm, steady base for the crucible, and by using an open-end burner and high-pressure air jet reduced the size and cost to less than one-fourth. By making the furnace bodies of a specially porous non-conductor, I doubled the power and speed of working, and the furnace remains now, after 10 years' experience, practically in the same form as at first. The germ of the idea of what I consider is, and always has been, the most perfect laboratory furnace ever designed, certainly came out of Mr. Lutschaunig's furnace; but in his form the size, cost, and general arrangement were such as to prevent its ever coming into general use. For special purposes, where power for blowing is available, I have frequently made burners with closed ends, in which the whole of the air required is blown in through a large jet, and in some cases, where the gas is delivered under a very heavy pressure, I utilise this pressure to draw in the required air supply; in fact, we are now making a burner to consume 200c.ft. of gas per minute = 12,000c.ft. per hour, in which the gas will be delivered by a Roots blower under a pressure of 2lb. per sq.in., and the whole of the air supply required will be drawn in by the force of the gas blast. The system admits of many variations; but I believe the present one is the only form in which it can be carried out in a compact and simple form at a very small cost.—THOS. FLETCHER.

AT the factory at Castleton, United States, there are manufactured between two and three tons of tal cards a day all the year round. The largest ever filled for one city was 4,000,000 cards, or velve tons of paper, for New York. They ,000,000 cards a month. Chicago comes ut 3,000,000 cards in the same period. 0,000 postal cards manufactured use is increasing daily.

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UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors

62321.	Watch Pivoting, &c., p. 231.
62342.	Weighing Machines, 231.
62344.	Hand Bells, 231.
62347.	Barbotine Work, 231.
62354.	Bobbin Making, 231.
62365.	Mirror Galvanometer, 231.
62513.	Telephonic, p. 329.
63517.	Reflecting Galvanometer, 329.
62520.	Problem for "Vladimir," 329.

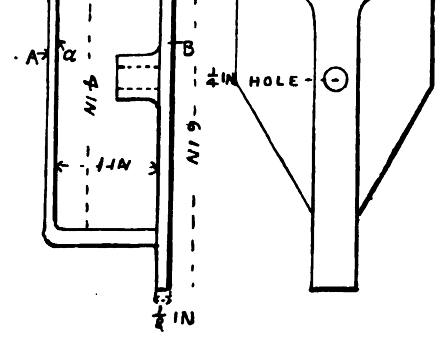
QUERIES.

[62757.]—**To Microscopists.**—Wrought iron under vibration becomes brittle when the direction of the vibration is at right angles to the length of the piece—e.g., railway axles, but not piston rods. This is supposed to be due to a change in the axial direction of the crystals by a rearrangement of the molecules destroying the bond or interlacing which gave the original strength. It is also supposed by some that fibrous iron at rest tends to revert to its original crystalline state, and may become crystalline in course of time. Can any of your contributors refer me to microscopical or other investigations into this matter? Highly magnified views of fractured surfaces would be very interesting to many readers of the "E M.," particularly as bearing upon the molecular structure of fibre v. crystal.—C. L. C.

[62758.]—**Optical Effects of Saturated Air.**—The house where I am living is some eight miles from the Brecon Beacons, the highest mountain in South Wales, and during the preparations for the jubilee bonfire, I had occasion to watch the men and mules taking the supplies up to the top to form the pile. On the evening of the Jubilee I looked through a telescope to see the pile for the last time, but I could hardly discover it, as the hill appeared to have sunk beneath the herbage intervening on a cemetery between my house and the Beacons. Yesterday, the 4th inst., I was astonished to find that the Beacons had risen much higher than usual, and I took the opportunity to roughly find out how much. It appears to have risen from one and a half to two degrees. I would like to know what connection there is between it and rain, or the saturation of the air, for last night we had rain for the first time during four weeks, and if the saturation of the air does cause such apparent rise, does the distant hill rise in proportion to the quantity of water in the air?—BRYN.

[62759.]—**Expansion Valves of Horizontal Engines.**—Will any of our numerous readers kindly volunteer a little elementary instruction on the expansion valve of ordinary horizontal engines? Its action in conjuction with the slide valve, &c.?—ONE WILLING TO LEARN.

[62760.]—**Finishing Brass Castings.**—Will some reader please assist? I have about 6,000 brass castings of the following shape to finish in the cheapest and quickest way—filing will be too slow. I have steam power. How should I proceed? A and B must be parallel with one another, (a) must also be finished. A ¼in. hole bored true must pass through the two plates.—R. L. H.



[62761.] — **Card Wire Machine.** — Will any mechanical reader kindly tell me who invented the card fillet machine, and describe mode of getting the necessary crown wheel for any given card fillet, and if there is any book on the above subject?—AUCEPS.

[62762.]—**Mounting Ordnance Maps.**—I have lately attempted to mount Stanford's ordnance maps for the pocket, but can only obtain an imperfect adhesion of the map to the canvas. Have used ordinary calico, washed and stretched on board; bookbinder's paste, which has been left on pieces for a minute before mounting, and then the whole has been subjected to an even screw-pressure between sheets of blotting paper. Yet on removing I find the edges and corners still loose, and the pieces may be torn off without difficulty. If this should meet the eye of one who has been more successful, I should be glad of a hint as to cause of failure.—VIATOR.

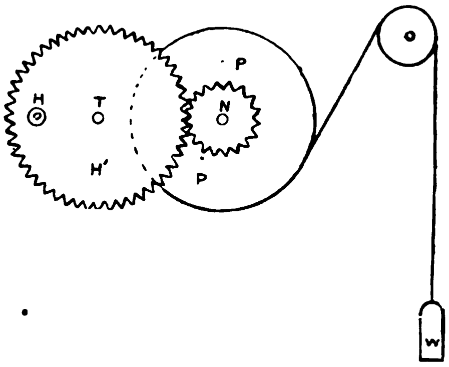
[62763.]—**Dynamo.**—TO MR. BOTTONE.—Would you kindly give me dimensions, size and sketch, of an A Gramme dynamo. 130c.p., and the quantity and size of wire? Should I have to put extra wire on machine, for 100yd. of leads and could I charge accumulators from it?—GWALIA.

[62764.]—**Loose Spokes.**—One of the spokes of the large wheel of my bicycle is very loose, the worm of the hole in the hub being gone. They are direct spokes. What can be done to it?—C. V.

[62765.]—**Slide Valve.** —TO "T. C.," BRISTOL.—I am exceedingly obliged for your reply. The ports of cylinders are ⅝in. wide. The throw of eccentric is ⅝in. the travel of valve.—W. J. J.

[62766.]—**Miners' Tools.**—TO "A., LIVERPOOL" AND OTHERS.—Will those with practical experience please give weight and particulars of sledge hammers in ordinary use on the Australian diggings?—QUEENSLAND.

[62767.]—**Mechanics.**—I wish to raise the weight W to a height corresponding to the circumference of the pulley P, by means of the knob or handle H on the face of toothed wheel T. T acts on the pinion N which is fixed on the axle of P. The handle H, and, of course, T also can only be moved a distance equal to one quarter of the circumference of T to H, therefore the pinion has only one-fourth the number of teeth which T has. Am I working on correct mechanical principles?—J. TAYLOR.



[62768.]—**Electro-Plating.**—I have a solution of of which this is the formula: Chloride of gold 6gr. + 3oz. of water (distilled), and ferrocyanide of potassium 12gr., From this solution used in conjunction with one Daniell cell I obtain no result in the way of plating with gold a small and properly cleaned silver object. My solution of auric chloride is not concentrated enough I fear, and is my battery power great enough, or where am I at fault? I may say the only result I do get is a complete and thorough blackening of the silver object.—J. K. N.

[62769.]—**Rusty Watchmaker's Lathe.**—I have in my possession a 5in. centre watchmaker's lathe with fly-wheel, chucks, &c.—the maker's name is engraved on side "im Heinemann," which I should think was German. I should be grateful for any information about it. Has been lying by for some time and got rusty. Would any reader kindly inform me best way to free from rust.—J. C.

[62770.]—**Uniting Carbon to Brass.**—One of the carbons of a mercury-bichromate bottle battery which I use for an induction coil has broken off from its socket. Will any of "ours" tell me how to unite again? I tried to solder it with spirits of salt, but failed.—GALVANISM.

[62771.]—**Past Phases of Moon.**—Is there any book which gives these during present century? If not, how should I proceed to calculate moon's age and hour of rising at Greenwich for a given date?—P. R.

[26772.]—**Lima Half-Crowns.** — I have a half crown of George II., dated 1746, in very good condition. Immediately under the bust of the king is the word "Lima," in large letters. Can any of our readers kindly explain its presence? On referring to Haydn's "Book of Dates," I find that an awful earthquake occurred at Lima, 28 October, 1746. Can the English Government have made a grant of money in aid of the distress and disaster and struck the name "Lima" upon the coinage, and that this half-crown may be one of the issue?—CYGNUS.

[62773.]—**Sundial.**—Would any of your readers kindly tell me how to graduate a horizontal sundial of the peculiar, but probably well-known, cross pattern? It consists entirely of a horizontal surface and a solid cross which leans to the south, at apparently the same angle at which the ordinary style leans to the north.—TIME KEEPER.

[62774.]—**Cartwright's Plane.** — I write for information respecting a plane, seen in a country cartwright's shop. Its use being for stripping shavings so that they curl in the working of the plane. The same tool would be used for making pipe lights, fire ornaments, and other fancy articles. I read the particulars in one of our back numbers in Rio, but I have lost that number—say six months back. If any of "Ours" will kindly describe the tool I shall feel greatly obliged.—RIO GRANDA.

[62775.]—**Deafness.** — TO "EOS."—I am glad you noticed my query of last week. My deafness came upon me about three months ago; it may have been caused by a slight cold I had, but have had worse colds than that which did not affect my hearing—was assuredly not caused by any of the other matters you mention—no deafness in family—can just hear watch if ¼in. from ear, not at all if an inch away, other ear all right—have used Needam's essence for deafness and noises in ear for a month with no effect—have now something from a doctor to drop in ear—no good results yet, and do not expect much as the other stuff was, I think, better. I had a kind of quivering of a nerve behind ear sometime before deafness came on making a buzzing noise—have now a dull singing noise always—there is a very slight stiffness or fulness about ear, but no pain and no swelling at all to notice. Shall be pleased to hear further from you.—J. COATES.

[62776.]—**Springs.**—Would Mr. Bottone or "T. C., Bristol" help me to some kind of spring power? I want to drive a small fan and get a good blast for a smith's fire. I have one, but it is too hard for one to turn. Could it be done with two or three dozen clock springs or any other way with little expense. I have a 5in. back gear lathe. I could fit up anything that would give power enough. I want the fan to go about 3,000,500 [3,500 ?] per minute.—ONE THAT NEEDS HELP.

[62777.]—**Drawing.**—I have obtained a piece of shoemaker's elastic. My purpose was to make a drawing on it, then stretch it a required distance. This answered very well, except that I could not draw on it well enough. Could any reader of the "E. M." recommend anything with a smoother surface, and that will act the same as the above elastic, only stretch one way? It must not decrease in width. And I want to be able to rub our drawing by chalking over, or any other method so as to repeat drawing.—YOUNG MACHINIST.

[62778.]—**Cleaning Filigree Silver.**—Can any correspondent tell me the best way of doing this? I believe it is done by dipping the article in a solution of cyanide of potassium, but I do not know the strength of solution or the duration of immersion, and a small mistake may destroy the very delicate threads of Indian filigree ornaments.—NOMAD.

[62779.]—**Ring Armature.**—Will Mr. Bottone or some other of our electrical friends kindly say what is the effect of increasing the number of sections of the cogged ring armature? What I should like, and I have no doubt that it would prove of very general interest, would be just a brief résumé of the principles governing the construction of these armatures, so that amaetur dynamo makers might be able to determine for themselves how many sections of wire would be best for any particular case.—LE JOUR.

[62780.]—**Nieces and Nephews.**—Will some legal friend kindly answer the following? An uncle of ours left his whole estate to be divided amongst his nephews and nieces—not mentioning any by name, but meaning his brother and sister's children. Can his wife's nephews and nieces (who are legion) also claim under their uncle's (by law only) will and rank with his own side? A reply will greatly oblige.—J. W.

[62781.]—**Oxide of Copper Battery.**—Can any of our electrical correspondents please say if having the cell of an oxide of copper battery made of copper gives perceptibly more current than a cast iron one of the same size would do? Also size of one cell, box shape, weight of zinc, oxide of copper, and caustic potash for charging same to light a 2½c p. incandescent lamp low resistance. In making a cell of thin copper plate, could it be brazed or must it be riveted?—QUAESITOR.

[62782.]—**Locks.** — Among our correspondence on mechanical matters I have seen little or nothing for a long time past on locks. Will any reader say what kind of locks of moderate price are practically secure for cash or deed boxes? Those by the most famous makers (or maker) are very expensive. Are they really so superior to other lever locks and are the latter trustworthy?—NOMAD.

[62783.]—**Waterwheel.**—Will any of "ours" kindly tell difference in power of two wheels (fall of water 14ft.) one taking water over, and the other a 20ft. wheel taking same stream at breast?—P. L.

[62784.]—**Electro-Motor.**—Will any of our worthy readers give me full information how to make one of Ayrton and Perry's motors about a ½H.P. (as described in S. P. Thompson's "Dynamo Machinery")? Giving a sketch and all dimensions and quantity of wire required and its gauge.—E. J. S'S.

[62785.]—**Green Japan.**—I shall be much obliged if some kind reader will inform me the best way for making green japan to cover with two coats for water cans and to dry in the oven?—J. C.

[62786.]—**Reflector.**—I have a bullseye lamp, the reflector at back of which I wish to renew. Will any of "ours" please tell me how to do it? What paste to use on the copper surface?—R. E.

[62787.]—**Dolls.**—Could anyone inform me how to get wax dolls back to their original gloss that have been spoiled by the sun?—T. H.

[62788.]—**Enlarging Lantern.** — Will any of "ours" kindly describe one of the above for a ½ plate? I am anxious to make one which I could easily do, only be put on the right track by "Ours." I should prefer a lamp, although artificial light could be used.—R. R.

[62789.]—**Foot Pathway.**—To "B. SC., PLYMOUTH."—Has a Highway Board a claim and right to remove doors and put steps inside private property, without the approval and consent of the owners of such properties, by lowering public foot pathway in a local country town which has no right of privileges belonging to it?—SOMERSET LAD.

[62790.]—**Surgical.**—About two years ago I injured the bones of my right hand wrist by a too vigorous move of a hand-power lever mortising machine. Thus it will be seen that the injury results from blows to palm of hand and wrist rapidly repeated. A pain as if bone were bruised has existed ever since, but intensified at times when engaged in extra heavy work. The wrist now is slightly swollen, very painful, and almost incapable of movement at the joint. Can someone advise me what to do for cure or relief? I have tried iodine, white oils, St. Jacob's oil, cold water, and a leather wrist strap, purposely made, but all without appreciable benefit. Rest from work would, I believe, prove effectual; but that I cannot afford.—A JOINER.

[62791.]—**Ingluvin.**—Can anyone tell me what is the preparation called ingluvin? Dr. Paul Mohr, of Cologne, writing in the *Allgemeine Medicinische Central-Zeitung*, mentions some cases in which he found this preparation give good results when other treatment had failed. In a very troublesome case of tabes mesenterica, in which nourishment of every description was invariably vomited, the very first dose produced a marked effect. About four grains were ordered to be dissolved in liquid nourishment three times a day, and in a few days' time food of various descriptions could be retained without difficulty. In two other cases somewhat larger doses—i.e., five grains four times a day—were employed with equal success. One was a case of delirium tremens, and the other one of severe dyspepsia associated with entozoa, the patient being utterly unable to retain the nauseous medicine necessary for the destruction of the worm. By means of ingluvin this condition was remedied, and the entozoon (a tænia solium) got rid of, a complete cure resulting. That seems to show the ingluvin to be a valuable medicine or food, and one would therefore like to know more about it.—B. P.

[62792.]—**Photography.**—Can any of "ours" help a young beginner in photography? I have a ¼ plate International camera with rectigraph lens, by Messrs. Lancaster and Son, and wish to know if the Ilford or Britannia plates would work well with this camera and lens, and what chemicals the above manufacturers advise as best for developing, toning and fixing their plates. Also the best negative paper to use, and the chemicals which suit it best. I do not want to know the proportions, but only the names of the chemicals, and those the very best.—BEGINNER.

[62793.]—**Sectional Figure of Moon.** — To "F.R.A.S."—Can you give me any information respecting the problem of determining the true sectional figure of the moon, as viewed in a plane along the line joining her with the earth, particularly as to whether any careful measurements (by means of heliometers) of parallax have been taken between the points near the edge of limbs and those near the middle? The stereo-photo I have, taken at a libration of about 6°, shows an apparent protuberance of 50 miles when viewed at a distance of about 40in. from the eyes, in a stereoscope especially made. Some investigations, I understand, however, give a probable protuberance of 3½ miles. I shall be glad of your help.—B.

[62794.]—**Distilling Whisky.**—Reading an account in the local newspapers of the death of a boy, caused by his tripping and falling into an open vat of vitriol in a whisky distillery, I am anxious to know what is the use to which this acid is put in the said manufacture.—A., Liverpool.

[62795.]—**Organ Building.**—To MR. AUDSLEY.—In looking over some back numbers of "Ours," I noticed one Nov. 19, 1886, in which Mr. Audsley promised on a future occasion to treat the art of organ building in a thoroughly practical manner. And I, as one interested, would like to see that promise fulfilled in the pages of the "E. M."—ANXIOUS ONE.

[62796.]—**Depositing Mercury on Metal.**—What two clear and distinct liquids produce immediately a congealed mass when mixed together in equal proportions? A portion of this creamy looking substance, if rubbed upon a piece of clean brass, will produce a mercurial deposit. The liquids have no colour whatever, merely like water.—CHAOS.

[62797.]—**Filling up Worn Brasses with White Metal.**—Will some reader of "Ours" kindly give details for filling up worn brasses with white metal? Is it a practical way of dealing with the brasses of a 3in. countershaft running 320 revs per minute, receiving the whole work of a 14 N.H.P. engine, running 90 per minute with 70lb. boiler pressure, cutting off at ⅝ the stroke?—ENGINE DRIVER.

[62798.]—**Sight Adjuster for Martini-Henry Rifle.**—Would some of your readers kindly tell me how to make a sight adjuster for Martini-Henry rifle, as I wish to shoot over the bar? And could anything be made to tell the force the wind is blowing? If so, would someone explain how and oblige?—CORPORAL.

[62799.]—**Potash Oxalate.**—Can any of "ours" give me correct quantities of carbonate of potash and oxalic acid that must be combined to form oxalate of potash, and best method of making it?—W. R. S.

PROF. J. W. MALLET, F.R.S., has analysed the ash collected at Bahia de Caraguez, about 120 miles west from Cotopaxi, where it fell to the depth of several inches. The specimen was a light brownish grey, very finely divided, mobile powder, soft to the touch. Quartz, two felspars, augite, magnetite, and thin scales of deep red specular iron ore were distinguished by aid of the microscope. When strongly heated, it turned dark red-brown, and fused to a nearly black slag. Several concordant experiments proved that silver was present to the extent of about one part in 83,600 of the ash, or about two-fifths of a Troy ounce per ton of 2,240lb. Small as is this proportion, it must represent a very large quantity of silver ejected during the eruption, in view of the vast masses of volcanic ash which must have been spread over such an area as is indicated by the fall at so distant a point as Bahia de Caraguez.

Tempering Mill Picks.—The *Millers' Review* says:—The tempering of mill picks is more of a matter of care and observation than any special material used in the process. More picks are spoiled by burning or overheating the corners than by any other part of their manufacture. A slow fire and heating back from the point is an essential feature. Do not draw the edge thin. Leave it a little blunt and grind for the proper edge. Heat to a cherry red, no more at the corners than in the middle. Dip in clear water, and draw the temper to a full straw colour. Brighten the edge surface on a grindstone or with emery paper before tempering.

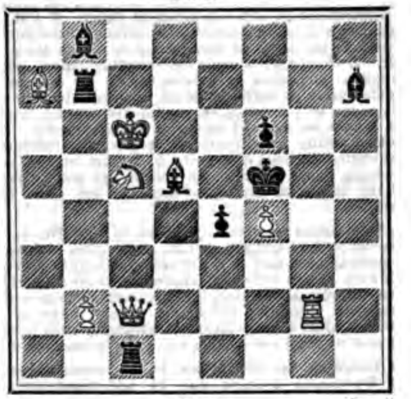
How to Take Castor Oil.—The *Monthly Magazine of Pharmacy* quotes the following suggestion as to taking castor oil from a French source: — Take a half-glass of frothy, sparkling beer, mix the dose of oil with it, and whip it up so as to make it froth strongly. The oil thus becomes intimately mixed with the froth, and if only the latter is drunk, he says, neither the taste of the oil nor that of the beer is perceived.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MLII.—BY A. BOLUS.

Black.

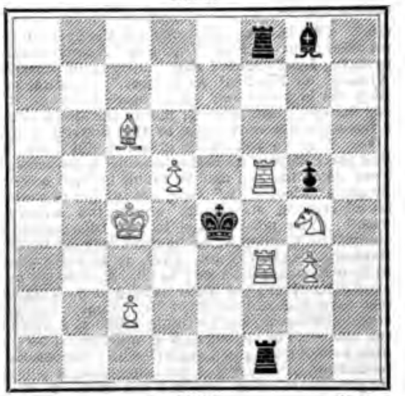


White. [8 + 7

White to play and compel Black to mate in four moves.

PROBLEM MLIII.—BY G. J. SLATER.

Black.



White. [8 + 5

White to play and mate in two moves.

SOLUTION TO 1,050.

White.	*Black.*
1. B takes P at K-B 6.	1. P-K Kt 3 (*a*).
2. B-K 5.	2. Anything.
3. Q, R, B, or Kt mates.	
	(*a*) 1. P takes B (*b*).
2. Kt-K B 6 (ch) &c.	
	(*b*) 1. B takes P ((*c*).
2. Kt-K Kt 3 (ch) &c.	
	(*c*) 1. Kt Q B 4.
2. Q takes Kt, &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solution to 1,050 by I. M. Brown, G. A. A Walker (very difficult, but variation 1. $\overline{\text{Kt B 4}}$ would be omitted with advantage); to 1,049 by J. J. Spence and Hensing.

Electric Lighting of Railway Carriages.—There are certain blunders of omission or commission in policy which appear inexplicable. One of these is the omission to light railway carriages by electricity, and another the recourse to gas and other highly dangerous appliances of illumination. The peril of travelling reservoirs of gas has been painfully illustrated of late. It is strange that any company has had, and still has, the hardihood to subject its passengers to the very grave peril which besets the use of gas in this way. More wonderful still is the neglect to use the motor force available for the self-generation and storing of electricity. Surely there would be no great difficulty in so adapting the necessary apparatus as to make the moving wheels of the carriage do the work of an engine. It is needless to emphasise this suggestion. There is, of course, nothing new in the idea; but it seems to be one of those very obvious matters which are seemingly too plain to be perceived, or in some way fail to impress that particular part of the mental constitution which we call the common-sense instinct. The task of providing trains which travel at night with special accumulators cannot be overwhelming. Those trains that travel by day, and only require lights for tunnels, could, we imagine, be utilised to charge the accumulators required by night trains.—*Lancet.*

DR. GEO. E. DOERING, Ph.D., says that an alcoholic solution of oil of wintergreen rubbed on the marble slab of a soda fountain will keep the flies away and not prove disagreeable to cust[illegible] It is well known that all essentia[illegible] poisonous to insects.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, July 13, and unacknowledged elsewhere :—

T. TAYLOR.—R. W. Turner.—G. Pottier,—L. T. Clarke.—Rev. W. J. Rooke.—E. R Harris.—Waterless.—Shale.—Querist, Hebden Bridge.—John Wood.—Hope.—G. S. H. —A. W. M.—E. Gobert.—H. E.—A Beginner.—Weald.—Eos.—S. Bottone.—Rolands.—J. Spencer Hollings.—Dr. Royston Pigott.

VINDEX. (We have no recollection of the book to which you refer; but perhaps Heather's "Astronomical and Surveying Instruments" may help you, or Merrifield's "Treatise on Nautical Astronomy.")—ALPHA. (Certainly the larger piston would move to the right and drag the small one after it, unless the steam pressure on the other side were equal to that flowing in by the valve. Why do you think it would not?)—A. B. C. (Full particulars of all useful batteries have been given in our columns, and can be found in such a work as Sprague's "Electricity." Why not inquire of those who are advertising statements about the battery?)—JUMBO. (You must scrape it, and then expose it to sunlight in a window, or in some way so that glass intervenes.)—AMATEURO. (Yes, it is objectionable; but by care it may be made to do. 2. Depends on the lamps themselves; see many replies in back numbers. Must give the resistance of the lamps. 3. Carbon; because, for one reason, platinum raised to a white heat is on the point of fusing, and as a matter of fact, does soften.)—MECHANIQUE ANGLAIS. (No; they are natural productions. Perhaps you mean magnets, as you ask if it is possible to make one that will repel. 2. You can obtain the electric light on a small scale with a five-cell battery. See back numbers and the indices.)—E. J. C. (Do you not understand that if it were necessary to give proportions, the patent would be worthless. Probably the patentees do not themselves know what proportions yield the best results. It is a matter for calculation and experiment. 2. The razors are ground and stropped. 3. Why use porous cells at all? See indices. Porous cells are to be bought cheaper than they can be made.)—T. W. B. (The inventor's description of the Wimshurst influence machine appeared in No. 1127. Other machines of his design have also been described; but why not procure the little work on the subject advertised on p. vi. last week? The machine would work in the conditions stated.)—AMATEUR. (The composition for taking a mould of type in order to produce an electrotype is generally the best beeswax tempered with from five to twenty per cent. of virgin turpentine to prevent it cracking. In summer time, or if the "shop" is very warm, very little turpentine suffices.)—ALBERT JOHNSON. (Vaseline is perhaps as good as anything; but those who are rarely exposed to the sun always "brown up" quickly, especially at the seaside. The cracking is troublesome; but it is doubtful if anything will prevent it except cold cream or vaseline, unless you keep the skin coated with sweet oil.)—HENRY HUMPHRYS. (The weight of water in the upper part acts on the air in the lower, which forces water out of the jet. A diagram of the common form will be found in No. 405. The pipe from the basin should take the water nearly to the bottom of the lower cylinder.)—ENO. (You can obtain reliable information about the Colonies from the Emigration Office, 31, Broadway, Westminster, S.W. Handbooks are published at the rate of 1d. each, and circulars can be had gratis. At your local post-office there should be a bill on the notice-board giving that information. As to the United States, there is a wide field and plenty of opportunity for an engineer and draughtsman; but he would be unwise to go unless he had sufficient capital to live on while looking for a suitable berth. As a rule, craftsmen are not "wanted" in the United States or the Colonies, but there is room in plenty for farmers with capital.)—J. A. (A diet of skim milk is recommended for diabetes. Such a case, however, ought to be in the hands of a medical man.)—W. R. (We do not. Think it most unlikely that a combined list is published; but see the catalogues of the publishers. 2. The numbers referred to containing replies about eczema are 941, 942, 945, and 946. They can be had, post free, for 10d., preferably in halfpenny stamps.)—HALESOWEN. (The "register" of designs is kept at the Patent Office, Southampton-buildings, London, E.C. If you address the inquiry to the Comptroller, he will give you full information as to an inspection.)—F. CAWTHERAY. (You want a frog-plate. There is a full description of the method of managing the frog in P. H. Gosse's "Evenings at the Microscope.")—H. H. (The subject was discussed in the last volume, pp. 507, 528, 547, 569.)—MAGISTER. (The better way would be to consult the "Voyage of the *Challenger*," for although the greatest depths of the soundings may be mentioned in many books, it is [illegible]ful if the lat. and long. are given. 2. We do not [illegible] any one publishes a "cheap, accurate contour map of the oceans.")—AMATEUR, Wolverhampton. (You can soften brass by making it red-hot or nearly so, and allowing it to cool. If in a hurry, you can dip into water. It is again hardened by hammering or rolling.)—H. WALKER. (You can put a coat of silver on a steel plate by first coppering the latter in a bath, and then, after rinsing, immediately transferring to the silver bath. A direct method is to prepare a bath composed of 15 parts of nitrate of silver dissolved in 250 parts of water to which 30 parts of cyanide of potassium have been added. When solution is complete, pour the mixture into 750 parts of water containing 15 parts of common salt. The iron or steel articles must be thoroughly clean and be placed for a few minutes in aquafortis; then they should be rinsed well in water and immediately transferred to the depositing bath. 2. See recent back numbers, and the indices. Perhaps a battery illustrated in No. 1,138, p. 435, will suit you. We think it would be best to buy the lamp.)—J. F. DONCASTER. (You will probably find some reference to the battery concerning which you put the question in a letter in this number, in which it is mentioned by its fancy or trade name. If you will refer to pp. 320, 435, Vol. XLII., you may possibly learn more about it, though it is doubtful, if, as you say, you have been a subscriber for 17 years, and have not learnt the simple lesson that as soon as anything wonderful in the battery way is introduced, a description of it will be found in our columns. We cannot undertake to recognise every battery that is brought out under a fancy name, and we are quite sure we have not "missed a very important notice." We are sorry to see that the instruction which has been kindly given by our correspondents has had so little effect—in your case.)—D. G. (Merely a lemon squeezed into a glass, with a little sugar, and a bottle of soda-water.)—C. J. CARR. (Nicholson's "Manual of the Art of Bookbinding," E. and F. N. Spon, 125, Strand, W.C., price 9s.)—W. G. (The process to which you refer is patented, and is worked, we believe, by Messrs. Brown, Barnes, and Bell, of Liverpool.)—SESAC. (There is no effectual remedy but thorough cleansing. Strip the paper off the walls and fumigate each room thoroughly with burning sulphur, stopping up the air outlets. Afterwards fill up all holes and cracks in the plaster with a mixture of whiting and plaster of Paris.)—F. S. FREESTON. (We do not know the address of "a good astronomist" who can read anybody's planet. You are thinking of an astrologer, and astrology is humbug. If you want someone to read your planet, you will not have much difficulty in finding him—that is, if you are prepared to pay.)—T. E. K. (It cannot be softened, in the ordinary sense, but heat will fuse it—and spoil it.)—MICROPHONE. (Kindly see back numbers and the indices, or else send a more definite question. It is impossible to guess what you mean by a microphone.)—E. H. (A practical method of demagnetising watches was given by Prof. A. M. Mayer in No. 762, p. 184. We believe that the simplest method—one found perfectly successful by attendants on dynamos, is to keep the watch spinning for some time near the field magnets, and in a variety of positions. That is, it is supported in a sling and made to rotate first with the xii. upwards, then with the vi., and so on. You will probably find similar treatment while your electro-magnet is excited will be successful.)—TREBER. (It remains with the "nervous party" to choose. Cocaine is used, but not very generally.)—WAVERLEY. (Leave such things alone; study the laws of practical hygiene, and obey them. If, however, you must have a galvanic belt, you will find them described in back volumes, and portable batteries too.)—BEGINNER. (The solution for the so-called storm or weather glass is made by dissolving together 2 drachms of camphor, 1½ drachm of nitre, 1 drachm of sal-ammoniac in 2¼ fl.oz. of proof spirit.)—CONTINUOUS BRAKES. (No more letters are wanted on this matter. Correspondents seem to be losing their temper all round. We really think it necessary to remind one or two that a man is not necessarily a lost sinner or an idiot because he believes in the Westinghouse or the Vacuum, and is deaf and blind to all demerits in either.) —T. H. RAMSBOTTOM. (If you want further information you must write the Lydney Dispenser direct. We have devoted nearly all the space we can spare to noises in the ears.)—J. H. (The basis of all depilatories is lime; it is harmful to the skin. The only effectual way of removing superfluous hair is by electrolysis. If you like to send a stamped addressed envelope to Dr. Allinson, 1, Duke-street, Portland-place, he will tell you where you can have this done.)—WATER BIRD. (The bath has been badly galvanised, and nothing but regalvanising or painting will be any good.)

HARNESS' ELECTROPATHIC BELT should be worn by all WEAK MEN AND WOMEN. It restores health, strength, and energy to the whole body, and promptly relieves and cures all Nervous and Rheumatic Affections, Liver and Kidney Diseases, Sleeplessness, &c. Thousands of testimonials received. Pamphlet and advice free of charge. Harness' World-famed Electropathic Belt may be obtained (post free) by remitting Cheque or P.O. for 21s., to Mr. C. B. HARNESS, Consulting Electrician, THE MEDICAL BATTERY COMPANY (LIMITED), 52, OXFORD STREET, LONDON, W. (corner of Rathbone-place).

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The address is included as part of the advertisement, and charged for.

Advertisements *must* reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

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Messrs. JAMES W. QUEEN and CO., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. IV., VII., XXVI., XXVIII., XXX., XXXII., XXXIII. XXXIV., XXXV., XXXVI., XXXVII., XXXVIII., XXXIX., XL., XLI., XLII., XLIII., and XLIV., bound in cloth, 7s. each Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.).

Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Pills.—These famous Pills purify the blood, and act most soothingly on the liver, stomach, bowels and kidneys—the great mainsprings of life. They are wonderfully efficacious in all ailments incidental to females. To the emigrant, traveller, soldier, and sailor, they will be found invaluable in the time of need.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Complete set of **Double Engine Castings**, 2H.P. Cylinders bored and turned, valves fitted. Stamp.—E. A., 2, Alexander-road, Knaphill, Woking.

Dynamo, laminated armature, 4½ by 5½, splendidly made machine, good as new. Exchange. Photo.—E. THORNTON Handpool-road, Barrow-in-Furness.

Cornet, by Wallace, new, two mouthpieces, and case complete, cost £4 4s. Exchange 50 or 52in. Bicycle, or cash offer.—JOSEPH BLAND, Hackenthorpe, near Sheffield.

Strong **Lathe Bed**, planed for slide rest, 7in. lathe heads and countershaft. What offers?—H. E. NEWSTEAD, Otley.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1863.

Mr. With will exchange an exquisite 8½in. **Speculum** for a Browning's 2in spark Induction Coil, and Bichromate Battery.—The Laboratory, Hereford.

Perambulator Fittings.—Lot of Rubber Wheels, Springs, China Handles, Hood Joints, Rubbers, Bodies, Ironwork, &c., for exchange.—LOWE, 86, Kirkwhite-street, Nottingham.

Capital **Boiler and Fittings**, 14 by 6½. Exchange for Stock and Dies over ¼in Whitworth thread, or cash. Stamp, particulars.—14, Tame-street, Hill-top, West Bromwich.

Wanted, wide angle **Lens**, Photographic Background, or anything useful to photographer, in exchange for last 8 Volumes ENGLISH MECHANIC.—BALMFORTH, Scout hill, Dewsbury.

Photographic Lenses, Suter's, 7 by 5, Rapid, and 12 by 10 Wide Angle, both quite new. What offers?—Z., 74, Tollington Park, London, N.

Fletcher's Patent **Gas Furnace**, with two 12lb. pots, bow tongs, casting ring and burner, complete. What offers? Value £2.—A. HANESWORTH, Lyndhurst-street, Bolton.

Wanted, Rover or Safety. Exchange good **Bicycle** and cash. Particulars by letter only.—JAS. PURDY, 59, Stockwell Park-road, S.W.

Exchange, "**Electrical Review**," Vols. XIII. to XVII., bound; "Modern Applications of Electricity," Vol. I., Hospitalier; "Electric Lighting" Urquhart; "Electrical Measurements," Day; "Magneto and Dynamo Machines," Higgs; "Practical Electric Lighting," Holmes; "Electricity and Magnetism" Silvanus Thompson; "Electric Lighting Act, 1882," Glen. Offers wanted in newest Photographic Accessories, Lenses, Amateur Requirements; other scientific articles considered.—M., 30, Belsize-crescent, Hampstead, N.W.

Boiler, 2H.P., 12 tubes, as new, fittings complete. Exchange larger, or sell £12.—MORGAN, 3, Lakefield-street, Llanelly.

Dynamo, Ball's patent, series wound, 300 Volts, 9 Amps, 80 20-c.p. incandescent lamps, 3 switches, 2,000 lamp holders, and fuses. Offers.—HUDDLESTON.

Printer and Two **Transmitters**, by Zantzi, Crucible and Furnace, 30lb. Mercury, Steam Tank, and Advertisement Board. Offers.—HUDDLESTON, 97, High-street, Woolwich.

Double cylinder **Oscillating Engine**, 2¼ bore, 3in. stroke, perfect condition, cost £5. Exchange Electro-Motor by good maker, and Oxide of Copper Cells.—Particulars, ARTHUR COWLEY, Fairfield House, Warrington.

Wanted, Waterbury or other **Watches** out of order, and Musical Cabinetto damaged. Good exchange given in useful goods.—41, Breck-road, Everton, Liverpool.

"**English Mechanic**," unbound, Vol. XXXIX. to present date, inclusive. What offers?—M., 11, Victor-road, Holloway, London.

ENGLISH MECHANIC required, posted a couple of days after publication. Give in exchange, Friday's *Bazaar*, posted Saturday regularly.—EDWARD HUGHES, Graigue, Co. Kilkenny.

Will exchange large **Screw Plate**, 12 holes, taps, 5-16 diameter, for Electric Bell and Battery. Offer on approval.—WILLIAM NAIRN, 9, Patiom-street, Tillicoultry, N.B.

Good 7in. centre **Lathe**, oak bed, 5ft. 9in., two socket rests, two T, one for iron, and one 5in. centre slide-rest, and good set of crockery, nearly new. Exchange anything. Engine or Tricyle, or parts.—THOS. ELLINGWORTH, Leighton Buzzard.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JULY 22, 1887.

MICROSCOPICAL ADVANCES. — XXI.

By Dr. Royston-Pigott, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians; Fell. Cambridge Phil. Society; formerly Fellow of St. Peter's College, Cambridge.

Diffraction, Ancient and Modern.

Destruction of Spurious Mercurial Discs and the Apparition of a New Test Diffraction Ring.

ONE-MILLIONTH of an inch will now be denoted by the unit (𝔪), and the trigonometrical canon assumed that a body magnified 1,000 times, will at 10in. subtend an angle of 20·6265" (seconds of arc).

The writer has spared no pains in determining, in the first place, the possibility of defining, by a power of one thousand diameters, a spider line presented as an image, reduced in miniature one hundred and forty times, so as to produce a fine black line, and pairs of them the 1-1,200,000th of an inch with a well-defined bright interval of 1-230,000th of an inch. (Exhibited to the Camb. Philosophical Society.) But an opinion has been expressed that the demonstration of the visibility of an optical image is a very different thing from showing a real object of this minute size. Impressed with the weight of this argument, the writer has sought for instances of real objects of a magnitude sufficienty minute to meet the difficulty. He now proposes to present the results of inquiries patiently carried out. The research consists intrinsically in producing objects of great decision and exceeding minuteness, microscopically, and comparing observations made upon them with similar observations made with the sister instrument—the telescope. In order to give some precision to the inquiry, it was found necessary to construct a handy table of magnitudes, and adopt the same critical test for each instrument—viz., the visual angle subtended within the focus of the eye-lens by the objects referred to. Vision is supposed to be adapted to a clear view at a distance of 10in.

The millionth of an inch magnified 1,000 *times subtends an angle of* 20". *nearly*[*]. *Tabulation:*

Diameter of object magnified 1,000 times.	Angle subtended at 10in.
	"
Half-millionth of an inch	10·3
The millionth " "	20·6
1-800,000th " "	26·0
1-600,000th " "	34·0
1-500,000th " "	41·0
1-400,000th " "	51·0
1-300,000th " "	69·0
1-200,000th " "	103·0
1-100,000th " "	206·0
1-80,000th " "	258·0 nearly

Under the microscope I have succeeded in developing brilliant objects approaching these dimensions, and in confirmation and illustration of these results I shall first draw attention to astronomical data provided by the measurements of double stars and other objects.

Object.	Observer.	Power	Magnitudes.	Size.	Interval.
Double Star Σ_2	J. Herschel	320	8·9; 8·9	½".	⅙".

Of this observation Sir John remarks:—"Charmingly divided with 320 (20ft. reflector). The discs like two grains of mustard seed separated by one-third the diameter of either. *Vicinæ*, according to Struve, but at least *pervicinæ*. Distance between centres ⅔"." From this it follows the discs were ½". in diameter divided by an interval of ⅙".,[*] in the clear, calm sky of the Cape Observatory.

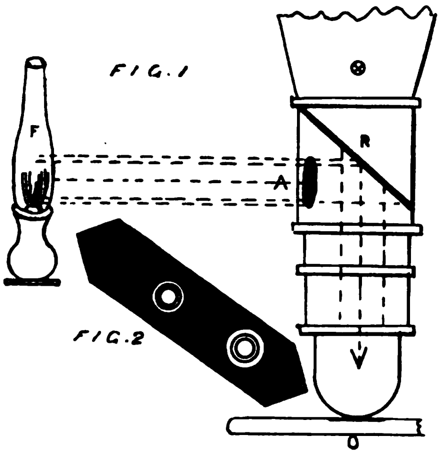


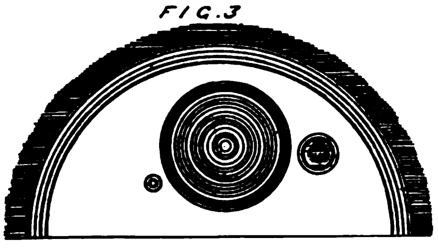
FIG. 1

FIG. 2

The disc magnified 320 times subtends a visual angle of 320 × ½" = 160". This, by our table, represents with 1,000 diameters instead of 320, a magnitude of 1-130,000th of an inch at 10in., whilst the black division forming the interval between the discs was 1—6th" × 320 = 53⅓". This visual angle with 1,000 diameters would have represented 1-380,000th at 10in.

Let us inquire at what visual angle the smaller magnitudes are seen. A rough estimate may be formed in such a case by the data given by Saturn's satellites, seen at a distance of 780,000,000 miles, at opposition, which I find to be for—

FIG. 3



Titan.	Iapetus.	Rhea.	Dione.
0·85"	0·45"	0·31"	0·13"
8th mag.	9th mag.	10th mag.	12th mag.

Considering, therefore, that a star is more brilliant than a satellite, a 13th-magnitude disc may safely be assumed to be less than 1-10th of a second.

Dione can be descried on a fair night with a power of 200: this gives a visual angle of 20", which is a visual angle presented by the millionth of an inch, seen at 10in. distance with a power of 1,000. But if a stringlet of these minute objects could be discovered, or, further, if they formed a continuous dotted line, their visibility would be much increased.

FIG. 5

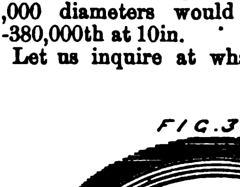
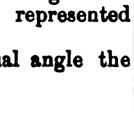


FIG. 4



Such a diffraction-millionth line, in a circular or other continuous form, beautifully bright, sharp and clear, I venture to bring before the notice of microscopists, as an exquisite test ring of microscopic excellence, and I propose to illustrate this by experiments and drawings.

We may observe *en passant* that both employ the same kind of eye-lenses, and that both vary the size of spurious discs. Now, the late Mr. Dawes stated that the divisibility of double stars was not so much affected by their smallness as by the aperture, and after numerous observations, inferred that *separating power* = 4·56" ÷ inches aperture for 6th and lower magnitude stars.

For dry lenses, the separating power is said to be—Wave length λ divided by twice the sine of the semi-aperture, which, for blue light and 150° angular aperture, is—

$$\frac{\lambda = 1—58000}{2 \text{ sine of } 75°} = \frac{1}{100000} \text{ nearly.}$$

But in this article I propose to demonstrate that very much smaller discs than 1-100,000th can be clearly seen, without spurious enlargements, and accompanied by the new brilliant test ring of almost inconceivable attenuation. This is the mode I adopt in preparing mercurial discs.

A bag of mercury is inclosed in a clean glass syringe. Slight pressure of the piston on the bag produced, at will, a perfectly clean globule. Struck with a steel spring it was crushed, the larger particles were continually swept away, and the remainder again repeatedly smashed. All these globules, however small, exhibited under substage illumination a bright halo, as though surrounded with a membrane!

It now seemed feasible to expect careful preparation would expose particles of surpassing minuteness. To define these as black points seemed at first a hopeless task. Besides, however, the sub-illumination, vertical light was now condensed downwards through the object-glass. A variety of phenomena then appeared, both new and significant (Fig. 1). The globules, protected with a thin glass cover 0·004in. thick, were illuminated, so that the object-glass condensed an image of the petroleum flame (*f*) upon the object (*o*). Among the small globules which did not touch the cover, their spheroidal surfaces reflected some very puzzling images, resembling indeed very strange diffraction rings, but of too great regularity and similarity. These images are drawn in Fig. 2.[*] The globules in upper contact presented the aspect of minute circular plane mirrors.

It then occurred to me the globules would be preserved from tarnish and complete oxidation by immersing them in oils. I had found the diameter of the bright image in the dry free globules to be nearly one-third of the globules, also at the same time seen by dimly illuminating it from below. But when petroleum was insinuated the image surprisingly diminished to nearly one-eighth of the diameter. It then at once seemed desirable to measure a good many globules as well as the images evolved, in order to fix an approximate ratio.

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[*] One-sixteenth should be added for accuracy, as 1—16th = 0·6265" nearly, as the millionth is 20·6265".

[*] If $6x$ be the diam. of discs, $2x$ is the interval. So, $3x + 2x + 3x = \frac{2}{3}"$
$\therefore 6x = \frac{1}{2}"$
$2x = 1—6\text{th}"$

[*] (r) is a transparent reflector throwing the light (f) down upon the object (o). The exact distance of flame f from the aperture (a) is from 8 to 9in.

VOL. XLV.—No. 1,165

The dry images—i.e., in "dry mounts" (Fig. 3). On close investigation and changing the objectives, the dry images on the non-contact or free globules were discovered to be formed of a *miniature* of the illuminated front and setting of the objective, and in each case seemed $\frac{1}{3}$ the globular diameter (*d*), Fig. 4.

The Oil-Immersed Globules. — The cause of the diminished images ($\frac{1}{8}\delta$) appeared to be the strong capillary attraction of the petroleum insinuating itself between the surfaces in contact, and reducing them to a more truly spherical form. The minute reflecting surfaces, caused by contact of the globules with the cover were also reduced very considerably in size.

A further and important result appeared. The extreme fluidity of the paraffin ultimately caused it to exude and spread, thus gradually forcing down the cover closer and tighter upon the globules, until even the smallest visible were reached. These globules at the instant of contact mostly assumed a minute circular shape, and in this form provided a great variety of star discs too minute to develop their minute images.

Castor Oil Immersion.— I expected the tenacity of this oil would temporarily master the capillary attraction, and preserve the lower globules from double contact. But this oil, after a time, also crushed down the particles. Before this state arrived, however, there was abundant opportunity to study the images ($\frac{1}{8}\delta$) in detail before the flat discs were formed by compression (see Fig. 3).

The brilliance of the reflected flame did not appear to suffer any dimness from reflection by the minuter planetary discs.

(*To be continued.*)

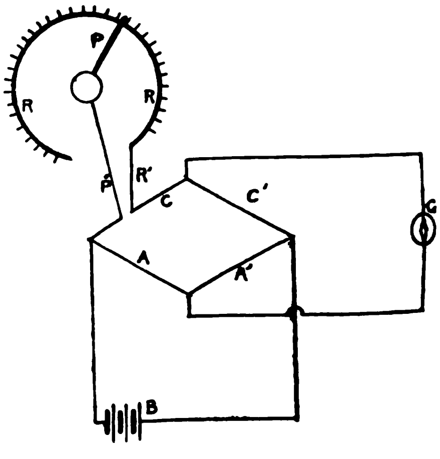
THE USE OF OIL FOR STILLING WAVES.

ALTHOUGH it has been shown that oil is of little use for quelling the turbulence of the waves at the entrance to ports, there is no question that it is of great advantage on the deep sea, and enables vessels to ride out a gale with comparatively dry decks. In view of this fact, Mr. T. F. Townsend, of Philadelphia, has devised an "oiler" which will allow the oil to escape as required in suitable quantities. The practice of using oil at sea for preventing the water breaking inboard is very ancient, for it is mentioned in the writings of Plutarch, Pliny, and Aristotle, who seem, however, to have had so much knowledge of the effects produced that they were aware of its comparative uselessness in shallow waters when urged into violent action by a storm. Oil spreads over the surface of the deep, rolling waves, and prevents them from being churned into spray; but, on a harbour bar, it seems to have but little effect unless supplied in very large quantity. In modern times Benjamin Franklin was one of those who examined into the question, and some of the results of his investigations were embodied in papers presented to the Royal Society in 1774. Franklin, writing to Dr. Brownrigg in 1773, mentions several things that he heard about the effect of oil on troubled waters; but, what is of more importance, describes his experiments at the large pond on Clapham Common. One day when the surface was very rough, he brought out a cruet of oil and dropped a little on the surface, but the effect expected was not produced. Franklin's being an essentially observant mind, he was not long in discovering that, being on the leeward side, the wind simply drove the oil on the shore. Accordingly he proceeded to the windward side, and "there the oil, though not more than a teaspoonful, produced an instant calm over a space several yards square, which spread amazingly, and extended itself gradually till it reached the lee-side, making all that quarter of the pond, perhaps half an acre, as smooth as a looking-glass." After that Franklin often repeated his experiments, and in company with Sir John Pringle and the above-mentioned Dr. Brownrigg, tried the experiment with success from a boat on Derwent Water. Naturally he would seek for an explanation of the cause, and after thinking over the reason that the wind is able to raise waves—at first small, but gradually increasing in dimensions—he came to the conclusion, or, rather, was led to imagine, that the wind blowing over water covered by a film of oil "cannot easily catch upon it, so as to raise the first wrinkles, but slides over it and leaves it as smooth as it finds it." Franklin argued that the wind being thus prevented from raising the first "wrinkles" on the surface cannot produce "waves"; but that argument does not apply in the cases where, a storm arising at sea, the master of the vessel uses oil to prevent the waves breaking inboard. An instance occurred recently with one of the Transatlantic liners, which, owing to some damage to the propeller, was being towed by another, and the sea, being rather rough, was naturally in a position to get wet decks. Signalling to the towing vessel, oil was slowly trickled on to the waves, with the result that the disabled steamer was towed along with a comparatively dry deck. The oil in these cases should be preferably of a rather viscous nature, the object being to spread a film over the surface, and prevent its being broken up into crested waves with the accompanying spray. Franklin seems to have apprehended that fact, too, for he says that when the wind blows fresh, there are continually rising on the back of every great wave a number of smaller ones, which roughen its surface and give the wind hold, as it were, to push it with greater force. This hold is diminished by preventing the generation of these small waves, and when, therefore, oil is spread on the surface the wind, in passing over the large waves, tends to press down the small ones. Franklin also says that once, in conversation with Count Bentinck, of Holland, his son, and Prof. Allemand, mention was made of a letter which had been received by the Count from Batavia, and in which the use of oil was incidentally referred to as having at least done something to save a Dutch ship from damage. Whalers in the Arctic seas often make use of oil for quieting the surface of the water, and their boats ride out a storm while attached to a whale from the lance wounds in which oil slowly escapes. The smooth sea, or slick, to leeward of a dead whale is also well known to all seamen engaged in the trade. The United States Hydrographic Office has taken an interest in this subject for some time, and regularly devotes a portion of the monthly issue of the "Pilot Chart" to reports received from masters of vessels and others, which reports have been issued in book form. Thus we find in the report that experience seems to demonstrate that the thick and heavy oils are generally the best—mineral oil not being so effective as vegetable or animal, though crude petroleum does give good results—its value decreasing in proportion to the degree of refinement. Fish oils, cocoanut oils, and others which become thick in cold temperature, may be advantageously thinned with petroleum or the refined oil. Two quarts of oil per hour is said to be sufficient; but in order to obtain the best results it should be supplied in such a way as to spread to windward. The usual method of applying the oil is by means of a perforated bag containing oakum or waste; but this is defective, because the quantity cannot be regulated, and it is not to be recommended, for when not required for use the bags are apt to be stowed away in corners where they become heated, and, if certain oils have been used, are liable to spontaneous combustion. Accordingly, Mr. Townsend devised his "oiler," which is a hollow metal globe about 10in. in diameter, and holding about a gallon and a half. To protect it from injury and to add to its strength, heavy wire rings are soldered on the outside, by means of which it is slung outward. It has an air-chamber to float it in a proper position, and an upper and and lower valve to regulate the flow of the contents. A ball in the upper valve regulates the flow of oil and stops it automatically when action is not desired, but the manner in which that is done requires some further explanation than the inventor has yet published. When the vessel is filled with oil the upper valve is adjusted, and the water gains entrance by the lower valve, gradually displacing the oil which is forced out through the upper graduated valve. A piece of tubing leading from the valve to the water may be used to prevent the oil from blowing to leeward; while the buoyancy and portability render the vessel extremely useful wherever oil is required for "stilling the waves." Now that so much attention has been devoted to this question, and it has been so abundantly proved that oiling the sea tends at least to keep the ship dry, it is probable that inventors will turn their faculties to the production of suitable appliances.

IMMISCH'S "APPARATUS FOR MEASURING HEAT."

AN electrical pyrometer, or apparatus for measuring temperatures, has been recently patented by Mr. Immisch, of Torriano Avenue, London, N.W., and is described in the following manner:—It is well known that the electrical conductivity of different substances is affected by changes of temperature in such conductors, and that effect has been already utilised for measuring temperature, but this invention consists in making use of it in conjunction with a Wheatstone bridge arrangement in which the arms are made of carbon and of metal, whereby the effect produced by the changes of temperature to which the apparatus is subjected is increased or multiplied, and the resistance which it is necessary to insert or withdraw in order to re-establish the balance of the bridge and bring the galvanometer back to the zero position, will be indicative of the degree of temperature to be measured. The choice of conducting substances depends upon the use for which the apparatus is intended. In the case of very high degrees of temperature, such as those found in furnaces for metallurgical operations, the patentee prefers to make the arms of the bridge of carbon and of platinum, but where the temperature is not so intense (such as when applying the invention to apparatus for clinical purposes), silver or copper is preferred in place of platinum.

It is well known that the resistance of carbon decreases, while that of silver, copper, and platinum increases, with an increase of temperature, and any heat applied will disturb the existing relation of resistances. The use of the Wheatstone bridge principle enables the patentee to a large extent to be independent of the resistance *per se* and of the current passing at any particular time. The calibration is performed empirically by moving a sliding contact in one of the arms along till a balance is obtained; the extent of such movement is the measure of the temperature acting on the apparatus, and is indicated by a pointer on a suitably divided dial. A suitable method of carrying the invention into effect is illustrated in the accompanying figure, which is a diagrammatic view. A, A^1 and C, C^1 represent the four arms of the bridge. A highly sensitive galvanometer, G, is included in a circuit between the point of junction between the arms A, A^1 and that of the arms C, C^1, and a battery, B, is included in a circuit between the point of junction between arms A and C and that of arms A^1 and C^1. The respective resistances of the arms are so arranged that at a given normal temperature no current will pass



hrough the galvanometer circuit, but above or below such normal temperature a current will pass in one or other direction through such galvanometer circuit. A suitable variable resistance, R, is arranged in one of the arms, and s shown in the drawing as applied to arm C, one end of same being connected by R^1 to C, while a wire, P^1, is also connected to such arm and to a pointer, P, capable of being moved over resistance R, with which it is in contact. Supposing arms A^1 and C^1 to be subjected to the source of heat (one being of carbon and the other of metal), and also supposing that it is required to measure a temperature of from 95 to 110° Fahr., as would be requisite for clinical purposes, the resistances of the arms are arranged in such a way that at 95° no current shall pass through the galvanometer G. Up to that point the current will pass through the galvanometer G in one direction, and when the temperature of 95° is exceeded the current will pass in the reverse direction. When the instrument has attained the temperature of the source of heat, pointer P is moved along resistance R, until a balance is re-established. The position of the pointer P on the dial will then show the temperature actually attained. As a matter of course, the calibration of the instrument is attained by submitting it to known temperatures and marking the dial accordingly. It will be seen that pointer P serves both to re-establish the balance and also to indicate the temperature on the dial. It will also be readily understood that the sensitiveness of the instrument depends on the ratio which resistance R bears to the whole resistance of the arm of which it forms a part. By introducing into the arm C known resistances, which can be either put in or taken out at will, the same instrument may be used for indicating different ranges of temperature.

Instruments of this description will be found useful for clinical purposes, as the whole may be made in a compact and portable form. As the parts to be exposed to heat can be made slight and small without detriment to the efficiency of the instrument, the indications are almost instantaneous, and readings may be taken without removing the instrument from the patient, while for metallurgical and other purposes the instrument will be found of great convenience, inasmuch as readings may be taken any distance away from the source of heat.

PHOTOGRAPHIC PRINTING IN COLOURS.

A PATENT has been obtained in this country for what is called "a photographic process for printing in colours," the inventor being Herr J. C. Hösch, of Vienna. It is not quite clear from the specification how the colours are obtained, but the patentee says that the invention enables him to produce exact coloured copies of objects of all kinds, such as living objects, oil paintings, aquarells, &c. As an example of how the process may be employed, let it be assumed that it is desired to reproduce a water-colour painting in six different colours—that is to say, one yellow, one red, one blue, one grey, one flesh, and one intensifying or finishing colour. In such case the process would be as follows:—A photographic negative would be first taken from the original water-colour drawing, and from this original negative five diapositives, or five glass positive pictures of exactly the same size would be made. These glass positives form the basis of the process of photographic colour printing. The glass positives are prepared by means of transparent and opaque varnishes—that is to say, the whole, half, and finer tints are applied to such parts as are not to be seen, or only slightly to be seen in each one of the above-named colours for the production of a coloured original picture.

The so-corrected glass positives are transferred in the ordinary photographic manner into glass negatives, and the so inversed parts are retouched. The patentee covers all the parts, surfaces, and lines, which are reproduced from the negative first taken and not required for the special colour—that is to say, he provides those parts which are transparent with the necessary coverings to such extent as the yellow, red, blue, or flesh colour, and the finishing tone of the original makes it requisite, in order to reproduce the colours contained in the original. He uses the first and direct photographic negative for the grey plate as a deepening of the tone for this plate, or the transformation into positive and negative is not necessary. He then has a plate in which all has been obscured but that which is to print or reproduce the yellow colour, another in which all but that to reproduce the blue has been obscured, and so on throughout the entire plates. When the negatives are used for producing gelatine printing plates, and these plates are printed in the corresponding colours, the six single printings are produced.

He copies these six negatives on gelatine printing plates, and prints the sheet yellow by means of the negative provided with yellow colour. This yellow print is now placed in the customary printing press, and printed with flesh colour from the plate provided with this colour. The sheet so printed with yellow and flesh colours is again printed with the plate provided with red, this sheet provided with the yellow, flesh, and red colours, is again printed with blue from the plate for the blue colour, and the picture produced with these four colours. The so-prepared sheet is now printed with grey from the negative printing plate containing the grey colour, and then with the tint applied to the last printing plate for intensifying, or finishing the colours, so as to produce the complete picture. It will be evident from the foregoing, says the patentee, that the successive printing of the sheet with the various negative plates, provided with the appropriate colours, will produce an exact copy of the original photograph in the colours of the natural object.

WHAT IS ELECTRICITY? *

IT is a common statement that energy can neither be created nor annihilated, and that the total energy in the universe is a determinate quantity. The first part of this statement, although true, is not in itself of vital importance, while the latter part is not true. It is perfectly true that neither time nor space can be created nor annihilated, and yet nobody attaches special importance to this fact, or says anything about the conservation of time or space, and certainly nobody ever tried to prove as a corollary that the total amount of time or space in the universe is a determinate quantity.

The true value of this principle of the conservation of energy is, that it is the expression of the quantitative relations of phenomena. Nearly all, if not all, phenomena consisting of change, or succession of events in time, are referred to force; now we find that all measurable forces have a definite quantitative relation to each other (the correlation of forces), such that the disappearance of one kind of activity, change of position, &c., of material bodies cannot take place without the appearance of an equivalent amount of some other form or forms of activity, &c. This it is that makes the conservation of energy the keystone of modern science. It is the modern equivalent for the old cause and effect.

Potential energy may always be expressed as the line integral of a force. When the force follows the law of inverse squares, as in gravity, electric and magnetic attraction, the integral is finite even when the upper limit of integration is infinite, providing the lower limit is finite; but if the lower limit is zero the integral is always infinite, and therefore the potential energy (in case of attraction but not of repulsion) of a finite system is infinite. If we have a system of attracting bodies, say, gravitating masses, this infinite value will represent what may be called the total potential energy of the system, but the bodies having come into actual contact, if we suppose them incompressible, have parted with all available potential energy, the other part corresponding to the dissipated energy in the theory of heat.

Now, this available energy where the bodies vary in size, shape, density, &c., is different for every final arrangement, as the closeness or final contact would depend on this; also the arrangement which brought the denser bodies nearer the common centre of gravity would, other things being equal, give the greater value to this available energy. As the order of approach of the bodies may be changed without altering the amount of energy, we must conclude that the latter is either infinite or indeterminate, according to which measure of energy we adopt. Maxwell states that "the existence of a potential function in the field near an electric current is not a self-evident result of the principle of the conservation of energy," as the potential has an infinite number of values differing by $4 \pi i$, so that an infinite amount of work may be done on a magnetic pole which is carried round the conductor an indefinite number of times. The work, however, is always a determinate quantity when the limits of integration are finite, as in the previous case. I consider the cases somewhat analogous. The kinetic energy of a moving mass is $\frac{m v^2}{2}$, and we sometimes see it stated that this energy resides in the body. But as the velocity of a body is merely relative, this kinetic energy will have a different value for every other moving body with which we compare the given one.

If two bodies collide, they will, in coming to a common velocity, convert all their available energy (available relative to each other) into some other form, and if we regard some third body as a standard of reference, there will still be a quantity of energy dissipated, the amount, of course, being different for each different body taken as a standard. The reason why the idea of the dissipation of energy has assumed such importance in the theory of heat is that the energy of a hot body is referred to a so-called absolute zero of temperature; but this being below the temperature of interstellar space, so far as we know it, we can no more reach it experimentally than we can the absolute zero of contraction mentioned above.

Prof. Dolbear, in his reply to Mr. Carl Hering on this subject, speaks of energy as an objective condition. Here is just where I would differ with him.

Energy is certainly an abstract concept, a class-designation for a variety of forms, and we in these times believe in the philosophy of Aristotle rather than that of Plato. Or to come down to later times, Kant considers time and space as subjective impressions, and it is in this category that I would place energy also, from its interchangeability with the others as a fundamental unit. To assist us in completely freeing our minds from absolute notions, let us consider a remark made by De Morgan in an article on the "Calculus of Functions," namely, that we are accustomed to regard quantity as being generated by the successive addition of *equal* increments; thus an hour is considered as the sum of sixty equal parts called minutes, a minute of 60 seconds, and a second may be considered as composed of an indefinite number of smaller equal parts. This is the most natural process for the human mind, but conceive of a mind to which the natural process would be to consider quantity as generated by the successive addition of *percentage* increments; to such a mind what to us is the theory of logarithms would be the common arithmetic, and what we express as $a + b$ would be a difficult operation. In fact, it was by employing this conception of kind that Napier discovered logarithms and not by the extended conception of exponents, as is sometimes supposed. I have given De Morgan's meaning from memory and do not quote his words.

Let us apply a similar method of analysis to the theory of fundamental units. Maxwell gives length, time, and mass as the three fundamental units on which all others are made to depend. These units, however, are fundamental only in a relative sense, as we may take other magnitudes as fundamental, and make length, time, and mass depend on these.

The most general statement of the theory is that, three independent units having been established, all other physical units may be made to depend on these, reducing the whole to a connected system.

Space, or the more specialised conception, length and time, are among the earliest abstract notions acquired by the human mind, but with mass the case is different. It is only since the general adoption of the principle of the conservation of energy that the conception of mass has attained its present distinct individuality, it being in fact a more refined substitute for the "weight" of the older science. The *vis viva* of Newton (which was equal to twice the kinetic energy) was not $m v^2$ but $\frac{w v^2}{g}$, m being the weight and g the force of gravity. Energy, then, has at least an equal title with mass to the position of fundamental unit, on the ground of being in the natural order of our mental processes. We may therefore substitute energy for mass, and using E as its symbol and Maxwell's notation we have the dimensions of the unit of mass $[E T^2 L^{-2}]$; and, in fact, the only definition of mass we have which is at all characteristic contains this formula by implication.

We may define mass as that which possesses weight or attraction for other masses; but it is only when we add that a mass moving with a given velocity is capable of doing a definite amount of work that we obtain any distinctive idea of mass; instead, however, of substituting energy for mass we might substitute it for either length or time, and conceive of a mind, according to De Morgan's method, to which this would be the natural order.

Again, we always think of a velocity as the ratio of a distance to a time; but there is no reason why we should not regard velocity as an independent magnitude, and a time the ratio of distance to velocity; or a distance, as the product of a velocity and a time, according to which substitution is made. Now, according to a statement of Prof. Dolbear, that energy has an objective existence as well as matter, of which the measure is usually considered mass, and ether, which as yet has no measure, we may construct a system of fundamental units of which one or two are the measures of objective realities, while the remaining two, or one, are merely subjective impressions. If the ether had an independent measure we might take mass, energy, and ether as fundamental units, making all three objective, or, adopting the vortex theory, and discarding mass, we must take in again one of the merely subjective magnitudes to fill its place. This proposition, to my mind, is a good deal like saying that one of the dimensions of space has an objective existence while the others have not. Preceding the discovery of the conservation of energy was the discovery of the indestructibility of matter, and in some of the older works on chemistry it is stated that, while all other attributes of matter are changeable, the absolute weight remains unchanged under all conditions.

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* By TOWNSEND WOLCOTT, in a paper read before the New York Electrical Society.

As the weight is only determinate under determinate conditions, it has been recommended that conservation of mass should be substituted for indestructibility of matter, mass being considered the only thing that remained unchanged. But is this correct?

All the chemical properties of a body have determinate magnitudes when a sufficient number of conditions are fixed, and the whole method of volumetric chemical analysis is founded on this principle.

I have gone thus at length into the general theory of conservation to show that it does not necessarily apply alone to energy and mass, but that the abstract generalisation from any complete series of quantitative relations between measurable magnitudes, not included in these two, is a new conservative principle.

For if it were not a conservative principle then the magnitudes would not always have the same quantitative relations. Conservation is the statement of the uniformity of nature, or, if you prefer the expression, the constancy of natural law. I will add that the conservation of energy is so broad a principle that nothing outside of it is likely to be of very great importance. From this point of view it is no more than we should expect that some one should establish a conservation of electricity, as Prof. Silvanus P. Thompson seems to have done, nor is it any proof that electricity is matter as Mr. Carl Hering appears to think. The most direct proof to my mind that electricity is not matter is the experiment of Maxwell, tried in 1861, to prove that the electric current has no momentum.

The answer to our question depends in a great measure on the definition of electricity. The electrostatic unit of quantity is identical with the unit of electrification, and the electrification of an insulated conductor in equilibrium is all upon the surface; that is, where the conductor ends and the new conductor begins. This quantity of electricity is as definite a physical quantity as any other, as the operations of measurement, addition, and subtraction may be *experimentally* performed upon it, which is all that we can do with any physical quantity. We may therefore regard electricity as existing in two dimensions (which, by the way, matter has never been known to do). Still, whether we adopt the theory of action in a distance, or Faraday's theory, mathematically developed by Maxwell, of stress in the dielectric, we cannot ignore the fact that there is a definite distribution of force in the surrounding space, which is investigated in the theory of potential. Let us take the analogy of a shadow. A shadow in ordinary language is a darkened *surface*, but this darkened surface is merely a section of a darkened *region*, and it is this darkened region that is called the shadow in astronomy. The superficial shadow cannot exist without the solid shadow, and, on the other hand, the solid shadow cannot exist without there being a superficial shadow on a properly placed surface. Of course, to us a shadow is a mere negative, the absence of light. But suppose some one to be investigating it, not knowing that it was only a shadow, he might regard the superficial phenomenon as the direct action at a distance of the opaque body, or he might assume an ether with all sorts of convenient properties, and explain matters in that way. But we regard the superficial and solid shadows as merely different phases of the same phenomenon.

The trouble with our question as usually put is that we define electricity as we have just done, then insist that this is the genuine article, and fundamental in its nature, while all other phenomena which are essentially electrical are merely consequences of this fundamental quantity of electricity, and then we demand, What is electricity? That is to say, which of three or four other things that we allow to have a real existence—viz., matter, energy, &c.—is it? I would answer emphatically *it is no one of* them.

Let us abandon absolute ideas and treat all electrical phenomena as equally fundamental, simply striving to discover their relations to each other, and to other phenomena; then each discovery is a partial answer, and the only kind of an answer we will ever have to our question. As to our present knowledge of the subject, it is as great as of any other subject in natural science. Indeed, Maxwell says in his preface:—"The internal relations of the different branches of the science which we have to study are more numerous and complex than those of any other science hitherto developed."

I have often put the counter-question to my friends, What is heat? The unscientific ones usually say, "Heat? Why anybody knows what heat is; there is no use of such a question!" Or "Heat is heat;" or, "Heat is the opposite of cold." Those that have read Tyndall reply very glibly that heat is a mode of motion. But Tyndall's book only proves, and indeed only sets out to prove, that heat is a form of energy. We know that electricity, as we define it, is not energy; but we do know what its relation to energy is, which is just as important and characteristic knowledge as we have in the case of heat.

PAINTING A COACH FROM THE WOOD.

SAID one who was but slightly acquainted with coach painting: "I can't see why a painter who has served a regular apprenticeship, and afterwards perfected his hand on light work, should not be fully competent, and feel no hesitancy in painting a coach body." Well, it does appear a little singular, because the methods are the same, and yet there is so marked a difference as to amount almost to a separate branch of carriage painting. Light work is quickly handled, therefore the workman on it does not acquire the extra patience demanded of the heavy body painter. Again, the surfaces being small the workman is ignorant of the method of colouring and varnishing large surfaces, some of which are plain while others are broken by drip moulding and windows. Then, again, the coach has many detached parts which have to be brought along. So much by way of introduction. A fine coach body fresh from the hands of a first-class workman is the embodiment of mechanical skill in joinery and graceful sweeps, and there are but few painters who do not look upon it with admiration. The wood is all so white and clean that it seems a pity that the fiend with the slush keg and paint pot should be allowed to soil it. First of all the inside must be "slushed." Now while this work does not require much skill, it is important that the coating be laid evenly as possible and no spot missed. The canvas is glued on, and therefore must be protected by a coat of paint which is impervious to water. Next comes the priming, which, by the old method, should be a coat of raw oil carrying a little lead, a trifle of Japan and turps if the job is to be moved along rapidly. Good brushes and clean smooth material should be used. The coat must be brushed on freely and worked well into the grain and nail holes and corners, and wiped out so as to leave no fat edges, fat corners or runs. A week is allowed for drying—when the body should have a light sandpapering and be throughly dusted. The second coat need not be more than half oil to one-fourth Japan and turps, and lead sufficiently to cover the wood. Lamp-black may be added or not, but if added, then just enough to stain lead. This coat must also be well brushed in, and wiped out smooth and even. At least four days should be allowed for drying.

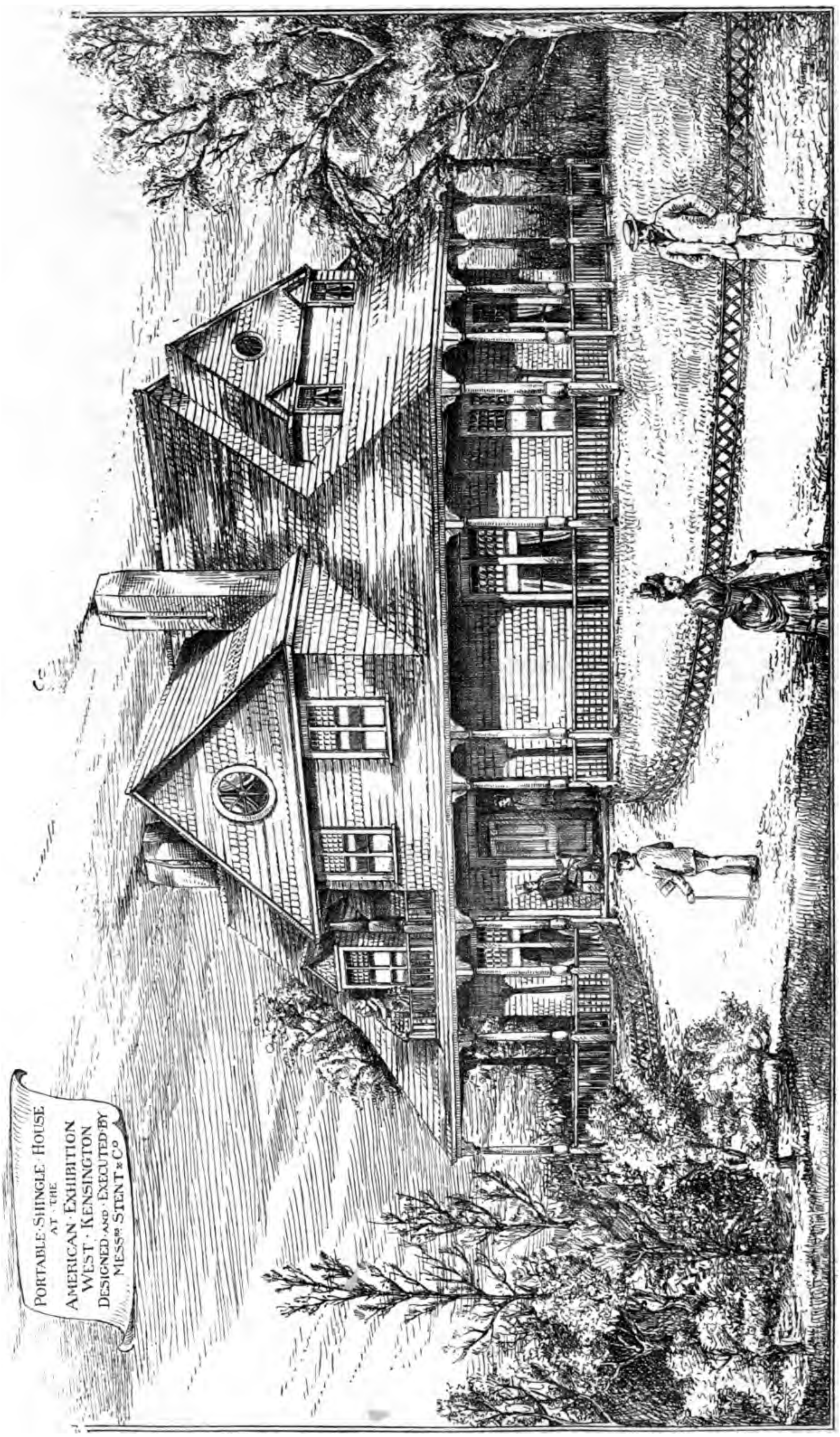
The nail holes may now be puttied half full with good tough putty, composed of equal parts of keg lead and whiting and a stain of Japan. On the second day thereafter give a third coat of lead with oil in small proportion, and lamp-black sufficiently to make it a shade darker than the preceding coat. After two days finish puttying the nail holes and plaster the grain, knifing it down so that none is left above the surface. Allow no falling putty to harden on any part. On the third day thereafter apply the first coat of rough stuff, made of English filling two parts and keg lead one part, and mixed in half and half of Japan and rubbing varnish, and thinned with turps. This first coat of rough stuff is a most important one to look after, for if it is laid on heavy and full of brush marks, it will return as a plague later on. It should be applied moderately heavy and worked down as smooth as a coat of lead. The three remaining coats may follow in twenty-four or forty-eight hours, according to circumstances. Last of all a stain or guide coat is to be given, mixed of lamp-black and a little rough stuff and laid on thin. Two weeks is none too long for the rough stuff to stand. The "rubbing out" or "scouring" is next in order, and although it is humble work, and very tedious and dirty, on it depends the perfection of the subsequent painting. The rubbing proceeds, downwards, and as water has to be used freely more or less of it will get inside of the body But there are some rubbers who flow more water than is really necessary, and if they are not watched will allow a pool of water to stand continually inside the body. The expert and sensible hand will work equally as fast, and yet flow but little water. Corners should be rubbed out nicely, so as to leave the lines clean cut, as they were before the paint was put on, and, more than that, a fat corner may in time ruin the whole painting by cracking.

The rubbing completed, the body must stand twenty-four hours to allow the moisture to evaporate, after which give a thin coat of lamp-black. Next day hair off this coat and examine for defects. Putty all such, and next day cut down the putty and touch it over with black. English purple lake is selected for the panels. Mix a ground work of Indian and Tuscan red and lamp-black to a medium toned brown. Apply two coats—one a day. Hair off the first coat, and see to it that the second one is fine and clean. The lake must not be stained by a dark Japan; gold size or varnish is preferable. Lay the lake somewhat heavier in the body than opaque colours. Two coats and colour—and varnish should make a solid job. The black parts may proceed with the panel colours, and when the colour-varnish has been lightly rubbed, black off the mouldings with colour made glossy with varnish. The second coat of varnish should be stained with black, while the third coat may be clear. Each coat of varnish should stand at least three days, and be rubbed on the fourth day. The second coat receives the most thorough rubbing, but it must not proceed so far as to reach the first coat. The third coat is flowed on free and full and as clean as the finishing one. A week is none too long for the coat to harden. But the gloss may be cut off on the third day, and the rubbing be completed when the trimmers are through with the body.

In rubbing the last coat remove the grit and cut the gloss well down with fine pumice, and follow the pumice with whiting, rottenstone, or omit both and give what is termed a water rubbing—that is, considerable water to little pumice. Use the water-tool freely in the corners and under mouldings and without stint. The finish differs from the varnishing, chiefly in the finer quality of varnish employed. The secret of laying the finishing varnish is to mass it on freely, and brush it no more than is sufficient to level it. Very large surfaces are given an extra quality so that there will be no fear of its setting before the panel can be brushed entire. The extra quality is gradually taken off and wiped into the wiping cup. It is the flowing coat that assists in drowning fine spects, and that produces that fulness and brilliancy noticeable on the best work. The beauty of the bare wood was spoiled by the first coat of paint, and the preparatory painting was very far from agreeable to the eye, but now, as a finished piece of painting, the colours and surfaces are so beautiful as to be a marvel to those who are familiar with the process which produces it.—*The Blacksmith and Wheelwright.*

SHINGLE HOUSE AT THE AMERICAN EXHIBITION.

WE illustrate this week a full-size Shingle House, of two stories, with a verandah all round, and a piazza leading from the upper floor. The house is very picturesque, and of pleasing design. In America great numbers of these houses are in vogue, where at the principal watering-places and summer resorts whole colonies of them are constantly being erected. No two designs being alike, the monotony usually observed in places of a similar description in this or other countries is entirely avoided. Individual tastes may be readily satisfied, both as to internal and external details, with the greatest ease. They are adapted for any climate, and the mode of construction renders them warmer in winter and cooler in summer than ordinary brick houses. (We may remark, in passing, that this has been well exemplified in the house in question during the hot summer we are now experiencing.) The buildings are prepared and fitted together in Canada and America, and as only the best Canadian white pine is used, this may be regarded as a guarantee of their longevity. Climatic influences have little or no effect whatever; indeed, they are improved externally in appearance by weathering. The house illustrated has been designed and erected by Messrs. Stent and Co., of New York, and 18, Parliament-street, at the American Exhibition, Earl's-court, and we believe that Company have already secured important orders for these houses, and are in a position to execute contracts on the shortest notice. We shall welcome the erection of many such houses at the seaside, for instance, and in country districts where the dull, unending, staring white plaster and stucco do much to ruin the natural beauty of the scene.



Portable · Shingle · House at the American · Exhibition West · Kensington Designed and Executed by Messrs Stent & Co

SNAKE-BITES AND THEIR REMEDIES.

IN continuation of his remarks on this subject (see p. 437), "Eos" sends us a long paper on "The Treatment of Snake-Bites in Victoria," by Dr. G. B. Halford, M.R.C.P.Lond., and Professor of Anatomy, Physiology, and Pathology in the University of Melbourne. The paper was read in 1872, and we give portions of it below, prefaced by the remarks of our valued contributor:—

"I send Dr. Halford's treatment with ammonia. I always had great confidence in this active stimulant to the heart's action. Sir J. Fayrer's experiences, as recorded in his valuable book, were nearly all based on experiments *in corpore vile.* I have noticed that the human patient, next to the domestic pig, struggles hardest and lives the longest, which is a highly-encouraging fact. There are men who have lived a whole week after a bite (as in the case I alluded to of the English officer who was bitten two years ago at Natal), and, in India, 24 hours; but natives succumb to the poison very quickly.—EOS."

Dr. Halford, in commencing his paper, gives 20 cases of snake-bite treated by various medical men with liquor ammoniæ, 17 of which proved the efficacy of the remedy, while the three fatal cases were those of children, and there were conditions which possibly explain the failure. He then proceeds:—

I pass now to the consideration of the state of a person dangerously bitten by a snake, and to the effect of ammonia when injected into the circulation. And here, in addition to a mere statement of facts, I must pass into hypothesis.

In fatal cases of snake-poisoning, whether in this colony, India, America, or Africa, it may be stated as a rule, with few exceptions, that the blood loses its power of coagulation, and becomes thinner and poorer; its colour resembling the most deoxidised form of Stoke's cruorine. This blood, however, after death greedily absorbs oxygen, when exposed to the air, and it absorbs it more than unpoisoned blood. Since my attention was first directed to this subject, I have met with Dr. Harley's observations on the influence of poisons on the respiratory gases. In a dog poisoned by a puff-adder, the blood absorbed two per cent. more of oxygen than the healthy blood similarly treated. Now, as I asked in my first paper on this subject, why, when no impediment exists to the access of oxygen, should the blood become so gradually deoxidised in people bitten by snakes, excepting on the supposition that something had been added to the blood which prevented those actions and reactions between blood and oxygen upon which the manifestations of life depend? The fluid state of the blood is also in harmony with deficient oxidation, and yet there is no hindrance to respiration; no reason, like in drowning, why oxygen should not reach the blood; it does reach, but in the presence of the serpent's poison its life-sustaining power is withheld, unless some other agent be added to the blood to counteract it.

I am inclined, however, to refer the changes in the blood to the introduction of germinal matter* from the serpent's glands, and all the symptoms to such changes. To explain: there is little, if any, difference chemically between starch and sugar, but physically they are very different; little difference chemically between fibrine and albumen, physically they are very different. But both starch and fibrine are rendered soluble by the addition of minute particles of germinal matter: in the first case from the salivary glands, in the second from the stomach. True, with the latter is combined an acid, but without the pepsine cells no digestion takes place, and, what is very remarkable, a very minute quantity is able to convert a very large quantity of fibrine into albumen, so long as the mixture remains acid; the pepsine cells require no renewal, since, for want of a better explanation, they are said by their mere presence to determine the conversion. A little spittle from a man's mouth will change starch into sugar within one minute. These things being true, is it unreasonable to claim for the secretion of another closely-allied gland to the salivary an equal power in another direction? What the changes produced in the blood are we do not yet fully know; but that which in healthy blood is called fibrine is diminished, digested if you will, in the presence of serpent's venom. If the quantity of venom entering the circulation is great, the changes are greater and the chances of recovery less. If the animal is small his chances are still less; if it depends much upon oxygen with a naturally highly fibrinous blood, rapid circulation and absorption, it soons falls a victim. Thus a bitten bird falls in a few minutes from a twig to which it has hopped to the waiting reptile beneath; hence the old stories of snakes charming birds. If the animal be in a great degree indifferent to oxygen—i.e., can live for a long time under water, in carbonic acid gas, as a reptile or hibernating animal, with correspondingly slow circulation and absorption, its chances of recovery are greater, it is naturally more indifferent to the presence of venom, and the probability of absorption from a wound is much less.

But, it may be said, the symptoms of snake-poisoning come on too soon for such changes in the blood to be produced; but recollect the nearly instantaneous action of ptyaline. Again, if venom enter a vein, one minute will certainly suffice for its entire circulation through the body. Estimating the quantity of blood in the body at 12lb., and the contents of the left ventricle at 3oz., then the whole mass of the blood would be circulated by 64 heart-beats; and, taking the normal beats at 75 per minute, this quantity of blood would pass through the heart, carrying with it the imported venom, in 51 seconds.

Believing, then, that in the blood itself the chemical changes occur which have their resultants in voluntary and reflex acts (will, motion), and in animal heat, let us turn to the condition of our snake-bitten patient. He is usually pale, with a great tendency to sleep, the heart's action is feeble, and in some cases deep coma ensues, from which it is difficult to arouse him; in fact, the countenance is like that of an epileptic after the convulsion. Do not the pallor and drowsiness indicate an anæmic state of the brain, or rather a diminution of the arterial capacity and extension of the venous surface analogous to that which takes place in a less degree in ordinary sleep, according to the researches of Mr. Durham? In all of the cases brought before you this evening, the functions of the cerebral ganglia and higher sensorium were completely in abeyance, or for a time extinct. Dead the sufferers were to both sound and light, and to this hour they have no knowledge of the injections to which they were subjected. Now it is worthy of notice that recent views ascribe the phenomenon of sleep to the using up of the previously stored-up oxygen in the blood, analogous to the views I propounded in June, 1867, for the accession of sleep in cases of snake-poisoning.

There is yet another system of snake-poisoning, which deserves the greatest consideration; I allude to the condition of the pupil. It is that of extreme dilation, depending, as I believe, upon the condition of the central optic ganglia. Light is pouring into the eyeball, and yet no reflex acts are produced. An exactly similar condition affects the auditory ganglia, vibration after vibration shocks the tympanum, each falling silently upon the central ganglia.

Sometimes this condition of the sensory ganglia, including probably the corpora striata, optic thalami, and corpora quadrigemina, exists whilst the higher cerebral ganglia either remain a long time unaffected or escape entirely; in the latter case, recovery resulting; in the former, constituting a most dangerous state, and one that should make the physician very anxious, more especially when accompanied by swelling or pain in the neck. From the details of cases I have read, I should fear these symptoms more than the deepest coma.

The treatment that I have recommended is that of injecting dilute ammonia, say, at the least, 30 minims of the Liquor Ammoniæ B.P. sp. gr. ·959 into a superficial vein. If properly injected, the vein having been first exposed, and its coats pierced with the nozzle of the hypodermic syringe, the alkali soon reaches the heart, vigorous contractions follow, blood that was recently stagnating in the capillaries passes on, cut vessels which had ceased bleeding bleed afresh, the temperature arises, the colour improves, the muscles contract, the sensory ganglia respond to external impressions, the nearly or quite inanimate mass is now animate. Light and sound are perceived, the faces of friends are recognised. This is no exaggerated picture, but such as I have myself witnessed in dogs (the central organ being exposed, and artificial respiration kept up for an hour) recovering instantly from the stupor of chloroform. I have also repeatedly pierced the heart itself, and there injected the ammonia, with similar good and no bad effects.

The remedy, then, is ammoniacal gas in solution, an old and favourite one for snake-bite the world over; but instead of putting it into a stomach, the stagnating vessels of which cannot absorb—for all the brandy and ammonia poor Mr. Drummond took were afterwards found in the stomach and intestines, and so no doubt of others—I inject it into the blood itself; the gas, experiencing a rise of temperature, expands, and presently is in direct contact with every tissue in the body, the capillary walls alone intervening—in fact, it becomes both a central and peripheral stimulus, so powerful that as yet no soporific tendency has counteracted it; none of the comatose states of snake-poisoning have failed to be removed by it; but as its power is expended, fresh supplies must be brought. It does not act as a transitory stimulus to the heart, it maintains vigorous pulsations for at least twenty minutes or more, frequently requiring no repetition. Its presence in the nervous system and muscles is shown by the resulting animation; there is also a rise of temperature. It is presumable, therefore, that oxidation is going on in the blood, where before there was little or none; that the abnormal molecular changes going on in the blood are arrested; that electrical action results; and that the capillaries of the muscular system, the whole body over, are inducing to form heat or excite motion—the wheel of life is turning again, so lately on the point of stopping—for the muscles are now recognised as nothing but machines for the conversion of heat into motion; the determining and directing power residing in the nerve tissue; the fuel in the blood.

The lessons we have learnt from those who have used this remedy and have sent their cases for publication to me, are that a good battle must sometimes be maintained ere recovery ensues. As with every other remedy, the amount required must depend, be judged of, by the effect produced; the great fear is that too little, rather than too much, will be injected. The greatest care should be used that none of the ammonia is spilt, or sloughing will follow; but if the canula of the syringe be properly introduced, and the injection be forcibly made so as to mix the ammonia immediately with the blood, I believe none will follow. A little inflammation may result; but what of that if the patient be saved?

AN ELECTRIC SEISMOMETER.

AT a recent meeting of the New York Electric Club, Dr. Otto A. Moses exhibited and described his new electric seismometer, and we make the following extracts from his paper:—

The instrument before you is intended to register the most delicate waves that progress over the face of the earth. They are not necessarily earthquake waves. They may be those waves that come from—and it is an old idea—the breathing of the animal—the breathing of the earth—because it has been discovered recently that there are regular pulsations of this earth. Now, it is not an unnatural thing to suppose that we who in examining nature can find the most minute forms of life in a drop of water, may look for forms of life just as much greater than ours as we are than those animalcula; so that these pulsations or waves that I speak of may be, without any very great stretch of the imagination, a breathing of an animal—not necessarily in the way that we breathe, but a pulsation indicative of life, for life is nothing but motion. Before proceeding to describe the instrument by which I propose to register the direction and force of earthquake waves, it would be well to define what is an earthquake, so that we may intelligently consider the requisites of the seismometer or seismoscope by which its movements may be recorded.

Those greater or lesser movements of the earth that are felt, seen, or heard, and which are caused by either an increase or diminution of internal or external pressure on the outer layers of the earth, are called earthquakes. They are made evident to us by tremors and undulations of the earth and sea, by the destruction of buildings, the permanent elevation or subsidence of strata, the opening of fissures, the escape of gases, and flames from them, and in their most powerful manifestations by the flow of melted lava from the interior of the earth, accompanied by the escape of steam and clouds of dust and ashes.

This condition of things is of very frequent occurrence on our globe, and if we could get some daily record of every part of its surface we would find that a constant inaction is going on between the *terra incognita* of the inner world and the superficial crust upon which we walk or sail. In fact, earthquakes belongs to the every-day occurrences; but when we consider that four-fifths of the earth's surface are covered by water, it is scarcely to be expected that we can ever organise systematic observations over a regular and close network of stations Indeed, the evidence of one and the same earthquake is very different at different times and places. It varies irregularly, from the foci to the extreme edge of seismic action, passing from the stage of concentrated convulsion at the epicentrum to the almost imperceptible tremors at the periphery, sometimes agitating the surface of the earth with a motion seemingly as great as that of the storm-tossed ocean billow, or sinking to great fineness of vibration that only the microscope and microphone can detect the disturbance.

A learned French scientist, Abaddie, wanted to get an absolutely tremorless surface by which to take the reflections of fixed stars, perfectly quiet, for certain astronomical measurements. In order to get that—as to the pure scientist time is no object—he constructed a cone of solid concrete, that was about 4 mètres, or 18 or 19ft., in height, but buried below the surface of the earth, and that rested on the solid rock. He there put a surface of mercury, which you know to be as unstable as anything can be, because there is no capillary attraction between the mercury and the inclosing walls. There seems to be a repulsion between mercury and other surfaces, so that the slightest movement communicates its motion to the mercury surface. He then put above that orifice cross-hairs, such as you see in telescopes, microscopes, and other observing instruments. From that he projected a beam of light down on to the surface of the mercury. The light rebounded and cast a shadow on the cross-hairs, and that was over the opening about 2in. on the surface, and to his surprise he never was able to get a quiet observation of the shadow of those cross-hairs. It never was at rest, and sometimes it would disappear entirely. There was some seismic action that he could not feel at all, that affected the surface of the mercury below so that he never could get that beam of light that he threw on the surface of the mercury to reflect back through the same orifice through which it came. There was always a tremor.

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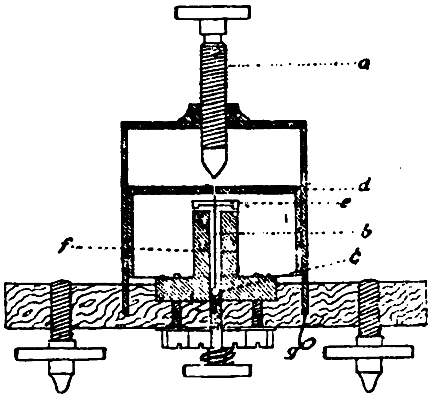
* *The germinal matter consists of nuclei 1-4,000in. diameter. The fluid is either slightly acid or neutral.*

Any instrument or piece of apparatus for registering the approach of an earthquake, to merit coming into general use, must combine several qualities which may not be easily united. It must be accurate in registering the work to be done; it must be delicate; it should respond quickly to the slightest or the strongest blow; it should recover itself instantly, in order to be ready for another record; it should not be affected by inaction by the change of perpendicularity, while passing from the trough of an earthwave to its crest and back again; it should be small, cheap, portable, always ready to apply a force, yet consuming no power while waiting; requiring no attention, being self-acting and self-recording.

Attempts have been repeatedly made to supply a seismoscope or seismometer which would fill all these conditions; but they have met with only partial success, for this reason, that they have all been made to act directly in measuring the disturbance of a force upon whose absolute constancy the instrument should depend for fulfilling all the conditions of accurate registration. If the disturbance of gravity be the thing to be measured, then the governing principle of the machine which is to record it should be other than the force of gravity—a judge should not sit in judgment on his own case.

You are all, of course, familiar with that experiment of inertia, the movement of a body under a surface at rest, where there is not sufficient friction to carry the body on the surface. This would be carried forward; the other body would fall. Now, that is the principle of the most successful seismoscopes and seismographs in use to-day. They have a very heavy weight. Of course, that weight is a little world in itself; it tends to the perpendicular, while the earth underneath it, which is drawing it, being, of course, drawn by the pendulum as well, the earth underneath it attracts it, and keeps it steady. If there comes a convulsion which moves it, the pendulum remains, and if, on the surface, you have some bristles, or a bit of paper which rests on a surface, blackened with lamp black, as the earth moves it will indicate by its movement the extent that it has moved. But that is only somewhat of a makeshift, because the pendulum, after a while, gets the motion of the earth. It is drawn with it, just as if you revolve a wheel in water, the water is taken with it; so that all those different forms of apparatus are very unsatisfactory. It is a problem of great importance, and one that a great deal of ingenuity has been spent on; but none of these machines are satisfactory, because they register only very small motions, and the earth, gentlemen, may be moving through space 50 or 100 miles, and you will not notice it—that is, you may move up or down 50 or 100 miles, and you won't know it. Now, that seems like a broad statement. You would say things would be upset. Not a bit of it. Suppose I had a bridge 8,000 miles long from parapet to parapet, taking the antipodes of the earth, and imagining the section of the earth to be a bridge. Now then, a pressure of 50 miles down and 50 miles up, on such a bridge, would not be a hundredth part of the expansion that takes place every day in the Brooklyn bridge, which rises and falls several inches. You will say, we would feel strange. Well, do we feel strange when the people underneath us at the antipodes are enjoying the meridian sun—do we feel strange because we are upside down? Not a bit of it, because the attraction of the earth is so great that our blood rushes to our feet, and we do not know anything about it. So we would not know anything about a movement of 50 or 100 miles on the earth, if it took place. Now, all these different apparatus are unsatisfactory, because they do not register the great movements in the earth that are taking place, that we may be entirely ignorant of. There is something which may be interesting just here.

The first conversation that I ever had with Mr. Thomas A. Edison was on the subject of this seismoscope. That was in 1878. I met him one day at Mr. Prescott's office in the Western Union building, and I carried a letter of introduction to him from Dr. Agnew, a mutual friend. We got in conversation, and I spoke of this, and he was very much interested in it. I had combined with it a feature, that I will afterwards speak of, that required me to use some of the carbon that he was then experimenting with. He was just making a seismometer, and he accompanied me over to Menlo Park. There I experimented with this machine. I wanted to find out whether it was possible to register the varying pressure of the carbon, and to make a registering instrument of a varying current of electricity to pass through the carbon, and one of the assistants in the laboratory said to me, "Here is a very curious thing I cannot explain." "Well, what is it?" He had a little carbon button such as those in use in the telephone, and there were very few of those buttons then, because he had not yet put the telephone on the market. Those buttons were all put under a weight of one gramme. Then a certain current of electricity was sent through it, and if the resistance was about 1 ohm, the carbon button passed muster, and it was then used, and put into a telephone. If it did not pass muster, it was rejected. This gentleman, Martin Force, one of Mr. Edison's assistants, said to me, "I cannot understand this. I have been bothering over this button for an hour, and at one time it registers more, and at another time it registers less." It was a cloudy day, and I said, "Perhaps it is absorbing moisture." He said, "No, it is not so, because it has been the same kind of a day all day, and this morning it registered so much, and at noon it registered more, and to-night it will register still more." Well, I thought that thing over a long time, and then it struck me that, perhaps, that gramme weight that he had on the surface of that carbon button did not weigh a gramme every time—every minute in the day; that may be it weighed three-fourths of a gramme at one time, and a gramme and a half at another time. It would seem as if that was a question that could be easily solved—that you could weigh it on a balance. Well, what would you balance it with?



a, permanent magnet; *b*, needle; *c*, globule of mercury; *d*, copper cup; *e*, platinum disc; *f*, copper segments; *g*, connection from copper cup.

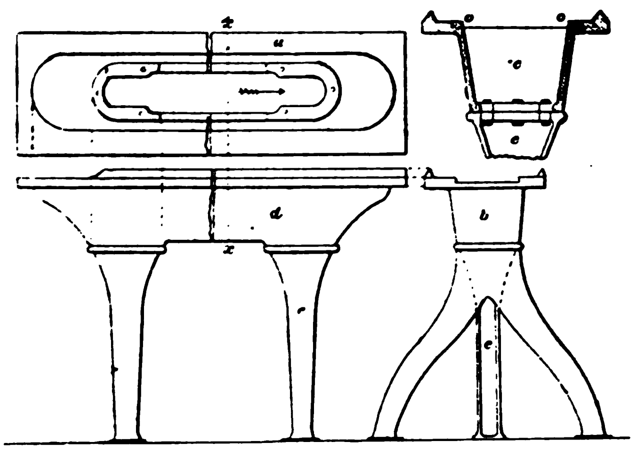
You would balance it with a weight that varied in the same way, wouldn't you? Therefore it would be impossible to tell the difference. We could only surmise there was a change of weight; but it would be impossible to observe the change of weight unless you brought another force than gravity into play. Now I thought here was this carbon button that under this varying pressure allows a varying current of electricity to pass through it. Well, it would seem as if that would be something easily determined, and Mr. Geo. A. Hamilton at that time was very anxious to have me try experiments. He put the elevator of the Western Union building at my service, and I tried the same thing on the elevator at the Stevens Institute, and could get no results at all on account of the moving masses of metal. Therefore, I had to give it up; but I think still, gentlemen, that that variation is caused by the variation in the weight of the object, and that the earth may be every day moving itself 50 or 100 miles, and changing the weight of bodies on its surface without our being able to know it.

The operation of the instrument which I have the honour to lay before you to-day is based upon what might be called a new principle. It is proposed by its means to suspend a body in stable equilibrium, and yet to almost entirely abstract it from the influence of gravity, and to control it by a force (as far as we know it) independent of the action of gravity. It consists, briefly, of a straight piece of soft iron, a little thicker than an ordinary sewing needle, and about 1in. long, which rests perpendicularly on its point, and is acted upon by a straight permanent steel magnet, whose axis is a continuation of that of the needle. The magnet is brought down gradually, so close to the needle that the latter is ready to fly upward into contact with the magnet upon the slightest diminution of the force of gravity ordinarily acting on the needle by which it is retained in position. This effect is brought about by the slightest check or blow. The needle is never allowed to come in contact with the magnet, but with an interposed piece of brass by which an electrical contact is brought about; the instrument can thus be made to register any earthquake blow coming from any quarter of the compass, including an upward blow.

Now, I have the seismometer, which we will dissect. The needle has a little disc of platinum upon it to give it weight and for making contacts. The permanent magnet above has a thread cut upon it. There is a thumb-screw upon the magnet, with which it can be brought down until the needle is just ready to fly. The lower point of the needle rests in a little globule of mercury. That cup is made of platinum, inclosed in copper. This little globule of mercury remains in there, and the needle is balanced on its surface. A wire connects with the cup, and leads to one pole of an open circuit battery. Above that needle, and interposed between the magnet and it, is an inverted cup of solid brass, connected through a register to the other pole of the battery. The cup is to serve as a surface, against which the needle, in its rise under the shock from below, comes in contact. The mercury globule below gives sufficient play for the needle to rise, so that when it comes in contact with the copper cup the circuit is closed. There is not a variation of a hundredth of one per cent. in the electromotive force, if you do not disturb it. Make your experiment, and you will get a very constant electromotive force. But if you put it on a closed circuit it deteriorates very rapidly. As you observe, this copper vessel is interposed between the needle and the magnet. Any movement of the needle will cause a current of electricity. Therefore, that copper disc between them serves as a damper. You all recollect that the retarding action of a copper disc on a magnetic needle led to the elucidation of all those wonderful laws with reference to electricity upon which we now thrive. Arago found that a needle oscillating a certain number of times in a minute would diminish the number of its oscillations by the interposition of a disc of any substance—water, copper, glass, anything; and that led Faraday to try whether the movement of a mass of metal in the neighbourhood of a quiescent magnetic needle would not cause the needle to move, and he found he could make the needle move as fast as the copper moved, inducing the current of electricity which reacted on the needle, and set it in motion. Now, that is what we have here when we interpose the cup of copper. The movement of this mass elongates and contracts the lines of force like so many indiarubber threads. I have heard them compared to threads of indiarubber, and it is as good a simile as I ever heard to indicate what the action of the lines of force is—assuming, for the sake of illustration, indiarubber threads trying to contract all the time. Now these threads cut this copper. The copper, of course, is permeable to the magnetic action, and a current of electricity is induced which reacts on the needle, and makes it stable, so that it stands there absolutely quiet. But it is prepared to respond with the slightest movement from any direction. Now I have the magnet brought down to a certain point, and I have a screw by which I can adjust the point of the needle below, and I can bring the magnet down to a thousandth of an inch, and in that way regulate the attraction to the greatest nicety. So delicate is it that I was trying to adjust it for a quarter of an hour without success. The vibrations of the voices in the room were enough to disturb it and frustrate me. You see the slightest touch on the table causes the needle to ascend to the copper disc. It comes in contact with the disc, thereby closing the circuit, and the upward blow is registered. There is underneath the disc a thick copper tube that is divided into eight segments each covered with a sheet of platinum. Each segment is connected with the register, and will indicate the direction of all earthquake waves, except those from beneath, which are indicated as heretofore described.

THREE-LEGGED LATHES, &c.

IT has often been said that lathes and other machines of a similar kind, as far as regards their understandings, would be better placed on three legs; and as this idea seems to have been revived recently in the *American Machinist*, Mr. F. G. Woodward sends the following description of the best way of carrying out the suggestion. It has already been stated that all lathes and planers should be placed on three instead of four legs, placing two legs at the heaviest end of the machine and one exactly central at the other end. Mr. Woodward says: Undoubtedly the best way to secure the most correct poise and action of any machine is to place it on three supports placed as above stated. This relieves the machine of all torsion strain. If all of the four-legged machines now at work could be correctly tested it would be found probably that the largest share of them were virtually resting on three legs; that is to say, it



would be found that one of the four legs was sustaining much less than its due portion of the weight of the machine, thus inclining the bed to a constant tendency to twist.

The present sketch shows what is deemed to be one of the best designs for a three-legged machine; *a* is the bottom plan of bed; *b*, end view of bed with legs attached; *d*, side view; *c*, cross-section as at *x*, looking, as indicated by the arrow, towards the single leg *e*. The legs are of the semicircular shell pattern with a plain ogee termination at top and bottom; they are held to the bed by three bolts each, by inside flanges as clearly shown. The design is such as to give the moulder an easy job, requiring no cores and having an easy draft or taper both inside and out. The sketch is made with considerable care, so that any patternmaker or machinist will comprehend fully the idea.

For machines of considerable length, say from 8 to 12ft., the centre of the legs should be placed 16in. to 20in. from the end of the bed, as shown. In the sketch the centre of legs is 18in. from end of bed. The track of the tool carriage is placed at the extreme edge of the bed, so as to leave no ledge outside to catch chip. The head and tail stocks being fitted to the corners at *o* do away with the usual gutters between two V ridges. The usual practice is to plane two V tracks on lathe beds, and fit the head and tail stocks to the inner track. This style forms a gutter, of course, which is an exceeding annoyance to the lathesman in keeping it free from chips.

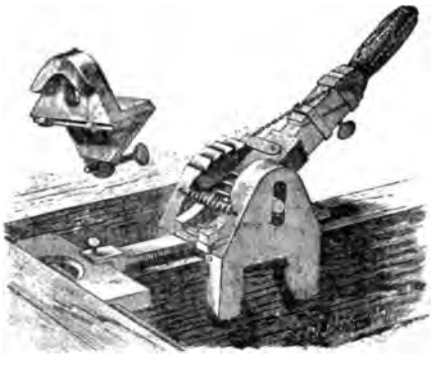
ELECTRICITY FOR STREET RAILROADS.*

It sometimes happens that a person unfamiliar with optical apparatus is best able to appreciate the magnifying power of a telescope by looking at familiar objects through its larger end, and not unfrequently the true condition of other problems may be best apprehended by viewing them inversely. Applying this method to a question of great practical importance just now exciting public interest, let us suppose a manufacturing establishment situated in the heart of a city like New York, where real estate is held at a high value, in which 150 machines, each requiring 10 mechanical horsepower, are driven by the usual equipment of engines and boilers. Now, let us suppose further that the New York State Legislature, in the exercise of the intelligent discretion which that august body invariably applies to the regulation of the internal affairs of the metropolis, should decree that on and after a certain date "It shall not be lawful to operate machinery by steam or any other power than horse-power within the limits of said city," so that it would become necessary for the proprietors of the establishment to purchase a sufficient number of animals to supply 1,500 H.P. continuously, together with the necessary additional real estate in the immediate vicinity, whereon to erect buildings and furnish stable accommodation for the few thousand head of live stock required, and to add the cost of provender, attendance, replacement, &c. We imagine that the parties concerned would regard themselves as extremely fortunate if the cost of power under the new conditions proved to be less than five or six times as much as before. Yet the situation we have pictured does not materially exaggerate the existing condition of affairs in respect to city transportation. A single street-railway line in New York has in service about 350 cars and 2,000 horses. Not less than 1,500 H.P. must be constantly employed in the movement of the traffic, yet it would probably be difficult to convince the managers of this or any similarly situated surface-railroad company that the whole line might be operated by a central steam plant and electric motors at something like one-fourth the cost, for power, of the existing system. The paper of Mr. T. C. Martin, read at the recent annual meeting of the Electrical Engineers, showed conclusively that so far as the use of electric power on small roads with light traffic is concerned, the domain of experiment has already been passed. Electric traction has become a settled fact, and from present indications, nothing can be more certain than that the smaller street-railroad systems of the United States will adopt the new method as rapidly as the required machinery can be constructed and applied. In the case of lines in larger cities with heavier traffic, a similar result may be looked for at no distant day. No valid reason can be adduced why the electric system may not be applied to the more important lines with even greater proportionate economy than has been the case with small roads. It is probable that the only serious obstacle to the change will be the spirit of caution and conservatism naturally inherent in the minds of the managers of corporations having thousands and even millions of dollars invested in horse-power plant, which will lead them to ponder long and carefully before committing themselves to an innovation so radical, and necessarily accompanied with so large an expenditure. Nevertheless, the advantages of the electric system in point of economy and of public convenience must ultimately prove so controlling that it hardly seems probable that even in such cases the inevitable change will be long delayed.

Mr. Martin's summary shows that there are now running in this country eleven electric railways, equipped with 68 motor cars, and that a much larger number are either under contract or in course of construction. The systems of electric distribution from a central station, both by conductors and by accumulators, have proved successful in practice, and it is difficult to imagine any difficulties of operation which cannot be surmounted by one or the other of these methods, or by a combination of the two. Investigations and comparisons of the different methods of electrical propulsion are being made by some of the largest street-railway companies in the country, and such investigations can have, we are confident, but one result.

BRADLEY'S IMPROVED FLOOR JACK.

The invention illustrated herewith provides a jack more especially designed for holding the boards in position in laying floors, but the device may also be used as an ordinary lifting or pressure



jack, says the *Scientific American*. It has spring-connected side pieces, hinged to a central box with open ends and top, the side pieces having ripped jaws adapted to take a firm grip upon the floor beam, and there being a rack-faced sliding bar in the bottom of the box, the outer end of the bar being enlarged and slotted to hold detachable a grooved and recessed block to receive the tongue of the floor strip to be jacked into position. Upon the upper inner surface of each side piece is formed a segmental cam surface, the entire upper semicircular surface of one of them being provided with transverse rearwardly inclined teeth. A lever is pivoted in apertures in the sides of the central box, the pin whereby the lever is journalled being made to project through vertical slots in the side pieces, and the lower end of the lever being made circular, with teeth adapted to mesh with the surface of the slide bar, to propel it backward or forward in the box. Each side of the lever has wedge-shaped lugs to engage the faces of the cam projections of the side pieces when the device is placed upon a floor beam, and force the teeth or ribs of the jaws into the beam as the slide bar is carried forward, and also to limit the backward and forward throw of the lever. The manner of attaching the handle is plainly shown in the illustration, but the part grasped by the hand is on a sleeve and connected with a spiral, by which, through a chain and pawl, the latter may be made to engage the teeth upon the upper surface of one of the side pieces, to hold the slide bar in the position to which it is carried when the lever is operated, the chain being of such length that when the sleeve is in its normal position the pawl will be elevated above the teeth. The spiral spring shown across the front of the jack serves to steady the side pieces in position, and just below it, attached to one side of the box, near the bottom, is a spring having one end bent at right angles over the front edge of the box, the angular end of this spring being adapted to engage the teeth of the slide bar to retain the latter in a given or fixed position. The recess in the grooved block abutting against the floor strip affords room for conveniently driving a nail, and the device can then be easily and quickly removed and entered in a similar manner upon the next beam. The small figure shows an extension piece designed for use in place of one of the side pieces when the floor beams are more than two inches thick. This invention has been patented by Mr. William E. Bradley, and for further particulars address the Giant Floor Jack Co., Roscoe, N.Y. Patents have also been taken out upon it in foreign countries.

A WOOD-TURNING JOB.*

(*Continued from page 456.*)

Roughing Out—Turning a Cylinder—Holding a Chisel—Cutting Off.

A turning gouge held in a position to pare the wood, not to scrape or to break, will cut the corners cleanly and easily from a square piece of work. The experienced turner will present the gouge to the work in the manner described, then, holding the tool firmly with both hands, traverse it from end to end of the work. As the motion is reversed at each end of the wood, the gouge is revolved slightly just enough to cause the chips to fly off and not strike the workman in the face. This "rolling motion" of the gouge also serves to present the cutting edge of the gouge a little ahead of the axis of the gouge. To comprehend this matter more fully just look at a thread-cutting tool when set ready for work or while at work. If this tool is cutting a right-hand thread the point of the tool inclines in the direction of the cut, and to cut a left-hand thread the tool must be moved into a position relative to the direction in which it is to cut, or, in other words, the cutting edge of the tool must be in the same plane with, and point exactly to, the place the chip is to be taken to. In still other and geometrical words, the cutting tool must be tangent to the line of cut, or of the circle formed by the material removed. Hence the rolling motion of the gouge as the direction of cut is changed. At all times keep the bevel of the gouge bearing upon the work in such a manner that if the rest were removed and the hand fixed rigid the tool could cut no deeper into the work.

It is quite a job to turn a straight cylinder with a gouge (it would not be a cylinder unless it was straight), but it can be easily done by practice. After the corners have being taken off, and the stick is round, both ends should be turned to the size required by means of a pair of calipers. After this is done, begin at one end and traverse the tool across the work, taking care to keep both ends of the same size. This is not necessary, but it combines just so much more practice by doing two things at once, turning to size and making a cylinder. The tool should go from end to end of the work, taking off shavings just about (when the wood is green) like apple parings. The rate of movement of the gouge determines the width of chip, and for ordinary work like this job the tool should move sidewise about one-eighth of an inch while the work is making one revolution. It is possible to do smooth, cylindrical turning with the gouge alone, also to do straight work on the face plate, but the chisel is very much better for that purpose. In like manner, hollows can be made with the chisel alone, but the gouge is always called upon to do this kind of work.

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* *From the Electrician and Electrical Engineer* (U.S.)

* By James F. Hobart, in the *Manufacturers' Gazette*.

The chisel is the hardest tool to learn to handle. The first time a young turner gets a chisel into a job, he invariably lets a corner of that chisel catch in the work, and either break the chisel, tear it from the workman's hands, or cut a big "nick" in the otherwise smooth surface of the work. Pick up a chisel by the right hand. Lay it on the rest, letting the cutting edge project beyond the centre of the wood in the lathe; now turn the chisel so the cutting edge faces a little ahead of where it is to cut, or so the length of the chisel is tangent to the future line of cut. Let the chisel touch the work. It does not cut, for its bevel rests upon the work. Pull the chisel backwards a little, and the edge will touch the wood, and then the chips will fly. If the chisel be drawn back too far, so that the corner touches, then snap goes something, and another "greenhorn" has "caught a crab." By the proper adjustment of the chisel may be found a place where the middle of the cutting edge will be in contact with the work, and still neither corner will touch. While in this position the chisel may be traversed exactly as was the gouge when turning a cylinder.

A lot of practice is required to do even a tolerable job, but "anybody can do it after they know how." All finishing should be done with the chisel, and in rounding the ends on a piece of wood the chisel must be drawn steadily backwards until the short corner is cutting. Revolve the chisel upon its axis, turning the chisel meanwhile, and drawing it backwards at the same time, and a round end can be cut, or a bead or a round easily worked with any degree of curvature desirable. The learner must not be surprised to see the chisel "take a bite" any minute and tear off all the nice, smooth corners. Rounding the end of a square stick, or cutting down a cylinder from a square stick, is another favourite feat of good turners. To do this neatly, the tool must be rested firmly on the rest, and a man of iron nerve is required to do a first-class job. After this is accomplished, try all manner of squaring up with both chisel and gouge.

USEFUL AND SCIENTIFIC NOTES.

Effect of the Electric Light upon Books.—Prof. Wiesner, of Vienna, has just called attention to an inconvenience attending the use of the electric light in libraries. It has been found that a large number of works in the library of the Technical School had become very yellow, and this led the director of the establishment to ask Prof. Wiesner to ascertain the cause of it. Experiment has shown that the coloration is due to light, but that it occurs only with paper containing ligneous substances, such as wood, straw, and jute, and that it does not take place when, through some chemical process, the lignine that forms the essential part of the wood is removed. The yellowing is due to a phenomenon of oxidation. Solar light acts more energetically than dispersed daylight, which itself exerts but a very slight action when it is much diffused, and especially in a very dry room. Gas-light is nearly harmless, by reason of the few refrangible rays that it contains. On the contrary, as the arc electric light, and, in general, all intense luminous sources, emit numerous refrangible rays, they favour the yellowing. As regards the preservation of papers, then, it will be well to choose gas rather than the electric light for the illumination of libraries.—*Revue Internat. de l'Electricité.*

Boring Glass.—A writer in a recent number of the *Revue Chronometrique* states that holes may be bored through glass by means of a rapidly rotating steel borer kept moist with turpentine "previously mixed with oxalic acid or the juice of onions." A writer in the *Zeitschrift f. Instrumentenkunde* quite properly declares these last-named additions to be immaterial. He adds: "The object may be accomplished readily by using a borer tempered at as low a temperature as possible (so as to be as hard as glass), and rotating it only slowly, taking particular care that it is kept constantly moist with oil of turpentine. [Even the turpentine is not necessary: water suffices.] Glass may also be bored quite readily with the aid of petroleum, though this does not possess the power of cooling the tool in the same degree as oil of turpentine. In order to prevent the chipping of the edges at the commencement of boring, it is preferable to make a preliminary hole with a glass hard, three-cornered steel point. This hole should be a trifle larger than that which is to be bored through the glass. The latter may then be drilled as described before. In order to prevent the glass at the opposite side from breaking or chipping when the borer begins to pass through, a piece of glass must be cemented against the other side."

SCIENTIFIC NEWS.

THE great German steel master and gun-maker, Herr Alfred Krupp, died on July 13th in the 78th year of his age. His father, Frederick Charles Krupp, started the celebrated foundry in a small way many years ago, and after his death the widow and the two sons carried it on until 1848, when Alfred, the deceased, became sole possessor. He had advantages in the fact that commercial rivals were practically unknown; but by the assistance of those he had gathered round him, Alfred Krupp made the place at Essen the most famous steel-casting foundry in the world. The enormous extent of the works may be judged when we give the figures computed some time ago. There were 10,600 men employed at Essen, besides 5,000 employed at mines and other sources of the supply of raw material, and the steel foundry covered an area of 500 hectares (or roughly 1,250 acres).

The death is also announced of a man who, in a smaller way, but not less deservedly, achieved success. Mr. William Hutchinson, of Sheffield, died recently in that town at the ripe age of 87 years. At first he and his brother started as scissors' makers; but, obtaining offers to take any surgical instruments he could make, William Hutchinson at once procured samples of existing instruments, and became a diligent student of anatomy and physiology, and almost, as a matter of course, a successful inventor.

Dr. Auwers has published the results of his investigations into the supposed changes of the sun's diameter, in which he compares the Greenwich observations with those of Washington, Madras, Oxford, and Neuchâtel. The apparent inequalities in the diameter of the sun are, according to Prof. Auwers, due to the effect of temperature on the instrument, or to the effect of difference in the telescopic appearance of the sun at opposite seasons.

Admiral Mouchez has determined to address an appeal to the admirers of Arago for subscriptions towards the erection of a statue on the Place St. Jacques, near the Observatory, Paris. Over £700 has already been collected, but the lists are to remain open until the end of the year.

The International Astronomical Society's Congress will be held at Kiel from Aug. 29 to Sept. 1.

The Institution of Naval Architects holds its summer meeting at Newcastle on July 26 and 28, and at Sunderland on July 27, when the following papers will be read:—"On the Application of Hydraulic Pressure to Naval Gunnery," by the Right Hon. Lord Armstrong, F.R.S., and Mr. J. Vavasseur; "Recent Developments in Marine Engineering," by Mr. Frank C. Marshall; "On Some Recent Experiments with Basic Steel," by Mr. W. H. White, Director of Naval Construction; "On the Present Position Occupied by Basic Steel for Shipbuilding," by Mr. B. Martell, Chief Surveyor to Lloyd's Register of British and Foreign Shipping; "Tyne Improvements," by Mr. P. J. Messent, Engineer to River Tyne Commissioners. Several excursions have been arranged to places of "scientific interest" in the neighbourhood.

The members of the Iron and Steel Institute hold their autumn meeting in Manchester this year at Owens College, and the local committee are preparing to give them a hearty welcome, the president being a Manchester man. The meetings will be held on Sept. 14, 15, and 16, thus following a week after the British Association. On the first day there will be a reception of the members of the Institute at the College by the Mayor of Manchester and the Vice-Chancellor of the University, after which the formal business of the meeting will be commenced; in the afternoon the members will pay a visit to the Royal Jubilee Exhibition, and in the evening they will be received by the mayor at a conversazione in the town hall. On the 15th the meeting will be resumed in the Owens College for the reading and discussion of papers; in the afternoon there will be excursions to Robinson's engineering works at Rochdale, and to Platt Brothers' works at Oldham; and in the evening the annual dinner will be held in the town hall. On the 16th the reading and discussion of papers will be resumed at Owens College; in the afternoon the members will be invited by the President of the Institute, Mr. Daniel Adamson, to a garden party at the Towers, Didsbury, and in the evening there will be a reception at the Royal Jubilee Exhibition by the executive council of the Exhibition. On the 17th an excursion will probably be arranged to Haddon Hall and Chatsworth.

The meeting of the Institution of Mechanical Engineers at Edinburgh will be held on August 2nd and 3rd in the University. Among the papers will be the following: "On the Structure and Progress of the Forth Bridge," by Mr. E. Malcolm Wood; "Notes on the Machinery employed at the Forth Bridge Works," by Mr. William Arrol; "On the Paraffin Oil Industry in Scotland," by Mr. St. John V. Day; "Description of the Electric Light on the Isle of May," by Mr. David A. Stevenson; "Description of the New Tay Viaduct," by Mr. Fletcher F. S. Kelsey; and "On the Dredging of the Lower Estuary of the Clyde," by Mr. Charles A. Stevenson.

In view of the meeting of the International Congress of Geologists, to be held in London next year, several American geologists have undertaken to prepare reports on the various formations as developed in their own country. The Nomenclature Committee of the Congress will assemble at Manchester during the forthcoming meeting of the British Association. Sir J. W. Dawson has recently suggested a scheme of federation among English-speaking geologists, whereby uniformity might be secured on questions of nomenclature and classification.

The proposed "trials of motors for electric lighting" to which the Society of Arts are prepared to award four gold and four silver medals, do not seem to have attracted the attention so independent a "competitive examination" deserves. "Revised conditions" have now been issued, and the time for sending in entries has been fixed for the last day of the present year. The trials (ten motors, at least, must be entered), will be held in London in May or June, 1888, and air-engines and those worked by hydrocarbons in any form will be admitted. The motors are divided into two classes—(1) those in which the working agent is also produced; and (2) those to which the working agent must be supplied. Each class will be divided into two groups—motors declared to develop not more than 10H.P., and those above 10H.P., but less than 20H.P. Full particulars can be obtained from the Secretary to the Society of Arts, John-street, Adelphi, W.C.

The Society of Chemical Industry held its annual meeting at Owens College last week. In the report of the council it was stated that the number of members on the register was 2,302. In view of the depression in the chemical industries, the council considered the position of the society eminently satisfactory. Good work had been done during the year by the sections at Manchester, London, Glasgow, Liverpool, Newcastle, Nottingham, and Birmingham. The President (Mr. David Howard), in his address to the members, referred to the varied industries coming within the scope of the society, and the illustrations of progress afforded by the chemical section at the Manchester Exhibition. With regard to the future, he thought that, amid much that was discouraging in the commercial aspect of chemistry, there was no small reason for a hopeful view of the future in the evidence of increased life in their industries, and a sound method and good work on the part of those who conducted them. The progress of science, no doubt, made their work easier; but, on the other hand, it demanded of them continually increasing efforts to keep up to a standard that was constantly being raised to a higher level. With regard to technical education, it was no doubt wanted; but it must be real and thorough to an extent that many who theorised about it had no idea of. On the motion of Prof. Dewar, the president-elect, Mr. Howard was thanked for his address and the attention he had given to the interests of the society.

At a meeting of the Mining Institute of Scotland held last week, the report of the committee on safety-lamps led to a long discussion.

in which the value and safety of the Scottish gauze lamp was considered. It was generally condemned, not because any accident had been traced to it, but because it could be tampered with, and it was also shown to be a most expensive lamp as regards upkeep and the oil used. The Protector lamp was declared to be proof against anything in the shape of tampering, and also safe in the case of an outburst of gas. The chairman said the report and recent events had given an impetus to the substitution of a better class of lamp for the Scottish gauze at all the collieries.

The Yorkshire Naturalists' Union, which has its headquarters at Leeds, will have ready for issue next month "The Flora of West Yorkshire," by Dr. Frederic Arnold Lees. Prefixed to the catalogue of plants, which enumerates more than 3,000 species (including ferns, mosses, lichens, fungi, and freshwater algæ), will be three preliminary chapters, dealing with climatology, lithology, and bibliography. There will also be a map, coloured to show the natural river-basins and the divisions adopted. The book consists altogether of about 800 pages.

The Delegates of the Clarendon Press, Oxford, have determined to issue what promises to be a valuable botanical periodical—*Annals of Botany*—edited by Prof. Bayley Balfour, University of Oxford; Dr. Vines, University of Cambridge; and Prof. W. G. Farlow, Harvard University, Cambridge, Mass. An endeavour will be made to give a record of all botanical works and papers in the English language.

M. Pasteur having consented to become a candidate for the office of Perpetual Secretary to the Paris Academy of Sciences, the other candidates withdrew their names.

The "Report of the Scientific Results of the Voyage of H.M.S. *Challenger*" is costing the country a large sum of money; but the *Athenæum*, speaking of the portion devoted to zoology, says: "In a paragraph headed 'Bathymetrical Limits to Distribution' is a statement to the effect that the hitherto accepted conclusion that reef corals are confined to depths of from one to thirty fathoms has been shaken of late years, and disproved by the *Challenger* results. Yet all the evidence to be brought forward on the subject is that specimens of two species of reef corals were dredged in from thirty to seventy fathoms, two in from one to forty fathoms, and one in from ten to forty fathoms. The author seems to misunderstand what this means. In reality there is no proof that any of the corals came from a greater depth than thirty fathoms."

An International Exhibition of Science and Industry will be held at Brussels next year from May to October, when premiums will be awarded to the amount of £20,000, and articles to the value of £40,000 will be bought for prizes in the lottery authorised by the Belgian Government. The general commissioner is Count D'Oultremont, Place de Louvain 11, Bruxelles.

The arrangements for the International Congress of Shorthand Writers of all systems, to be held in London during the week beginning on September 26, are nearly completed. The Lords of the Committee of Council on Education have granted the use of the theatre of the Geological Museum, Jermyn-street, for the Congress meetings. There will be a conference on each day, occupied mainly with discussion of topics of professional interest, and the evenings will probably be devoted to gatherings of a more or less social character. Lord Rosebery will deliver the inaugural address on the Monday, and on Wednesday the Phonographic section will celebrate the jubilee of Mr. Pitman's system, and present its author's family with a marble bust of himself, now in preparation by Mr. Brock, together with other testimonials to be forwarded from America and the colonies.

An American paper makes the statement that one of the leading photographers of London has taken out a patent for producing photographs in permanent colour without the aid of the brush.

At a recent meeting of the Ophthalmological Society, Mr. Nettleship gave an account of two cases in which temporary amblyopia had followed the internal administration of quinine. One of the patients had an idiosyncrasy to the drug, which even when administered in small doses caused gastric disturbance, and on two occasions previously had brought on temporary failure of vision. Mr. Doyne inquired whether any alteration in the calibre of the arteries had been noticed. He had found the arteries very much contracted in a case of quinine amblyopia, afterwards the discs became whitened, though ultimately the sight became fairly normal. Mr. Nettleship, in reply, believed the arteries were always small during the stage of amblyopia. He did not know of a single case of complete permanent blindness from this cause, though in some cases which recovered the fields were small and the arteries constricted. Mr. Hutchinson alluded to the great interest of the subject of visual lesions dependent on food or drugs. He quoted a case in which it was clearly proved that coffee had caused temporary deafness.

In a communication to the Paris Academy of Sciences, Prof. Germain Sée returns to the subject of the treatment of pain by antipyrin. He thinks it preferable to administer the drug by hypodermic injections in doses of half a gramme (7½ grains troy), with an equal quantity of water. The injection is, it appears, followed by a disagreeable feeling of tension, which lasts a few seconds; but, when that passes off, the pain, whatever may be its cause, at once abates. Antipyrin has the great advantage over morphine of giving rise neither to vertigo nor vomiting; nor does it produce either the somnolence or the artificial stimulus which lead to morphinomania. Lastly—and this is the great point—to its sedative effect it adds a curative action, which morphia does not possess. The diseases for which Prof. Sée would more especially recommend the substitution of antipyrin for morphine are numerous—acute rheumatism, acute gout, herpes zoster, lumbago, ataxia; also hepatic and nephritic colic, angina pectoris, and acute asthma; but he also concludes that it replaces morphia with advantage wherever that drug might be called for.

Another German expedition will start for East Africa this month in order to make practical trial of the fitness of the Swaheli region for agriculture and plantations. The chief of the enterprise is a Bavarian, Herr Küntzel by name, who has already visited those countries, and has very roseate hopes of their adaptability to European methods of culture, especially as regards Indian corn, oil, fruits, and tobacco. Under him half a dozen young farmers have clubbed their capital, and mean to experimentalise for a year at least on the soil of Swaheliland, after which their future action will be decided by results.

Mr. G. A. Audsley is preparing for publication (by Sampson Low, Marston, Searle, and Rivington) his "Handbook of the Organ," a comprehensive and practical treatise on the appointment and construction of church, concert-room, and chamber-organs, giving directions for the construction of all parts, and hints for voicing, regulating, and tuning. Specimen pages and prospectus can be obtained from the author, Devon Nook, Duke's-avenue, Chiswick. The work will be freely illustrated with photo-lithographic plates and engravings.

Multiple Writing by Electricity.—Some few years ago, at a time when there was a rage for all kinds of apparatus for multiplying facsimile copies of handwriting, it will be remembered that Edison brought out an ingenious "electric pen," in which a small needle darting to and fro at great speed made minute perforations in the paper, the printing being effected by an inked roller, which was run over the perforated paper like a stencil plate. The movement of the needle was produced by means of a tiny magneto-motor mounted upon the style, and driven by a couple of bichromate cells. The cells had, however, to be of large size, the motor requiring a good deal of current. Moreover, it was impossible to write very fast with the pen in the first instance, owing to its weight and the necessity for holding it in a vertical position. Recently, M. Garel has succeeded in obtaining similar results by more simple means. He writes with an ordinary black-lead pencil upon very thin paper, which is laid upon a smooth carbon block. The lead of the pencil is connected to one terminal of a small induction coil, and the carbon block to the other terminal. A spark then follows the pencil point, and the paper can be used as a stencil.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

ASTRONOMICAL—OΣ 298, AND OTHERS.

[27616.]—IF it was possible to rejoice on account of a blunder, I would almost do so with regard to my mistake about the binary OΣ 298, seeing it has brought forth such valuable letters as those contained in No. 1163 of the "E.M." from your correspondents, "M. M.," J. E. Gore, Kenneth J. Tarrant, and H. Sadler, to whom I give my best thanks. It is nice to have such willing and helping hands in time of need, and examples of this nature are not wanting in the "E.M." Had I confined myself to my best observation of the above double star, the one of June 8, 1887, my observation would have been very good indeed considering the closeness of the star. This observation was quite overlooked, and gives for the P.A. 130°, power 180. In all my other observations I find I have inserted the angle, and they vary from 300° to 360°, according to the state of the air, and perhaps also of my eye; they may also be the result of bias. On the other hand, I am very pleased to find that out of ten double stars I find seven agree so fairly with the positions given by the best double-star observers of the day. β 355 must be increased by 180°. About OΣ 285 the figures have changed their places; you must read 72° instead of 27°. As for γ Coronæ, the angle is decidedly too small. On the other hand, the distance given seems to me rather large, even though the principal star be of the fourth mag. Σ 2114 ought not to have been in my list, as it is a very easy object, and OΣ 309 ought to have had for P.A. 239°, the mean of five observations.

Taking the actual P.A. of OΣ 298 as 115°, may I ask Mr. Gore if he does not think the agreement between the observed and the computed position angle is far from being satisfactory? The difference also in distance seems large; but I suppose the object is a very difficult one even for professional double-star observers.

The observation of close double stars with the lowest possible power is, I find, the best exercise to educate the eye and to enable it to see minute objects. The advantage of this education is seen at once when one observes the details of planets and particularly the *minutiæ* of the moon's surface. My observations of such stars have that end only in view. Therefore I shall always be thankful for anyone who knows to correct me when I make a mistake. In this wise I send again the following short list:—

OΣ 303 P.A. 145°
OΣ 315 „ 160 easy.
OΣ 321 „ 360 one obs. only.
OΣ 331 „ 320
OΣ 342 no elongation.
Again „ a point towards 250°.

C. M. Gaudibert.

DIAMETER OF MARS AND OTHER PLANETS.

[27617.]—IN looking over your back volumes, always an instructive way of filling up a spare half-hour, I noticed a letter from our esteemed correspondent, Mr. Franks, drawing attention to the different values of the diameter of Mars given by various authorities.

I thought a method by which anyone, with a minimum of mathematical knowledge, could compute the values of the diameters of the planets would interest many of our readers. They can even employ their own observations.

The equatorial diameter of the earth is about 7926·5 miles.

On page 278 of this year's *Nautical Almanac* the semi-diameter and horizontal parallax of Mars on 1 Jan., 1888, are 4·0″ and 6·4″; the diameter of the planet in miles is, therefore—

$$\frac{7926\cdot5 \times 4\cdot0''}{6\cdot4''} = 4{,}954 \text{ miles.}$$

If, however, by observation on that date the semi-diameter should be only 3·6″, the diameter would be 4,459 miles.

On pages V. and VI. of the *N.A.* we find the semi-diameters of the planets and the parallax of the sun—these readily give us the diameters in miles, the formula being—

$$\text{diam. of planet in miles} = \frac{7926{\cdot}5 \times \text{semi-diam in sec.}}{\text{sun's parallax.}}$$

I give the computation for Jupiter put in logarithms:—

Log. 7926·5	= 3·89908	
Log. 8·848″	= 0·94684	
	2·95224	
Log. 98·19″	= 1·99207	
Log. of Jupiter's eq. diameter	= 4·94431	= 87,966 miles
Log. ·939 (*N.A.* p. VI.)	= 9·97267	
Log. of Jupiter's polar diameter	= 4·91698	= 82,600 miles.

A similar proceeding will give the diameters of the other planets. A slightly different proceeding will give the diameters of the sun and moon. If asked for, I shall send details.

The diameters of planets are very variously estimated. I give below several determinations of the semi-diameters:—

MARS.	Semi-diameter.
Pritchett (*Ast. Nachrichten*, No. 2,232)	4·935″
Bessel	4·664″
Le Verrier (*Annales*, Vol. VI.)	5·55″
Hartwig (Mean of several)	4·676″
VENUS.	
Hartwig	8·775′
Le Verrier	8·305″
MERCURY.	
Young (*M.N.*, Jan., 1879)	3·262″
Le Verrier	3·34″

Tria.

DAYLIGHT OCCULTATION OF ALDEBARAN.

[27618.]—THIS was well observed at Lewisham on July 16th, 13h. 16½m. to 13h. 34m. The star was slightly projected on to the moon's disc at immersion, which may arise through my having adjusted the focus to the star, and which I find differs slightly from that of the moon. At emersion the reappearance was nearly instantaneous; but certainly not absolutely so. Telescope, 8½in. reflector by With; power, 125. Assuming Aldebaran to be the same size as the sun, and its parallax 0·516″, its diameter is only 0·005″, to traverse which the moon takes 0 01 second. If the star only makes a short chord, it would take longer to disappear—perhaps as long as three or four seconds if its diameter is 0·005″. **Tria.**

P.S.—I think I see (Eta) η Coronæ elongated, and even divided in direction 10° or 190°, with 310 power. What is the present angle and distance?

TECHNICAL EDUCATION.

[27619.]—"TO him that hath shall be given." But were not the intelligent lads and men to whom "Shaper" would confine his efforts in technical education once themselves ignorant schoolchildren, and will not the mass of ignorant schoolchildren some day be engaged in various works? Nobody supposes that capable mechanists will be turned out of the board school; but the boy of 13 who can make a packing-case (even if he does call it a box) to given dimensions, is one step nearer being a capable mechanist than the boy who can not; and if, in addition, he has learnt to work out in solid material from drawings and written directions, even the simplest objects, he will have learnt what many otherwise capable mechanics find a difficult task for lack of primary instruction. But if it be of value to those whose fortune it is to enter a good shop, far more would such training benefit the mass of the population who, as things are, scarcely attain a moderate handiness. School certificates of proficiency, whether mechanical or literary, are perhaps of little after-value, and it is easy to laugh at them; but they represent honour and glory to the competitors. And the fact that the bulk of such rewards at present go to clerkly proficiency is unfair to those whose aptitude lies in other, perhaps, more really useful directions, and no doubt aids to lower the dignity of handicraft in the eyes of the people—a most undesirable consummation. Again, education has other ends besides specific acquirements; the formation of habits, order, and industry among the chief. In Sweden, elementary handicraft trading is rapidly becoming universal, and its indirect value is reported to be very high. Drawing is the only hand training at present general in England, and speaking as an employer, I certainly attach great value to school proficiency of this sort, not so much because the positive attainment is great, or even the effort well directed, but as an indication of aptitude. A great deal has been said about the board school being a ladder set up from the gutter to the university. I would rather see it a ladder to the workshop. By all means let us have laboratories for the advanced student; but such things only help the leading spirits. We want also to drill the rank and file of the industrial army to fit them for their places in the workshop and as citizens in the nation.

W. A. S. B.

PRIMARY BATTERIES.

[27620.]—'TIS true that from time to time we are startled with the comet-like appearance of primary batteries. They appear spasmodically, and seldom singly, eventually becoming relegated to oblivion.

As "Nun. Dor." truly writes: "The principles which underlie any possible combination that can be called a primary battery are, and have been, known for some time." This applies more especially to Zn combinations. The laws relating to the conservation of energy, Joule's mechanical and other electro-chemical equivalents seem to be totally ignored by the inventors of these innovations. Educated electricians know that when Zn is used without a saleable bye-product, its present cost is too much to be economical, independent of the use of a polarising solution, were the same results attainable.

Again, all two-fluid batteries labour under the disadvantage of being useless in a few hours (as far as lighting goes), owing to the mixing of the solutions, even when not worked at all, besides the trouble of recharging, &c.

However, if "Nun. Dor." will publish his address (which I forget) I will send him a sodium nitrate depolariser formulæ which differs but in the imagination, or, in the use of extraneous ingredients, from the one used in the loud-heralded "Eclipse," so that he can test the economy of working for himself.

This solution costs about 5d. per gallon to make; 4 half-pint cells containing quarter-pint porous pots give collectively an E.M.F. of about 7·6 volts, and will well light a 3c.p. 5 to 6-volt lamp continuously for eight or ten hours. As to the mechanical arrangement of the battery, it is not even a factor compared with the depolarising solution; so that there will be little difficulty to an electrician like our friend "Nun. Dor." obtaining the results above mentioned. **H., Bristol.**

HOW TO SHARPEN A PLANE-IRON.

[27621.]—GLANCING over the instructions given under the above heading on p. 385, causes me to come-plane.

I cannot set myself too keenly against the folly of grinding ordinary tools of any kind, so that, when properly set, they have the convex sides of a razor. This deprives the cutting edge of its natural and necessary support. Thus, upon studying the action of the cutting edge in a plane, it will be seen that, although the necessary support is afforded to its cutting edge by the usual methods of grinding and setting, no part of this backing can come to bear upon the timber so long as the edge is throwing up the shavings as it ought to do.

Common perceptiveness ought to teach anyone that a razor-edged tool would be unsuited for cutting anything which was not as soft as the proposer of such an idea. I fearlessly maintain that the cutting edge of any tool, as produced by a careful and observant workman, is similar to that which we find upon the diamond—that is to say, it will, and ought to be, slightly rounded behind, so as to support the edge. If undercut, a gapped edge will shortly supervene. I advise not to keep the cap on front iron on, as it is in the road both during grinding and setting. This plan would necessitate much more trouble in washing and drying the same, and no one ever did, or ever will, succeed in putting a good, lasting edge upon a plane-iron, unless he occasionally lays it on its flat front side down, and takes care that the whole process ought to consist, as far as possible, of a pushing-from-him movement, not pressing so hard when drawing it towards him, finishing it off by alternate rubbing upon the palm of the hand upon each side, and should any wire edge be noticed during the setting it ought to be removed by drawing the edge across the grain of a piece of wood. Finally, when a man attempts such a lazy proceeding as to try to put an edge upon a plane iron without the removal of the cap, he is simply a demned lazy, good-for-nothing. It is entirely opposed to workshop practice amongst those who have an ear attuned to the music of the planes. **A., Liverpool.**

[27622.]—ON p. 385 is a description of "How to Sharpen a Plane Iron," which, on p. 386, turns (in my opinion) into how not to do it. "The proper way to oilstone a tool is to continue the grinding by rubbing on the oilstone until the bevel level left by the grindstone is entirely removed and the edge keen and sharp. If this be properly done, *the tool need not be touched on its face to the stone*," &c. Have any of your readers heard of a workman who could put a keen edge on a tool whetting one side alone? My plan, when I get a new tool, say a chisel, is to (after grinding) to "stone" the *face* until every mark of grinding is effaced, before touching the bevel. This is the secret of putting a keen edge on the tool, if there is a secret. A few slaps on alternate sides on the ball of the hand puts on the final razor-edge. **Silke.**

DR. SKINNER'S PRESCRIPTION FOR NOISES IN THE EARS.

[27623.]—DR. SKINNER'S (letter 27595) is a remarkable instance of the utter recklessness of M.D.'s as to what they order to put into *other men's* stomachs, while they would be horrified were their own wives to put their gold jewellery into the said mixture.

Of all metals gold is the one least affected by oxygen, and consequently the most difficult to dissolve by chemicals. Unaffected by the powerful acid hydrochloric, and also by the still more corrosive nitric acid, yet a mixture of these two effects its solution, thus obtaining its name with the ancient alchemists of "Aqua Regia."

Now, in the face of this, we find Dr. Skinner prescribes, and "Eos" is imprudent enough to endorse, the putting into the delicate, sensitive human stomach a corrosive fluid strong enough to dissolve the *nitric-acid resisting* gold!

That the poisonous (fatal) action of each of these acids in large doses in their concentrated form, and the semi-poisonous action in large doses of their dilute form, has been well studied by many members of the medical profession conscientious enough to declare their convictions, and to turn these observations to use by taking the symptoms of disorder produced as guides in the treatment of disease, the voluminous literature of modern medicine speaks conclusively enough—at least for **The Lydney Dispenser.**

P.S.—As to the ultimate result of medicinal treatment—sometimes promptly curative in long-standing cases, sometimes quite powerless—Dr. Cooper, of the Great Ormond-street Hospital, has read several papers at this Institution, in the library of which I conclude they are kept for reference.

MANUAL LABOUR v. "GENTEEL OCCUPATIONS."

[27624.]—THE views set forth by the writers in the "E. M.' on this point are from one side only, and this is not the side which exists to any extent in practice. The average ordinary clerk is mentally and physically of a rather low organisation, and the same clerk, limited by his mental and physical capacity, would doubtless be in a worse position in any manual employment. His remuneration would not be higher, but probably less; he would not be "on the staff," and would therefore be only paid for the hours worked, which would be variable, with frequent total stoppages on account of weather, variations of seasons, trade, and other things constantly and seriously affecting the working class. His companions would be rougher, and he would be treated in a rougher manner, both by his companions and his employer; whilst his hours of work would be longer, particularly in that most disagreeable of all times, an English winter's morning. The cheap clerk can only class with the labourer or unskilled workman, and with an equal amount of perseverance, work, and useful knowlege, the cheap clerk has at least as good or a better chance to rise than the unskilled workman. Having passed through the grades myself, both in the office and at the work-bench, without any expectations further than depended on my own efforts, I should for an average "duffer" select the office in preference to the bench as the most comfortable method of obtaining a bare living. This was my opinion twenty-five years ago, when I was a workman at the bench, and now, as an employer of about two hundred men, I see no reason to alter it.

The average workman of the cheapest class, by severe physical labour, has all the energy taken out of him at the conclusion of his day's work, and has no desire, and usually no power, to exercise his mind. The average clerk of the cheapest class does not labour under this most serious disadvantage, and if he has anything in him he has a better chance of rising in the world. The worst of it is that the average cheap clerk has no desire to rise by his own efforts; he does not care to work to qualify himself for more responsible positions, nor does he study technical details, or strive to acquire by steady application a "head" which would at once bring him to the front as one fit to exercise responsible control and to keep others to their duties by his intimate knowledge of theirs and his own also. A man who has developed this capacity is valuable in any office, and will fetch his value without difficulty. If he wants to commence business for himself he can usually do it on the strength of his reputation alone, without any further capital than he can easily save. A man trained to the bench under the same conditions has by no means the same chance; the mechanical trades not only require capital, but to work them successfully they require also commercial knowledge which the workman has no chance of obtaining. In fact, the clerk can buy his manual labour at any stage; but the workman cannot, with certainty, buy his commercial skill, and in the race for success the clerk therefore is necessarily in much the best position to start and to hold his own, as a general rule. If a man can acquire both, and is right mentally and morally, he is his own master, and practically has the world at his feet to do as he likes with up to his capacity.

The question of success, commercially and socially, rests, to a very large extent, on the manner in which a youth utilises his spare time and the amount of useful knowledge he can obtain and store up before the pressure of earning his daily bread comes on him and reduces his mental liberty, and the nearer he can struggle to the top the more room he will find, and the more comfortable he will find the world. If he begins by obtaining commercial knowledge as a clerk, he commences nearer his goal than if he begins as a workman, and I form this opinion, as the Editor knows, from personal experience of both sides of the question.

An Old Correspondent.

HOW TO DO BLACKSMITH'S WORK.

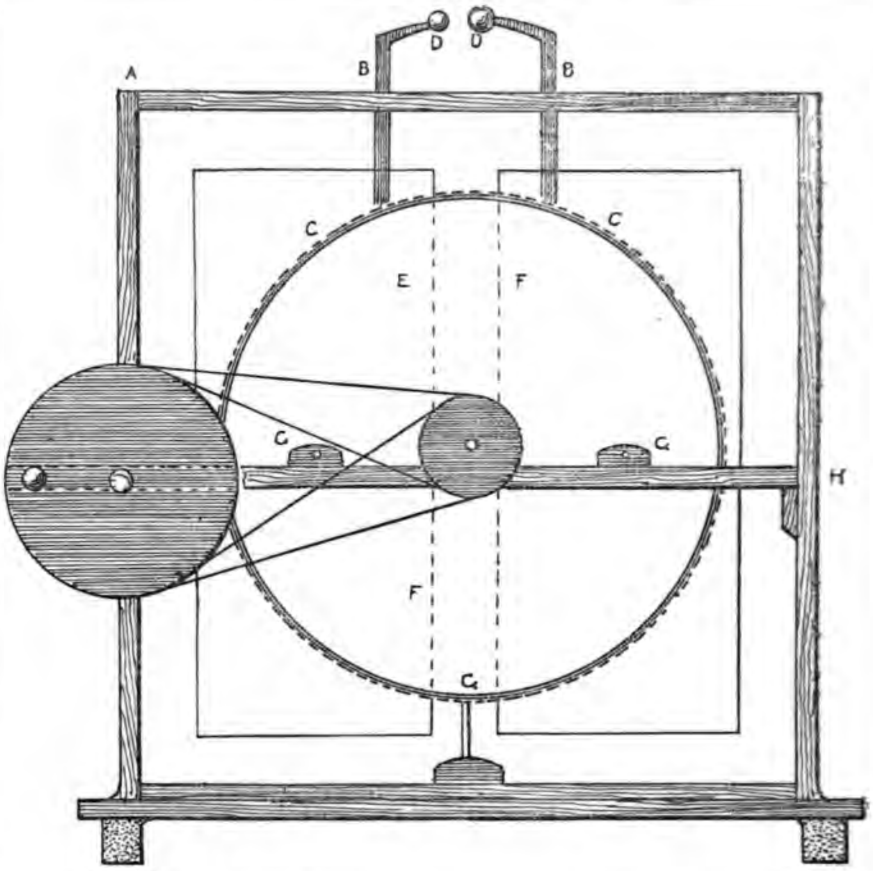
[27625.]—WHEN a smith employs a striker the "tapping" is evidently the language which informs the striker when to stop, when to strike "uphand," when "about sledge," &c.; but I am sorry to say I don't understand the language. Perhaps one of our smiths will give us the interpretation. A great deal of tapping is, of course, meaningless, and appears to result from the desire to fill in odd intervals during striking, giving a busy, inspiriting tone to the shop, the long intervals between the thuds of a heavy hammer being seemingly irritating to a busy man.

In my apprentice days I was led to believe that smith's work was not worth learning; but I now know that this is the trade of all others that should be mastered by an engineer. It is the basis of all mechanical operations. At the forge one learns what can and what cannot be done in wrought iron. One gets an insight into the nature of the material and its characteristics as compared with cast iron, and learns what proportions are suited to certain work. A man without having had the handling of wrought iron, hot and cold, is very apt to make his designs for wrought work too clumsy. From the amateur point of view, again, if you are a good hand at the forge you can do anything—carpentry and turning are mere child's play when you have mastered the smith's art. Skill at forging can, of course, only be acquired by real practice; the principles of the whole art might, on the other hand, be set forth in words, making a valuable and interesting addition to the other subjects of the "E. M." I hope this appeal may have some effect. I should be pleased to make any drawings, if wanted.

Silke.

ORIGINAL ELECTRIC EXPERIMENTS.

[27626.]—REQUIRING an electric machine suitable for being carried about for lecturing purposes, I designed and made one as per diagram, which gives me great satisfaction, and will probably interest some of "ours." This is a powerful machine, and unless due care is taken to follow my directions, it will burn holes in certain parts of the foil used in its construction. A is a dovetailed mahogany case, measuring 26in. square by 6in. deep, made of ¾in. stuff, and the outside French-polished. A groove around the opposite front to that in view takes a sheet of glass. There is a loose strip 2in. broad, which is removable on the top side, in order to put in this sheet and to fix the glass tubes, B B, in which tubes are cemented two pieces of ⅛in. brass tube, say, 2in. long each, which are continued down until through the tubes, say, ½in. with ⅛in. brass wire, to the ends of which are soldered pieces of thin sheet brass, say ½in. broad and 2in. long, in order that they may make connection with the tinfoils C′ C′, which are pasted upon the inside of the front sheet of glass, and which act either as conductors, as shown, or similar to Leyden jars upon applying to the front face of a light frame covered with calico, sized and coated with tinfoil of same area as the square of the two C C's. The case is screwed to a basepiece, as shown, made of deal 1in. thick and 11in. broad. The balls D D move about in the brass tubes, and can be removed at will, and a variety of experimental affairs can be substituted in their places. Here it may be as well to point out the erroneous conclusions arrived at and propounded by Thomas Gray, upon page 32 of the book published by J. Wimshurst, 1886, entitled, "Static Electricity, &c., &c.," where it will be found, "That the applying of the outer foil to this arrangement, as described, and which is virtually a Leyden jar with a movable outside foil, wonderfully increases the thickness and power of the discharges." E the pair of discs, both inside of the sheet of glass; these are furnished with 18 sectors each, and are 20in. diameter. They are thickly coated with lac, as previously described; also upon the inside faces, as this machine is started by a few rubs upon the front with a foil rubber. The inside of the large sheet also is well coated all around the foils with shellac, going in over it for, say, ⅛in. The connections with foils C C are by means of short pieces of violin bass string attached to the foils by means of pieces of paper and paste at F F, so as to make contact with the inside disc only, as I don't find any gain by making contacts; also with the outside disc I also find (*pace* Mr. Wimshurst) "that three brushes are the best number to employ," lettered G G G. These are pieces of bass string having 1⅛in. untwisted and pegged into small brass tubes as shown. The discs run one upon a piece of casehardened gaspipe (I could not procure steel tube in this city), and the other upon brass. The iron runs in broad brass bushes upon the shelf H. Two mahogany pulleys connect with the driving wheel, which has two grooves in it, and is of mahogany, French polished. The belt is in one piece, and is made of the best window sash-line. I prefer to alter the distance betwixt the balls whilst working, by means of a glass rod held in the hand. The movable outside coating requires no fastening, as the attraction whilst the machine is in motion keeps it in place.



If two separate outside coatings be used, each almost connected by a foil jump to its opposite inside one, the inside foils will have holes burnt in them, unless the contact be large, as I have described. This effect is also observable under other arrangements. I am at present of opinion, as I have before expressed in these pages, "That the electricity termed minus, negative, and expressed by —, is current which is similar to that in a magnet arrangement, and which develops heat." But more of this anon. There is a thin wooden back covering all but the driving pulleys, which is removable, and not shown in this diagram.

A., Liverpool.

THE VOGELSANG PROPELLER.

[27627.]—CAN any reader give any details of the Vogelsang propeller, which is said to be attracting considerable attention by reason of the remarkable accounts of its performances on the Continent? It is stated that when applied to a German torpedo boat, without any increase of power the speed of the boat was increased from 21 knots to over 26 knots. There is trustworthy evidence that it has increased the speed of a number of launches and other small craft as much as 33⅓ per cent. This invention is about to be tried on one of the North German Lloyd steamers between Bremerhaven and London. It was developed by the inventor at the Washington Navy Yard, and it seems strange that it was never officially reported upon in the United States. Mr. Vogelsang's patent covers the following claim:—"1. A propeller consisting of a hub provided with two or more blades or wings grouped upon but one side and unequally distributed about said hub, but in which the distance between the blades is not uniform, and in which no two blades are diametrically opposite, substantially as and for the purpose specified. 2. A propeller having its blades grouped upon one side of the hub or shaft only, and in which no two blades are diametrically opposite, and in which the distance between the blades is not uniform, and a non-propulsive counter-balance arranged upon the side of the hub or shaft opposite to that on which the blades are located, substantially as and for the purpose specified. 3. A propeller consisting of a boss or hub provided with two or more blades grouped upon one side only of the said hub, and in which no two blades of the group are arranged diametrically opposite, and a single blade arranged opposite to the group of blades, but in which the distance between the blades is not uniform, substantially as and for the purpose specified." The inventor says of what he has been able to accomplish:—"With propellers in which there are a large number of equally distributed blades, the water is so greatly churned that it is difficult for the blades to obtain a solid hold in the fluid, and consequently the loss by slippage is very great. By arranging the blades as herein described and shown, forming a more open space between them, they are enabled to take a firm hold upon the water, and the slip is much reduced, and this reduction is shown in an increase of speed with a given number of revolutions. It is also evident that as the blades are located to one side, one side of the shaft will take the wear and will run upon the bearing-box, the pressure travelling around the box instead of around the shaft, as heretofore. This change of pressure is very advantageous, as the box may be made with a replaceable bearing, and the life of the propeller-shaft would be greatly lengthened."

It is a common saying amongst marine engineers that every one of them believes he could produce a superior propeller to the others; but when it comes to testing they are all at sea in a double sense, and the advantages of the new devices are conspicuous by their absence.

An Old Salt.

THE SIMS-EDISON ELECTRIC TORPEDOES.

[27628.]—THE following account of the new form of "fish" torpedo, the joint invention of Mr. W. Scott Sims and T. A. Edison, will interest many of your readers. The "boat" has been under test by the Government officials here for some time, and an order for ten having been given, a trial of the first came off the other day at Willett's Point, and I send you the following account, which has been published here. There were not many spectators beyond those interested, and probably the report is exaggerated.

The first thing seen was a long, cigar-shaped tube made of copper, about 28ft. long, and 21in. in diameter in the thickest part, the centre. This was the torpedo. Beginning at the pointed end, the prow, Mr. Sims explained that the tube was constructed of four different portions or apartments. The first, at the prow, was the chamber, in which 450lb. of dynamite or explosive gelatine is placed. The second contains about two miles of cable, in this instance, or as much more as may be required, by means of which the torpedo is connected with the shore electric battery. The cable is about 1in. in circumference, and it is through this that the electricity is conveyed from the shore to the torpedo, and it receives its propelling power, steering power, and explosive power at the will of the man in charge of the electric battery on shore, or wherever the terminal station may be. The operator can at will start, stop, or steer the torpedo to port or starboard, and explode the charge, which can be arranged to explode by contact if desired, and he also receives notice when the hull or blade meets with any obstruction in its progress through the water. The third chamber is occupied by all the instruments necessary for the connection with the electric battery on shore, and of interest only to the electrician, while the fourth chamber holds the propeller and steering-gear. All these chambers are arranged in such a way that their weight is properly adjusted, so as to throw the centre of gravity into the cable chamber; so that when the cable is paid out, and the torpedo necessarily lightened of just so much weight, the centre of gravity will not be destroyed.

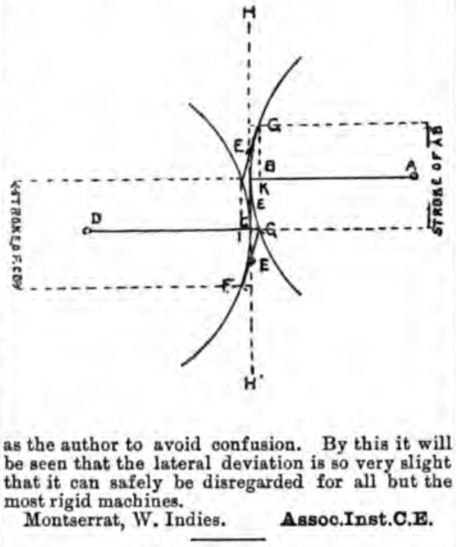
Above the torpedo, about four feet, and attached to it by bars of copper or steel, was a boat covered with a deck, and about the same length as the torpedo. This, the inventor explained, was the float, and was filled with light machinery, and used to suspend the torpedo at the desired depth under the water. From the prow of the torpedo, inclined at an angle to the bow of the boat or float, was a strong sword, which experience has shown will either cut through an obstacle, or, if too heavy and strong to be treated in that way, will enable the torpedo to dive under it and come out unharmed on the opposite side. Having explained all this, Mr. Sims, assuring the ladies that for this test his dynamite was gravel and could not explode, ran the cable through a tube from the aperture on the bottom of the centre or cable chamber of the torpedo to the stern, attached it to the battery, and declared all was ready for the start. The little machine was slowly lowered into the water, where she lay looking like a harmless little pleasure yacht without her mast, with the torpedo lost to sight in the water. At a given signal the electric current was turned on, and the torpedo boat seemed suddenly endowed with life. It darted out toward a a troop of fishing vessels at a great rate, and in a perfectly straight line. On went the little war engine at an eleven-mile-an-hour rate, throwing the foam from her bows as she ploughed her way. "Starboard!" rang out the clear command from Capt. Knight, in charge of the trial, and as though the boat, at the distance of a mile, had heard the word, her head came slowly but surely round to the right. "Steady," and her head again forged on. And now 5,000ft. of cable of the 10,000ft. in the centre chamber of the torpedo had been payed out, and the order to return came. Quickly, at the word of command, her head came round, and, with her prow pointed directly at the little group on shore, she forged ahead at undiminished speed. When within a few hundred feet of the shore, she suddenly stopped and lay like a log; as one expressed it, she looked like some animal that had died suddenly of heart disease. And, indeed, she had; for, as Mr. Sims explained, the end of the cable had come, and the electricity had left her; and without electricity she was without life.

I need not tell you that lately we have been beating up a "scare" about our unprotected ports, and as not much money can be got for building a "fleet," the scaremongers will labour hard to get a set of torpedoes for each port, and inventors are hard at work devising the most promising contrivances of the kind. The above will give you an idea of a "fish torpedo boat," which at least promises well.

Newark, N.J., July 8. **J. M.**

THE THEORY OF MACHINES, X.: BY FRANCIS CAMPIN, C.E.—LINK MOVEMENTS.

[27629.]—IN this article the author has given a description of two well-known forms of Watt's parallel motion, and he adds a fact known to mathematicians that the path described by the point e in his diagram is not a true, straight line; it is, in fact, a curve; but if the links are properly proportioned it is of almost infinite radius. Practically speaking, however, and for all machinists' purposes, it *is* a straight line, and it is most misleading to the unmathematical reader who hopes to get more light upon the subject by referring to the diagram, to find such an incorrect exaggeration as is to be found in Fig. 41. Why are the perpendiculars fi and gk of such widely different lengths instead of being equal, or nearly so, as they must be if described by connected rods of equal radii? I say of nearly equal length, because the driving radius rod has a tendency to extend the arc of the driven somewhat, in consequence of the vertical distance of the points b and c being shortened as the connecting link bc assumes the diagonal, and it is this extension of the arc of the driven radius rod which causes the path of point e in the centre of the connecting link bc to depart from a mathematically straight line. It is, therefore, incorrect to say that "ff', gg' are the arcs described by the ends c and b of the links cd and ab"—f' being extended much too high and g' much too low, consequently, ek and ci do *not* "represent respectively the lateral travel of the ends b and c of the link bc." I append a diagram in correction, but retain the same lettering as the author to avoid confusion. By this it will be seen that the lateral deviation is so very slight that it can safely be disregarded for all but the most rigid machines.



Montserrat, W. Indies. **Assoc.Inst.C.E.**

TWO CENTRING BITS.

[27630.]—To the amateur turner in hard metal I can strongly recommend these two bits for taper centre holes required in rods and cylinders. No. 1 is made of the best steel, with four sharp facets sloping to the point, angles 60° to suit the lathe centres, usually of this proportion. I make mine by cutting the exact profile of my lathe centre in a piece of sheet tin, and inserting the same till I made a correct fit; then I forged my lump of steel to a taper, I put it in a chuck, and smoothed the whole, making the neck or shank $\frac{5}{8}$ths to fit correctly in the main chuck; then I removed it, and with a new file and gauges trued the four angles and edges. Lastly, I polished and hardened the tool. No. 2 is a taper half-round bit, with two sloping edges, useful for smaller centre holes. In employing the No. 1 with any small, sharp drill, first bore a hole $\frac{1}{8}$in. deep, or even less; into this insert the bit, tightening up, and using lubricant as you proceed. No. 2 is to be worked in exactly the same way—small drill hole, back feed, and oil; leave a little of small drill hole at bottom of work.

FIG. 1

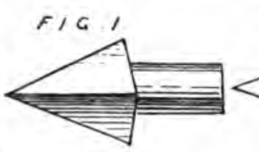
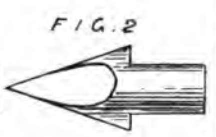


FIG. 2



Eos.

THE EDMUNDS LATHE MANDREL.

[27631.]—MR. G. T. PARDOE ("E. M." 1,163) disagrees with me as to my views of friction in bearings, because he treats it as a case of friction of the surface of the mandrel against the bearing, whereas I regard it as friction of the particles of lubricant against one another, the solid surfaces not coming into contact at all; but being separated by a film of oil. From this point of view he is no doubt quite correct in his calculations and inferences, except the clerical error of "foot-pounds" for "inch-pounds."

It has been ascertained by experiment that the friction of solids against liquids is almost, if not quite, independent of the pressure, and varies with the surface and speed. In a bearing properly constructed, the journal does not come in contact with it, but is completely oil-borne. It may, therefore, be considered as revolving in a vessel of oil. If the bearing is badly constructed either as to fitting or as to sufficiency of surface, the oil will be squeezed out, and the metallic surfaces will come into contact. Increased friction and heating will then follow.

If Mr. Pardoe considers the very small amount of friction in well constructed and well lubricated machines, and compares the amounts under widely differing pressures, he will at once see that the laws applicable to the friction of solids are not those applicable to well constructed and lubricated bearings.

In the "E.M.," 1,164, Dr. Edmunds suggests making the cylinder-base of the standard mandrel part of a very long cone. This appears to me objectionable. 1. Special gauges would have to be made for the purpose. 2. It would not be possible to estimate the accuracy of these gauges, and consequently to gauge work by them with such delicacy as is possible with cylindrical gauges.

In the case of the latter, their fit is estimated by the variations of force required to rotate or to pump the cylinder in its corresponding ring. This pumping is impossible with a conical gauge, and rotation would be fallacious, for though the cones might fit all round at one part, they might not fit elsewhere. In fact, to quote Dr. Edmunds's own words, "I know of no means by which coned surfaces can be reproduced or matched with approximate accuracy." The fit of the cones would practically have to be tested by the looseness, or shake, when it was attempted to move the gauge across the axis of the cone. This would obviously be much less delicate than the pumping or twisting of a cylinder in a ring, as an indication of accurate fitting.

3. If the cones did not fit equally along their whole length, they would wear unequally, and rapid deterioration would ensue. **A. Gray.**

RAILWAY JOINTS—METRIC SYSTEM OF MEASURES AND WEIGHTS—TECHNICAL EDUCATION.

[27632.]—I AM glad to see that Mr. Edward M. Richards expresses the same views on the use of suspended rail-joints as I did in previous issues of this paper. In the same letter (27570) this gentleman speaks of the superiority of the metric system over the English system of weights and measures. The latter are antiquated and irrational.

The invention of the metric system is one of the greatest boons which the great French Revolution has conferred upon the world. Most Continental nations have adopted it, yet England persists in the use of a system which, to speak the truth, has not the least bit of common sense about itself. The employment of metric measures in which linear measurements and capacities are so interdependent that the change of unit is an easy thing, simplifies greatly calculations, and as practice does not, as a rule, require a greater accuracy in calculation results than half a millimètre, it is always possible to find a dimension which will answer without having to try again and again as with inches and feet. As an engineer, I can but say that the system of English weights and measures is a most absurd one, and affords once more a proof of that outrageous conservatism which too often characterises the English nation in some technical matters. Some English firms being asked to send drawings and estimates as to some work or orders to be executed abroad, never fail to make drawings in English measurements: it would be far more polite, and especially more satisfactory for both parties, if the measurements were in millimètres, kilogrammes, &c. I have been repeatedly asked abroad how it is that England has not adopted or enforced the use of the metric system. That is for them a subject of great astonishment. No doubt the change would be no easy one, but it cannot and must not be made at once. A certain term must be fixed by them, and of which the complete change must have been fully accomplished. It was done in that way in Germany, Austria, Hungary, Roumania, &c., and now these nations are quite accustomed to it.

I was very pleased to read "Nun. Dor's." letter on technical education, and I thoroughly agree with him. The technical education of foreigners has nothing to do with competition: this is simply due to our blind free-trade policy. No doubt our system of elementary education wants improving, but there is great danger of us running into the deplorable extremes into which our neighbours have fallen; they compete, but they do not create much. I should like to see the learning of foreign languages made compulsory in elementary schools. You always complain of the Germans underselling Englishmen in this country and abroad. Well, do like the Germans; their system of education is three centuries old. The money spent in this country for educational purpose amounts to sums which ought to secure results better than, if not as good as, those obtained on the Continent.

E. Gobert.

RAILWAY COUPLINGS.

[27633.]—MY coupling was merely given as an example of an automatic coupling, and I originally wrote in the hopes of inducing those who had made more perfect appliances to give us readers of the "E. M." a sight of them, and also of having opinions on the chances of a coupling being adopted at all. Many of the inventors of the "Nine Elms" couplings would probably have made more useful appliances if they had not been misled about that "blessed" hook—there would have been no "knocking out of waggon backs," for instance. If a universal change of couplings is once decided upon, and the right one is found, there will be no difficulty in making the change; there will be no such thing as first fitting non-automatic and after that automatic couplings. Therefore, let inventors understand that it is a perfect automatic *coupling* appliance that is wanted, not a hook catcher. If such perfect coupling can be devised, utilising the "hook," so much the better; but by all means let the hook, in any case, be a secondary consideration.

If "Rover" is ever in the neighbourhood of Southampton, and will give me his address, I shall be pleased to tell him where he may see my model.

Silke.

G.W.R. (SO-CALLED) EXPRESSES.

[27634.]—SOME time ago there was a long letter n the "E.M." contrasting the G.W.R. and G.N.R. lines for speed and the like, pointing out the revolution the G.N.R. directors would make in the service of trains to the West of England. I may give an instance of the punctuality of this line, once so celebrated for speed—i.e., between the years 1845 and 1855.

On Saturday evening, July 9, I travelled from Paddington by the train leaving at 5.45. This is timed to reach Swindon at 7.22, or in 1h. 37m.—no great achievement, considering the line is tolerably level, and that there is not a single stoppage. The train left Paddington at 5.54 and did not reach Swindon till 7.41, or in 1h. 47m., ten minutes slower than the allotted time. The point I would remark is that the train was never once stopped by signal; it scarcely "slowed" in passing through Reading, and did not seem at all unusually long.

Viator.

MODERN COMPOUND ENGINES.

[27635.]—WITH reference to remarks that have been recently made about modern compound engines, it must be remembered that there is a limit to which the steam-pressure must be confined, until some new form of generator is adopted. Quadruple expansion may give you increased economy; but high pressures must have some final standpoint, though that may be, say, 400lb. on the square inch. Many of your readers will remember that a steam pressure of upwards of 300lb. was successfully carried on a small steamer called the *Anthracite*, built on the so-called Perkins high-pressure system, which visited America in 1880 to demonstrate that high pressures could be safely and efficiently utilised to furnish motive power on an ocean voyage. Her machinery was tested by a board of naval officers in New York. With an average steam pressure of 316·51b., expanded 25·7 times in triple-expansion engines, there was required 21·64lb. of feed water per hour per indicated horse-power. The engines were small, the aggregate indicated horse-power developed being but 67·7. Still, the cost was quite high—no lower, in fact, than has been obtained in exceptional cases with good condensing engines, and about what ought to have been expected with an ordinary compound engine using a steam pressure no higher than 80lb. The same engine, tested in England by Sir F. Bramwell, furnished a horse-power for 17·81b. feed water per hour, the water level being then carried lower, so that the steam was superheated considerably. The superheating of the steam at these high pressures is not desirable in practical work on account of difficulty with the packings and lubricant. In the Bidwell experiments in Boston with superheated steam, it was considered that 450° was the highest temperature which should be permitted. Proper precautions would indicate that even this temperature should not be allowed in sea-going engines involving so many responsibilities. The temperature of steam of 300lb. pressure is about 420°, and that, in the opinion of Mr. C. E. Emery, is as high as can be carried satisfactorily in average practice either on sea or land. It seems certain that the highest steam pressure admissible would be limited by the temperature rather than by other conditions. In some of the marine engines using steam at 160lb. pressure, it is found that there is a sufficient precipitation of water to permit the use of oil to be dispensed with after the engines are fairly started from port. The temperature due to this pressure is but about 370°. In the *Anthracite*, designed for a higher pressure, with some superheating, all the packings were made of a metal adapted to obviate the necessity of using oil.

On the steamers which ply on the rivers of Western America—e.g., the Mississippi, &c.—steam is often as high as 180 to 200lb., and it is possible to go up to 300lb. perhaps with safety and economy; but the construction of the boilers must be changed. Cylindrical boiler shells 12ft. and upwards in diameter, and $1\frac{1}{8}$ to $1\frac{1}{4}$in. thick cannot be recommended, although used in practice. To limit the thickness even to the figures named it is necessary to use steel; and to procure even this of sufficient tensile strength it is necessary, for such heavy plates, to use steel that is rather treacherous, and that should be thoroughly annealed after every operation. Some think that the whole boiler when finished should be annealed, but it is, as a rule, too large for that. The alternative is to use boilers without shells, except those which are called "drums," and are comparatively small in diameter: in that form there is no difficulty in making steam generators to withstand pressures as high as 400 or 500lb. The other difficulty then comes in—that the steam is too hot, and burns up the packing and the lubricant, and scores the cylinder.

E. A. M.

CARBOLISED OIL FOR BURNS.

[27636.]—I CAN quite corroborate the statement of "Eos" as to the utility of this subtance for burns and scalds. I have used it with great success in several cases lately. One in particular I may mention: A young man employed in chemical manufacture scalded the whole back of hand and fingers by upsetting some boiling glycerine on it. In several places the skin was cracked and peeling off, and I quite thought he would lose the use of his hand. I dressed it by covering it thickly with lint saturated with carbolised olive oil, and every day or so poured on more without removing the dressing. It healed well and left no scar. The dressing came off easily, and the hand received no permanent injury of any kind. **Sozedus.**

UNIFORMITY OF NATURE.

[27637.]—NOBODY has supposed, as "F.R.A.S." would suggest, p. 459, "comets exerting *influence* on the earth"; but Newton and Halley, and every astronomer since them, have had to admit (as well as Comte, the great satirist of modern astronomers) that they are falling on the earth from time to time, with an average frequency, I undertake to prove, of over a dozen per million years, and therefore did so in past ages, *if nature be uniform.*

Instead of proof that one ever did so, we want proof that nature is *not* uniform, but was once so cometless as to admit the Lyellian and Darwinian long periods without catastrophes. I do not say it never did; but that if it did, nature was not uniform then and now.

July 19. **E. L. G.**

THE ORTHOSCOPIC LENS—OPTICAL QUESTION.

[27638.]—AS I was not asked to give a definition of positive and negative foci, but only to describe the above lens, so I did not go deeper into the matter, but, to set the matter at rest, I now quote that portion of "Sutton's" which I left out in my description, thinking it unimportant:—

"We would take this opportunity of observing that in optics the signs *plus* and *minus* are introduced into formulæ, from their property of being able to represent, not merely the operations of addition and subtraction, but also the contrariety of position and direction. By calling lines measured on one side of a lens *positive*, and on the other side *negative*, and affixing the signs *plus* or *minus* to the magnitude of a line, according to its position, it is possible to make one formula include a great variety of different cases. The convention adopted in optics is to call lines measured *towards* the origin of light *positive*, and in the opposite direction *negative*." **S. Bottone.**

AN AMERICAN CHURCH ORGAN OF THE LATEST TYPE.

[27639.]—THE readers of this journal, who are conversant with organ matters, will scan with much interest the following description of an important instrument just commenced in the Roosevelt factory, at New York. I extract the notice from the Chicago *Indicator* of June 25, 1887:

"A SUPERB ORGAN.—Within a year from this time the Trinity M.E. Church of Denver, Colorado, will possess an organ of extraordinary dimensions and remarkable construction. Mr. Isaac E. Blake, a wealthy gentleman and musical connoisseur, of Denver, has just contracted with Mr. Frank Roosevelt (successor to Hilborne L. Roosevelt), of New York, for an organ to be placed in the above church, which is now in process of construction, and which will be one of the finest of its kind in this country.

"The organ will comprise four manuals of fifty-eight notes each, and a pedal clavier of thirty notes. Lack of space prevents the printing of the entire specification, which undoubtedly would prove most interesting to every organist at least, but a short description of the organ may not prove unwelcome. The total number of pipes in the scheme is 3,738, which are divided as follows: Great organ, sixteen stops, 1,218 pipes; Swell organ, eighteen stops, 1,204 pipes; Choir organ, eleven stops, 638 pipes; Solo organ, six stops, 348 pipes; Pedal organ, eleven stops, 330 pipes.

"By this it will be seen there will be sixty-two 'speaking stops,' besides which there are to be eleven couplers, seven mechanical accessories (i.e., tremulants, wind indicators, &c.), fifteen adjustable combination pistons, and thirteen pedal movements, making a grand total of 108 stops and mechanical appliances. Of the many peculiar features of this splendid instrument, the most striking is the number of swell-boxes; namely, in addition to the usual swell-box containing all the pipes of the Swell organ, there are to be two other separate swell boxes, one to inclose the entire Solo organ, and the other to inclose, not only the entire choir organ, but all of the Great organ, excepting two stops of 16ft. and two open diapasons of 8ft. The great value of these extra 'swells' cannot be fully estimated unless one has investigated organs similarly constructed, and has been able to appreciate the wonderful effects of *crescendo* and *decrescendo*, as well as the possibility of shading the tone of each manual. By this means not only the solo played upon one manual can be made expressive, but also the accompaniment upon another, thereby rendering both parts elastic and free from monotony. In other words, a higher degree of artistic finish is made practicable.

"One particularly charming effect, peculiar to this system and which is utterly impossible upon other organs, is that which is produced by gradually opening one swell-box while closing another. When skilfully managed the sensation is to the ear what dissolving views are to the eye. The three balanced swell pedals placed side by side can be easily controlled by the player, and a device will be introduced to close or open all the boxes simultaneously. Another important feature is the Roosevelt system of adjustable combination pistons and pedals, whereby any combination of manual and pedal stops with their couplers can be set by the player and altered at pleasure. By this means the organist can, before beginning to play, arrange as many different combinations as there are pistons and pedals, then by merely touching the right piston or pedal, the required combination is secured. Accordingly any combination of stops is under immediate control, and the quickest changes of registration are most easily accomplished.

"There are other points of special interest in this organ; for instance, a double open diapason of 32ft. in the Pedal organ, a Solo organ of six extremely effective stops voiced on extra pressure of wind, octave and sub-octave couplers, three tremulants, and last and by no means least two hydraulic engines for supplying the wind.

"Throughout the organ Rosevelt's patent wind chests are used. The principle of this system is known as 'tubular pneumatic,' and for each pipe there is a separate pallet. By this means the action of all the manuals and the pedal, even when coupled together, is as light and agreeable as the most perfect pianoforte. There is no possibility of 'wind robbing,' and the tone is always steady and reliable. This method insures the most rapid repetition of chords as well as single notes, which on the ordinary pneumatic action is impossible.

"The specifications for this remarkable organ were drawn by Mr. Walter F. Crosby, the able manager of Mr. Roosevelt's New York establishment."

I feel much gratification at the information conveyed in the above notice, for it clearly proves that some, at least, of the principles of artistic organ building which I have so long advocated, and have recently explained in these columns, are in a fair way to be thoroughly tested on a large scale by the leading organ building firm in the United States. Turning to the notice, we find that the number and disposition of the swell-boxes are pointed out as "the most striking" of "the many peculiar features of this splendid instrument." I have always held that a far too timid use of the swell-box has been made by organ builders. In my "Notes on the Church Organ," which concluded in your issue of March 25, 1887, I advocate the introduction of three swell-boxes, inclosing, respectively, part of the Great organ, the entire Swell, and the entire Choir department. In addition to all this, I suggest the advisability of inclosing certain of the Pedal organ stops in one or other of the manual swell-boxes. So far as the Church Organ is concerned, Mr. Roosevelt and his talented manager, Mr. Crosby, have carried the application of the swell-box, in connection with the Great organ, somewhat farther than even I have ventured to advocate. With my new tonal scheme for the Great, however, the inclosure of the majority of its stops is not so necessary as it is with an ordinary loud-toned appointment.

In my "Notes on the Chamber Organ," which concluded in your issue of Nov. 19, ; 1886 I go farther with the swell-box than is proposed in the present American scheme. I advise the inclosure of all the Great stops save one in *two independent swell-boxes*, the inclosure of all the Choir stops in *one of these swell-boxes*, the inclosure of the Solo organ stops in an *independendet swell-box*, and the inclosure of certain of the Pedal organ stops in *an independent swell-chamber*. In my forthcoming "Notes on the Concert-Room Organ," I shall treat of a still greater development of the expressive appliances of the Organ.

About fiteen years ago I realised the shortcomings of the inartistic methods of organ building in vogue at home and abroad; and, so far as my own Chamber Organ was concerned, set myself to improve them. Putting aside, for my present purpose, all details relative to the tonal structure of the instrument, and confining myself to matters relating to its powers of expression, I may recoid that I divided my Great organ into *three sections*, inclosing *two sections in two independent swell-boxes*, and leaving the *third section*, consisting of the *Open Diapason* alone, outside the swell-boxes. In addition to this, I inclosed my entire Choir department in one of the swell-boxes.

Taking the nature and size of this instrument into consideration, I may justly claim for it that fifteen years ago it presented, and even at the present hour presents, the most advanced and interesting use of the swell-box known in the organ-building world. Any reader desiring to know more on the subject may consult my "Notes on the Chamber Organ" in your issues of October 1st and 15th, 1886.

After the above remarks, it can be understood that the description of the forthcoming Roosevelt Organ is of the greatest interest to me, recording, as it does, an important step in advance in American organ building—a step which our builders may perhaps take it into their wise heads to follow some time in the 20th century. At this point let me direct the reader's attention to the last paragraph but two in the letter by "Country Solicitor" (22604) in your issue of last week.

On the other important appliances which the new Roosevelt Organ is to contain—namely, the Roosevelt "patent wind-chests" and the Roosevelt system of "adjustable combination pistons and pedals," I need not enlarge in this letter, as I shall have to direct special attention to these landmarks in the history of the Art of Organ building, which have had their birth in the genius of my highly-esteemed and deeply-lamented friend, the late Hilborne Lewis Roosevelt, in a future contribution to Organ literature. It is sufficient to say that the former are the most perfect wind-chests ever invented; and the latter embraces unique appliances of immense importance, which no modern Organ of any magnitude should be without. I do not say too much when I affirm that it is a disgrace to our leading builders that they have not long ere this introduced appliances of a similar nature, or have not adopted the perfect system invented by Mr. Roosevelt.

Taking everything into consideration, and knowing from personal examination the perfection of every part of the Roosevelt Organ, I am justified in believing that the new Organ, in course of construction for the church at Denver, will be the most interesting and perfect Church Organ yet constructed. **G. A. Audsley.**

THE PHILOSOPHY OF WATERING OUTDOOR PLANTS.

[27640.]—THE very valuable and excellent extract in last week's "E.M.," page 455, from the *Gardeners' Chronicle*, by "J. J. W.," leads me to offer a suggestion I have often considered would be well worth an experiment, for irrigation on a large scale, or, indeed, in any position where there is a system of under-drainage of land by pipes.

Not only, as it is remarked in your extract, that the application of water to the surface injuriously lowers the temperature; but the enormous quantity required to saturate a dry soil before it can penetrate to the roots of plants, renders the application of water by artificial means an expense prohibitory on a large scale.

My proposition is this: Perfectly close the *exits* of drains where the land water is delivered at the lowest point of the under-drainage; then at the highest point have an arrangement for the influx of water from a storage so as to let in as much as would be required to *fill* the system of pipes by which the land has been drained. The water would thus be supplied to where it was most required, at the roots; it would rise in vapour from this depth, and the vapour would be detained by the earth above, and, as I believe, would quickly reinstate the soil into the condition in which it was before it had suffered from a lengthened dry season.

Roots of plants penetrate the earth to a great depth, and they appear to run after moisture as it were, directing themselves towards any supply of water, and even altering their character according to the supply, as in a dry situation becoming a mass of small fibres, while in more favourable positions or seasons a quarter of the number would have sufficed. All this must be at the expense of the growth of the plant, for if its food were ready to hand, this effort to obtain that food by increasing root power would have been directed to the growth and development of the plant.

The more the farmer can assimilate his system of cultivation to that employed by the gardener, the more he will command success, and if this can be achieved without increasing expenses, it would be mistaken policy not to advocate its adoption. In the garden no attention to the requirements of the plant is neglected. The cost to achieve this attention becomes the impossible on the large scale. I would suggest the advantages of a system of irrigation on this principle would be—

1. The total absence of expense for distribution of water.

2. As the temperature a few feet below the surface of the ground alters little, being away from the direct influence of the sun, it is probable the water supplied would be at even higher temperature than the earth at that point where the water would be delivered; therefore, it would act beneficially rather than otherwise—raising the temperature rather than lowering it, having the effect of a bottom heat.

3. All expensive attempts at surface irrigation by pipes interfere with working the land, and pipes exposed to the atmosphere suffer immediate decay. The expense of attempts in this direction were prohibitory and infinitely inconvenient, and are thus totally superseded.

4. Irrigation by this system would require the smallest quantity of water to be employed, as every portion supplied would go to the position where it was most required, and none would be lost by the evaporation into the atmosphere, which means waste of the water and injurious reduction of temperature.

5. The large quantity of water required to saturate the surface sufficiently, so as to allow it to penetrate to the roots of the plants, where only it can be useful, prevents the possibility of irrigation by the farmer. By this system it would be brought within his power.

6. The great necessity of studying the state of the atmosphere when watering, selecting a dull or cloudy day, is thus obviously unnecessary and uncalled for, as no surface evaporation takes place. Indeed, the higher the temperature of the air the greater the heat the water would convey with it to the roots of the plants.

7. The only expense to be incurred would be to arrange the delivery pipes to close and open so as to serve for irrigation or drainage, and to form ponds or tanks for storage of water.

I should be pleased to hear remarks and criticisms from "ours," from those who may have already given their attention to this subject, or who, from reading the above, may now feel inclined so to do. **John S. Bowley.**

"SHOULD WE EAT SALT OR NOT?"

[27641.]—I AM not at all clear as to whether Dr. Allinson intends us to understand that taking salt into our system in any way is injurious, or whether he only condemns the practice of adding salt when cooking or eating our food. I am inclined to the belief that he means the latter, for he says (p. 310) that "The only way man may take common salt or mineral matter is when it forms an actual part of the food he eats." If this is what he means, the question after all is not, "Should we eat salt or not?" but "Do we eat too much salt?" If Dr. Allinson had confined himself to the question of quantity, I daresay his remarks would have passed unchallenged, for all that "F.R.A.S.," "Eos," and others have done is to show that animals in their natural state do take and benefit by the use of salt—a fact which Dr. Allinson denies in his first letter, although in his second letter he leaves himself a large window when he says that "*given right conditions of life*, salt is not only unnecessary but injurious." From this we may think that since most of us do not, according to Dr. Allinson, live under proper conditions, we may perhaps take salt with impunity; but, no—for says the doctor (p. 310), "Civilised man has accustomed himself to eating salt, but he is no better for doing so, but, on the contrary, is injured by it," so that after all there is no escape for us. We cannot even say, "Well, even if it is not necessary we like it, and its use gives us greater relish for our food," for says the doctor again, "Salt is a mineral, and therefore should never be used. Man is not fitted for absorbing mineral matter, and if he takes such material, either as salt or in the form of medicine, he must do himself harm." I beg to deny the assertion "that man is not fitted for absorbing mineral matter," and the doctor himself contradicts it when he says a little further on, "Salt . . . is quickly absorbed by the blood vessels of the stomach and taken into the blood." But why all this fuss about mineral substances?

Dr. A. knows that there is no real difference between mineral and other substances. If he replies that food should only consist of such mineral substances as have been previously built up as the result of some vital process, I will refer him to water. Water is a mineral substance which we take over and above our food as we take common salt, and if we were to dine on apples and parsnips, as some people would have us do, we might not want to take any additional water.

But what are the injurious effects of eating salt? Dr. A. says that "It causes us to over-eat, and from overeating comes seven-tenths of our ailments." This, if true, would be bad enough, but I have seen it stated, perhaps by the doctor himself, that bad ventilation causes three-quarters, say another seven-tenths, of our ailments, from these two causes alone, then, fourteen-tenths of our ailments proceed, and at least another seven-tenths must be added for those ailments said to be caused by drink. Never mind the arithmetic! Another so-called injurious effect is that it thickens the blood, causes thirst; drink must therefore be taken, and the kidneys are thus overtaxed. Does Dr. A. really wish us to understand that the amount of extra work thus thrown upon the kidneys is injurious? The function of those organs is to secrete water and other matters, and we have yet to learn that the exercise of function within reasonable limits is injurious to any organ; on the contrary, it is a distinct benefit.

The last injurious effect mentioned by Dr. A. is the delay of digestion for at least half an hour; this is not worth further mention. We have then a practice which has existed amongst human beings from times too remote for its origin to be traced, and which we find at present existing amongst animals. This practice Dr. A. condemns as injurious on the grounds that it causes us to over-eat. It delays digestion half an hour; it gives the kidneys overwork and injures them. Then we have his unsupported assertions that "being a mineral, it must be injurious," and "that all careful physiologists must admit that disease must arise from its habitual use." But eminent physiologists, whether careful or not, admit nothing of the kind, but teach exactly the reverse. For example, Professor A. Gamgee says, "Its (common salt) presence in and passage through the animal body and its various tissues and organs appears to be absolutely essential to a variety of the chemical and especially physical processes which have their seat in these." Your readers can choose between the distinguished professor and Dr. Aliinson, who further states that the effects of salt eating are many and varied; but that the greater number of these effects *are not fully known*, yet ventures to say that it must be injurious, and that no disease can arise as a consequence of abstaining from it; who, moreover, backs up his case with instances of pigs refusing to eat coke when green stuff is provided, of a person who takes salt in ridiculous excess, and who finally winds up a scientific argument with a quotation from *Tit-Bits*. Do we not require a pinch of salt to take with Dr. Allinson's letter?

Kensingtonian.

RETROGRESSION OF NIAGARA.

[27642.]—THE value of Niagara as a time-measurer, or rather the ease with which it may be so applied, has been hugely exaggerated. If the geological structure were at all like that shown in the coloured frontispiece to Lyell's "Second Visit to the United States," the problem would, indeed, be far simpler; though not admitting of reduction to the rule-of-three sum that most writers on it, like "J. H. G." (p. 437), seem to fancy sufficient. Instead of a "rate of recession" of so many feet per century, we should at least have to fix a quantity of cubic feet worn away per century. At this moment the falls are working on a width of brink about four times the average width of the seven miles of gorge, so that their present lineal rate of retreat could barely be a quarter of the past average rate, even had the height of fall remained constant; but we know that when they began their work at Lewiston the upper stream and Lake Erie were about twice as elevated above Ontario as they now are. This would make the problem of time very difficult and uncertain, even were the geology that of Lyell's frontispiece, those three horizontal beds of uniform thickness. Even were it so, there must be hundreds of cascades in long-settled, rocky countries, as Greece, Italy, or even Wales, far more available as geo-chronometers than Niagara could ever be.

But this regular stratification was so entirely fanciful and misleading that Lyell afterwards, at the end of chap. xv. of the later editions of his "Principles," says all the strata dip southward as much as the depth of the gorge in every two miles. In that distance the rock that formed the brink of the fall becomes their foot. How a traveller of the least curiosity, "geologist" or not, could ever visit such a place without noting this, or could perpetrate such a drawing as that frontispiece to his "Second Visit," is to me inconceivable; but the famous reformer of geology would seem really to have learnt only in that visit (1845) that waterfalls do recede—only in the very same year, indeed, as myself, a boy who never till then saw a gorge or a natural waterfall! He was, years before, famous enough for me to have met with, and been aghast at, his perpetual motion theory, that secondary rocks were metamorphosed by heat into granite below, and so round and round *ad infinitum*, "world without end."

Of course, it follows from this dip of the strata that the present concentration of the main amount of fall in a simple leap is a state of things quite exceptional and temporary. Both the rate and modes of working when the bed is limestone rock above shale (as now), or shale above hard rock, must be entirely different. If there was a single leap of 300ft. at Lewiston, its upper and lower portions soon parted company, and two or several falls followed each other up the gorge, each at a different speed, so that the first and last were commonly miles apart. Their happening now to be reunited in one leap of 160ft. is a mere accident, owing to 80ft. of limestone here overlying about 80 of shale. The recession is not by wearing the stone, but the spray undermines the soft shale below it, till "table rocks" of perhaps half a rood are left unsupported, and suddenly fall, with concussion enough to break neighbouring windows. (H. G. Madan, in *Nature*, Vol. 27, p. 174). According to the U.S. Geology Surveyor Gilbert (*Nature*, Vol. 34, p. 559), the middle of the "Horseshoe" has retreated 200, or even "275ft., in the eleven years since 1875."

For any practical science, the history of Niagara begins with Peter Kalm's visit, only a century and a third ago (*Gent. Mag.*, 1571), and only his description, not his drawing, is of much use; the latter being plainly only a little modified from that of the Jesuit Hennepin (who 70 years earlier insisted the cataract was 600ft. high, and almost robbed us of the name Niagara to dub it after his own patron saint, which he, alas! succeeded in giving to the second greatest in the continent). Now, Kalm is most positive that all the French engineers agreed and were convinced by trigonometric instruments that the full leap was but "exactly 137ft." The rapids above can hardly have sunk unperceived, and therefore the water immediately after falling must have been some 23ft. higher than now. This is confirmed by what he says of the gorge:—"Canoes can go yet half a league above the beginning of the carrying place; but higher up it is quite impossible, the whole course of the water for two leagues and a half up to the great fall being a series of smaller falls one under another." Nobody would so have described the present gorge, which seems the most level seven miles of the river's whole course, the velocity being only from compression in so narrow a channel. All those "smaller falls," amounting to 23ft., have been levelled down.

Kalm also says, "The river (or rather strait) runs here from S.S.E. to N.N.W., and the rock of the great fall crosses it, not in a right line, but forming almost the figure of a semicircle or horseshoe." (Any segment, even if very flat, has perspectively that look, and is so called or believed by most people.) "Above the fall, in the middle of the river, is an island, lying also S.S.E. and N.N.W., or parallel with the sides of the river; its length is about seven or eight French arpents (an arpent being 120ft.). The lower end of this island is just at the perpendicular edge of the fall" (p. 16). "It was formerly thought impossible for anybody living to come at the island that is in the middle of the fall; but an accident that happened twelve years ago, or thereabouts, made it appear otherwise" (p. 17). Then he tells the story of two Indians who got drunk and had to land on the island, and remain till heroically rescued by two others of their tribe with long stilts (p. 18). "But if the King of France would give me all Canada I would not venture to go to this island; and were you to see it, sir, I am sure you would have the same sentiment." . . . "The breadth of the fall, as it runs in a semicircle, is reckoned to be about six arpents. The island is in the middle of the fall, and from it to each side is almost the same breadth." (His view, like Hennepin's, makes the western exceed as about 5 to 4.) "The breadth of the island at its lower end is two-thirds of an arpent or thereabouts." That would be but half the present height of American Fall, and his drawing makes it not a third thereof.

Now, all those particulars can be very well plotted on the latest survey—Major Comstock's, dated 1875; and it is plain "the island," some 900ft. by 80ft., was not Goat Island (which is still *ten times* that area, after a century and a third of *diminution, as vulgarly held*). Neither of the "*falls*" (*as they are now called*, but in his time halves of "the great fall") can have then yet begun to touch Goat Island. The island of the heroic rescue has plainly now only its south extremity left, under the present name "Luna Island." The size and form of Goat Island (which he never mentions, unless it were one of those to which the Indians went to hunt deer) have probably never varied since; but the chief fall has travelled along its whole N.W. side, scarping what was a mere low shore into a cliff. In this process it has come to lower parts of the inclined bed of limestone, has had less and less thickness thereof to remove, and thus, becoming a lower fall than the American, has constantly got a greater share of the river, and before retreating another furlong will have got all. The American Fall, retaining its height, will have dried up, and its bed, with all the islands, become part of New York State. If they made through the village a few more tunnelled canals they might utilise much of the power.

E. L. G.

FIVE-FIGURE versus SEVEN-FIGURE LOGARITHMS.

[27643.]—IN reply to the remarks of "A Fellow of the Royal Astronomical Society" (27590), I admit that it would be more correct to say that a 7-figure logarithm *usually* requires two references, rather than to say, as I have done, "that it requires two references," which might be interpreted as meaning that a 7-figure mantissa *always* requires two references.

The power of writing down a sequence of figures after one inspection must vary with the capacity of the individual, and I can well imagine that some people could write down a sequence of nine or more figures after once looking at them. For my own part (and I think my experience must be that of the majority), I cannot with certainty write down a 7-figure mantissa after one inspection, as I can easily do with a 5-figure one. Five-figure mantissæ may, and are usually divided in tables into two parts as 85 781, and one can easily retain the 85 and the 781 in the mind; but with the corresponding 7-figure mantissa, 8578148 broken in tables into 857 8148, although one may remember it, there is in my mind uncertainty enough to make a second inspection necessary.

C. J. Woodward.

NEW SEASON'S TEAS.

[27644.]—THE plant is raised from seeds, and the first crop of leaves is gathered in the third year. The leaves are gathered from one to four times in the year, according to the age and strength of the plant. Most commonly there are three gatherings—the first about the middle of April, the second at midsummer, and the third in August; so that, so far as the grocer or tea dealer is concerned, the "New Season's Teas" placard may be considered a perennial affair. The leaves that are earliest gathered are the most delicate colour and most aromatic flavour, with least fibre or bitterness; leaves of the second gathering are dull green; whilst the last are dark green, and of inferior value. The quality is further influenced by the age of the wood on which the leaves are borne, and the degree of exposure they have been accustomed to; leaves from young wood and those most exposed are always best. After the shrubs have attained the age of six or seven years their produce becomes so inferior, that they are removed to make room for a fresh succession.

E. S. H.

THE CARE OF RIFLE BARRELS.

[27645.]—NOW that our "shootists," as it is becoming the fashion to call them, are doing wonders at Wimbledon, the following remarks on the care of rifle barrels, by E. P. Roche, M.D., in the *Science News* (U.S.) may attract some attention, and I therefore send them for the comments of the riflemen amongst your readers. Dr. Roche says:—"The equipment of the modern soldier grows more expensive year by year, in spite of machinery and improvements in arms. Undoubtedly the most important weapon is the rifle, and the most essential part of that, so far as accuracy is demanded, is the barrel. No matter how fine the workmanship, if the inside of the barrel be crooked, the weapon is uncertain, and the soldier using it is placed at so great a disadvantage as to be liable to defeat from a smaller force better armed. Notwithstanding the close and minute attention given to all parts of thes oldiers' equipment, I can recall no change in the inspection, from the days of Knoxville and Petersburg to the present, designed to detect errors in the straightness of the rifle barrel; so long as it is clean and bright, its ability to "shoot around a corner" passes unchallenged. Few are aware how easily the barrel of a rifle can be sprung by careless usage, such as carrying knapsacks slung across it, or sticking it into the earth by the bayonet. I once, at a field hospital in Virginia, examined several Springfield rifles left by the wounded, and nearly every one was bent in the stock, so that the muzzle pointed upwards. As a consequence, when fired, the shot must have gone high. The last finishing touch given to the barrel before rifling is to straighten it. This is done by reflecting the image of a straight line into the bore of the barrel; and, if the reflected line appears crooked, the barrel *is* crooked, and is straightened accordingly. The reflection of the line for purposes of straightening necessitates a true cylinder: hence it is done before rifling; the grooves of the rifling, by breaking the continuity of the reflected line, preventing anything but an approximate straightening after they are cut in the barrel. Some years ago the following plan to overcome the difficulty occurred to me; and, never having seen anything of the kind in print, I offer it to the readers. It may have uses beyond rifle barrels. I would propose that, after the barrel has been finally straightened, three fine lines, cut with a diamond-point tool, be made the entire length of the barrel, on the outside, and at about equal distances on the circumference. Now, if the barrel is bent in any direction, one of these lines must also be bent, and serve as a tell-tale. As the outside of the barrel is not a true taper, the following device may be useful. It consists of a mirror, on which is cut a true straight line. Opposite the mirror is a stand for the barrel; by turning the barrel in the stand, the tell-tale line can be reflected alongside the standard one on the mirror, and any damaging deviation noted. Of course, all this is not for the Sunday inspection; but the army has surgeons, farriers, veterinary surgeons, engineers, and ordnance officers—why not a skilled inspector of arms?"

It seems to me that there is a useful suggestion and a valuable hint or two in the above; but at any rate, it will be readily accepted by some of those who have failed to hit the eye quite so often as they ought to have done.

One of the H. A. C.

A STRANGE BIT OF NATURAL HISTORY.

[27646.]—THE greatest compliment ever paid to my "artificial flies," was that of a colony of spiders, creatures that from the multiple magnifying power of their eyes I had always supposed to be the most wary and discerning of all creation! Thus it occurred: I had taken a long-deserted European house in the N. Himalayas, as a sojourn during my fishing and botanising excursions at the Government Tea Planations of Hawulbagh. I had tried several dozen very small and gaudy specimens of artificial attractions, being from my boyhood rather a neat hand at the art; the final stage of tipping the heads with transparent varnish was to be carried out, so having driven a few nails in the woodwork of a sunny window, I proceeded to suspend each fly, after the above process, in scattered display, to dry off. I shut the door, and left the empty cobwebbed room for some hours. On my return I was utterly astonished to find a legion of *Arachnidæ* surrounding my collection. I quietly withdrew to a few feet distant that I might ascertain their intentions. Occasionally one of the host darted out in a ferocious manner, then, on nearly touching the lure, he retreated backwards at great speed for some inches, watching the mystery intently. There were several sizes and species of these house spiders, which continued to carry on this "come and go" movement as long as I left the flies in the window! Was it the smell of the varnish, or a closer examination of the lure which repelled these attacks? But here are some similar facts of deception: Our wall lizards of India are very insectivorous, and are treated with great consideration by the inmates of dwelling rooms, for they hunt all flying and creeping things as cats do mice. I have seen the scorpion and cockroach captured and worried, to be eventually devoured! One day I thought I would try their visual powers (the eye shines like a black diamond). I "whipped" for them with a dark imitation house fly, and hooked every rise, of course releasing them immediately. Then I threw a large ruddy imitation of a cockroach on some ponds, hooking a fine aquatic frog every cast. The bat, and the swallow, too, I have known captured on a hot midsummer evening in the West of England, when the fisher was bringing back his line to make a fresh cast.

Boa.

POISONING OF CATS.

[27647.]—I, TOO, have rejoiced in my feline favourite; but being jet black, she defied the fates. Twice, out of bounds, her foot was mangled by the keeper's sharp rabbit traps; but he, being a friend of the cat's proprietor, mercifully released her. I must say I love my birds and flowers more than my neighbours' cats; the mischief they do is only to be felt by a horticulturist, not by a contented citizen with *rus in urbe*. I witnessed a grand smash when staying with a lady friend at Richmond. After the usual noisy prelude to a combat, the combined screeches and wailing of a furry host assembled on a wall, there ensued an [illegible] half-way up, so that an increased pressure on the pedal will cause the double thickness to rest in front of the hammers, which causes the tone to be modulated to an extreme degree of softness. It is, of course, optional whether a second soft pedal is employed to produce this effect; if so, it is generally called by some special name, such as a "harp," or "pianissimo pedal." Weighted blocks, to glue behind the stickers, may be obtained from Messrs. Brooks, Cumberland Market, or they are very easy to make at home. These, however, are only necessary where the hammers are inclined to stick. If a heavier touch is desired, it would be better to bore a ¼in. hole in the key—just at the back of the hopper—and fill it with melted lead.—W. H. DAVIES.

[62685.]—**Still.**—I may tell "Loyal" that I have a nitric-acid apparatus, and have to pay 10s. yearly for it to the Excise authorities, which I think is a great injustice. The Exciseman knows what I manufacture, and classed it as a still, which it really is.—SHALE.

[62690.]—**Boracic Acid.**—On this subject I would wish to state my experience, though I do not mean to offer a scientific opinion upon it. I have long used boracic acid, apparently with good results, and I have great faith in its efficacy as a medical remedy. I consider it was a mistake for the French Government to have entirely prohibited its use as a food preservative. It requires, no doubt, to be used in moderation, but a small quantity only is sufficient for its purpose. I seldom take more than half a teaspoonful in one day. With regard to its effects, I may say that I was troubled with an itching skin for a number of years, and I had tried several remedies in vain—sulphur ointment I found to be utterly useless—until I cured myself with only two applications of boracic acid. My manner of applying it was to reduce the acid to a fine powder, wet it with water, and then rub it into the skin, after having first washed the skin thoroughly. Whenever I have the misfortune to swallow meat "in high order" (too usual in this hot weather), I always relieve myself with some boracic acid to neutralise the decomposing tendency of the meat. I should suppose, moreover, that boracic acid must be very good for preventing griping and pains in the belly. As an anti-ferment it prevents milk and fruit and other articles from turning sour, and it should, therefore, be expected that it would also prevent the food from turning in the stomach.—M. Z.

[62701.]—**Canoeing from Oxford.**—The querist will find a great deal of information in Taunt's "Illustrated Map of the Thames," (Taunt and Co., Oxford), both about "camping out" and the various locks, hotels, &c., on the Thames, its tributaries and canals. It is illustrated by a large number of little photographs, and all the points on the river, distances, &c., are marked out, with the express object of assisting boating parties, &c.—E. M.

[62707.]—**Dumb-Bells.**—The rule about weight of dumb-bells is to have them no heavier than can be held out in front, both in one hand—not sideways, but arm straight out from chest. Then never practise after feeling of fatigue sets in. Mine are 7lb. each, and that is heavy enough for ordinary people.—JOCASTA.

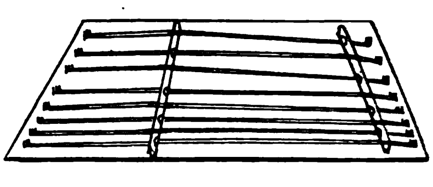
[62716.]—**Slide-Valves of Model Engines.**—After seeing that the eccentric rod and valve spindle are correct in length, the valve for so small an engine may be set as follows:—Revolve the shaft until crank draws piston to its extreme position nearest shaft, place eccentric in such a position on shaft that the port nearest shaft shall be open sufficiently to admit a narrow strip of paper. This partial uncovering of the port is called the lead. First-rate descriptions will be found in Vol. XXXIX. p. 143, and Vol. XLII. pp. 233 and 301. The size of the steam ports may be ⅛in. by ⅜in., and exhaust $\frac{3}{16}$in. by ⅜in. The valve should have at least $\frac{1}{32}$in. lap over each port when in mid-position. A load on the engine makes the beats more audible, but they are not likely to be very distinct.—F. M. C.

[62731.]—**The English Language.**—"A Foreign Student" may be surprised to learn that the English language is as varied as the English character, being indeed a reflex of it. It is news to me that the personal pronoun "thou" has been abandoned, as it is only a few hours since I heard it made use of. I hope to hear it again in a very short time. I know neither German nor French; but I remember a young German being surprised at me "thou-ing" my own brother—his surprise, I opine, being evinced at the discovery that we had the word. He told me "thou" in German was used only between great intimates and blood relations, though not always or generally. In the Northern counties the use of "thou" is general. I must take exception to his statement ". . . . German and French, these two principal factors in the English language." A recent writer says: "The German speech, in truth, is a compound; it is not a primitive language, or even a national language. . . . By its complex mode of expression, and its habit of compounding words, it proves its debased origin and its incapacity for improvement. Like all savage languages, as distinguished from pure and cultivated tongues, it is confused and complex. Though it incorporates some good Gothic words, it cannot be simple. Luther's Bible has fixed it, and upon a wretched basis. . . ." It is not likely that a race speaking a pure language such as Celtic, improved by the Latinity of the Roman occupation, would debase it by adding to its vocabulary from an impure tongue; the tendency would rather be to strengthen it by the resumption of old and forgotten words, or the addition of new ones, from dialects of the parent stock. Horne Tooke, in writing of Latin, says: "What it had not from the Greek, it had from the Gothic." Who were the Greeks? Whence came they? Were they not a branch of the great Celtic family? Then the Angles and the Saxons, they were not Sarmatians, but En Gael (the Gael), and Scythians, also Celtic. With regard to French the case is different. The French were Gauls; the Normans were a Celtic family from the North of Europe, and history would seem to prove that whenever and wherever two or more branches of the Celtae coalesced, the result was not only greater national strength, but greater mental activity and higher achievements. I must not, however, be too prolix. Suffice it to point out that English is not indebted to German. English was written in the thirteenth century, very much as it is now spoken in many parts of the North. Had German an existence, or even a name, then? No doubt they both owe much to several dialects of one language. As from the earliest times of which we have authentic information, the Gauls and the Britons held intercourse with each other, it is not surprising to find many words common to both languages; and I think it would be exceedingly difficult to establish any priority of claim, in the case of many of those words marked Old French and Norman French in our dictionaries, nearly all lexicographers having utterly ignored the great stock upon which the English language is grafted; many words, for which roots could not be found, especially those termed "slang," being traceable to Gaelic or some allied Celtic tongue, were referred for their origin to some supposititious circumstance or other. With regard to the absence of the French *u* and the German *ü*, a foreign student must remember that the English language is one of purely native growth, and better adapted to the wants of the people than that of any other nation. Had the want of these signs been felt, they would have been introduced. Their absence—expressed symbolically—may be explained by the fact that the various pronunciations of the *u*, in such words as bull, dull, but, &c., are sufficiently well known without having to be especially marked. He will also find that the guttural *ch* is still in use, therefore it has not been dropped—character, choir, chaos, chasm, &c., are cases in point. In many Anglo-Saxon words the *h* was dropped—no doubt as superfluous—and *c* hard retained. (We still have kirk for church; kist, kest, for chest, &c.) *Th*, I should imagine, has been in the language ever since—perhaps before—it was one, seeing that it is found in the Gaelic, Anglo-Saxon, Gothic, Greek, and Hebrew, a judicious mixture of which, including the Latinised Greek and Gothic, constitutes modern English, so that in this language *th* finds a quite natural resting-place. "A Foreign Student" may not be aware of the great diversities which exist in English. He will understand my meaning better if he gets someone to read to him, with proper emphasis, a bit out of Carlyle, and then a bit out of Ruskin. One with an ear for music, not knowing English, would refer them to different languages. The former, strong, forcible, piercing as the north wind, gives us the Anglo-Saxon aspect of our language; the latter, soft, persuasive, like the murmur of distant waters, convincing by its very gentleness, shows us the Italian side. In conclusion, I would say that the English language, as generally spoken by the inhabitants, is vastly different from either of these types. There are many words, phrases, and peculiarities of expression which never find their way into print. Then the language partakes of the characteristics of the Anglo-Saxon, wherever he may go, in its flexibility and the ease with which it adapts itself to circumstances, and assimilates new, or, as I have heard them termed, "fossil" words, generally for the sake of abbreviation. As an illustration, I will instance *boycott* as, perhaps, the best known word recently added. The single word conveys to the mind of the reader what, before its introduction, would have required a whole sentence to explain, and as to its adaptability to meet circumstances, witness Nigger English in the S. States of N. America, and the Pidgin English of the Chinese seaboard. In English are many paradoxes.—E. S. H., Coatham.

[62731.]—**The English Language.**—In response to "Foreign Student's" inquiries into some of the mysteries of our tongue—(1) The use of "thou" is not abandoned in country districts, and it is professedly retained by the Society of Friends, or Quakers, who call it the "plain language." It is supposed to be less respectful than the plural form, and yet no one ever dares to address the Diety as anything but "Thou"! The Bible uses "thou"; but the diction of the Bible was antiquated even in 1609. Its contemporary, Shakespeare, uses both forms, even in the same sentence or speech. "*Thou* thinks't not of this now! Nay, I remember the trick *you* served me," &c. In Shakespeare it often marks a change of tone or feeling. See Sylvia's conversation with Julia ("Two Gentlemen," Act IV. Sc. 4). (2) It is not only the absence of certain vowel sounds that puzzles a stranger; but the whole system of vowel notation is irregular and haphazard to a degree. It is said that in Chaucer's time the vowels had their foreign sounds. At present it is risky to try to pronounce a word you have only seen in print. (3) Undoubtedly, the guttural *ch* was used in old English or Anglo-Saxon. There are those living in remote districts who can remember the peculiar guttural sound given to local names containing those letters, and corresponding to the Scotch *ch* in *loch*. (4) In Anglo-Saxon there were two sounds as now for *th*, and two characters to represent them. One of these has somehow got confused with the letter *y*, and so we see *ye* written as an archaic form of *the*. People should be consistent, and write *yt* for *that*, *ym* for *them*, &c. For further information, "Foreign Student" might be interested in looking into an Anglo-Saxon grammar. He will probably find that English was not derived from German, as he seems to imagine; but both from an ancient language, the nearest surviving example of which is the Icelandic. Some of Max Müller's works would interest him.—NEPHESH.

[62738.]—**Piano Wrest-Plank.**—TO MR. DAVIES.—I do not quite understand whether "Apollo" means a solid brass plank or only a facing. A brass plate does not require either cement or glue, but it will be better to bed it on a piece of flannel, otherwise jarring noises may arise, especially in the treble, which are often very difficult to cure. The pin-holes should be fully large, so that the pins should be quite free. It is, perhaps, unnecessary to add that a face-plate is for ornament only, and although it answers this purpose admirably, it is no addition to the strength of the plank.—W. H, DAVIES.

[62753.]—**Dulcimer Tuning.**—Each set of 3 strings must pass over one bridge and under the other alternately, to the right and left, as shown in cut. The right-hand bridge being placed as near as possible to the wrench-pins, the left-hand bridge is shifted towards the centre, until the notes produced by any string passing over this bridge are exact fifths—that is to say, A on the right and E on the left of the bridge. So those strings which are divided by the left bridge into nearly equal lengths give each two notes; while the ones which pass over the right-hand bridge give only one note each. The three strings at the wider end of the instrument should pass over the right-hand bridge and under the left; the next should pass over the left and under the right, and so on alternately. The following table will show how each set of three strings should be tuned, the lowest note, D, being at the widest end of the instrument:—



A	D	
		G
G	C	
		F
F^{sh}	B	
		E
E	A	
		D
D	G	
		C
C^{sh}	F^{sh}	
		B
B	E	
		A
A	D	
		G
G	C	
		F
F^{sh}	B	
		E
E	A	
		D

—S. BOTTONE.

another solution: Gold trichloride, 1 grain; potassium cyanide, 10 grains; distilled water, 200 grains.—Aloin.

[62767.]—**Mechanics.**—Yes, you are quite correct.—T. C., Bristol.

[62767.]—**Mechanics.**—Yes, quite right. Power varies inversely as the speed.—Elag.

[62769.]—**Rusty Watchmaker's Lathe.**—I have had some experience of rusty tools. I have bought neglected articles of steel and iron at auctions, and have had much damage of that sort from wet climates; of late I have tried a soaking with pure paraffin oil (American crystal). Having applied this two or three times in 48 hours rub the prominent rustspots with a smooth sandstone, then wet it again with the oil and leave for 24 hours in a warm room; scrub with fine white sand, then smear the work well with olive oil. Heat some chalk lumps red-hot in a fire, break them into powder immediately; put your metal into a tin box, sprinkling this quicklime well, and throwing a good quantity of same all over it; shut down lid of box, shake it about slowly, and leave it alone in a very dry room for a few days; then withdraw your metal, rub it clean with a woollen rag, and scrub with emery sticks. Lastly, polish with fine emery paper. I use a weak wash of dilute muriatic acid to stubborn spots, in a few minutes wash off with boiling water, subsequently using the steel wire scratch brush, and you will get rid of them. Any screwed parts, of course, must be very carefully handled, as they cannot be cleaned by abrasive substances. After the lime treatment, rinse them well, and shield with cork and sheet lead while you are doing the smooth metal, soaking with oil in time, and soft rubbing will make them clean, and, if of hard steel, the dry scratch brush of soft brass wire will not hurt them. Examples.—A gardener's pruning knife, dug up in a wet border, and encased in a coat of rust and clay, is doing good work again in the owner's hands. The blade, though disfigured by deep pitting, is improved in quality. A large clasp knife, found in the bed of a stream, its rivets rusted away and part of the buckhorn handle decomposed, I took to pieces, and have restored the chief parts for the sake of showing that such could be done. A sewing machine and my heavy lathe I always clean with the above American oil. Rust and dirt are dissolved rapidly.—Eos.

[62770.]—**Uniting Carbon to Brass.**—Drill a hole through carbon and brass, and bolt together with small bolts (those used for model engines, &c.) If you wish to solder it, roughen your carbon and deposit a layer of copper by electrotype; the solder will unite with copper, but not with carbon. Use zinc chloride as flux.—Principia.

[62770.]—**Uniting Carbon to Brass.**—Deposit a slight layer of copper on part of carbon to be soldered, when it will take the solder readily. This may be done by making the carbon the negative plate in a sulphate of copper cell, dipping in only as much of the carbon as is required to be soldered.—Elag.

[62770.]—**Uniting Carbon to Brass.**—Thoroughly soak all the bichromate, &c., from your carbons by letting stand all night in water, then dry thoroughly; now rig up a Daniell cell and connect the carbon plate to the zinc pole of the battery, letting just so much of the carbon plate as you wish to solder dip into the copper solution; let the battery work till you get a fairly stout coating of copper; remove the carbon, soak in water until all the sulphate of copper has been dissolved out; dry the carbon. It will now be found easy to solder this to the brass in the usual manner.—S. Bottone.

[62772.]—**Lima Half-crowns**—Lima is the capital of Peru. Half-crowns with Lima below the bust were made of silver captured by privateers. —A. McCredie.

[62774.]—**Cartwright's Plane.**—The plane you saw would be very likely to be known as a chariot plane. It is a very old plane, and one our grandfathers used, and is not used now by cartwrights. It is used by carpenters; but the plane known as the panel plane has taken its place, and is far superior for the work you name.—J. C.

[62775.]—**Deafness.**—I think your case of a very common type. One of our modern medical writers considers repeated colds as very prejudical to the system; patience, and a trial of the ear drops I recommended will most probably effect a cure. On going to bed saturate a small bit of cotton wool with camphorated spirit; put this in the cavity, and sleep with that side of the head on a soft pillow as much as you can. In chronic deafness medical electricity has achieved many remarkable triumphs over the aurists.—Eos.

[62776.]—**Springs.**—To Mr. Bottone.—I would strongly advise "One Who Needs Help" to discard all idea of driving his fan by spring power. To get 3,500 revs. per minute (not to speak of 8,000,500) for even ten minutes would require a very costly arrangement of springs; and when arranged would be eminently unsatisfactory. Far better use a little of the waste heat of the forge to work a small "Daussin" engine.—S. Bottone.

[62776.]—**Springs.**—In any arrangement of springs you would have to work a little harder than you do now at the fan to wind them up: so you had better not waste any time or money about them. I should think fan out of order.—T. C., Bristol.

[62778.]—**Cleaning Filigree Silver.**—In No. 1153, p. 200, there is described a way of cleaning above ("Scraps from my Workshop," by "Eos").—Principia.

[62779.]—**Ring Armature.**—To Mr. Bottone.—The principal advantage in having several sections in the cog-ring armature lies in the diminished fluctuation in current. When an armature has only two sections, it is very evident that the fluctuation of current must lie between the very highest the machine can give and 0. Hence the fluctuation is really $\frac{1}{2}$ or ·5 of the whole current. The annexed table gives an idea of the effect of increasing the number of sections:—

Sections.	Percentage of Fluctuation.
2	± 50·00
4	14·04
10	2·88
12	1·70
15	1·10
20	·61
24	·42
30	·28
36	·19

A large number of sections also mitigates the evil of the self-induction in the neighbouring coils; but this evil is less felt in the cog-ring than in the plain ring.—S. Bottone.

[62780.]—**Nieces and Nephews.**—An uncle left his estate to be divided amongst his nephews and nieces. His wife's nephews and nieces have no share under this provision.—B.Sc., Plymouth.

[62781.]—**Oxide of Copper Battery.**—It makes but little difference whether iron or copper be used, as after a few seconds metallic copper is set free; the E.M.F. in either case is about ·8 of a volt, the current on short circuit about $\frac{1}{10}$ of an ampère. You would probably require four cells each exposing about 1sq.ft. of negative surface to light well a 2½c.p. lamp having a cold resistance of 2 ohms. The copper cell (if cells must be used instead of plate) might be brazed.—S. Bottone.

[62783.]—**Water-Wheel.**—There would be less power obtained by any size of water-wheel larger in diameter than one just adapted to receive the full height of the fall, because it would be larger than needful, and would, therefore, be a waste of both force and material. The power depends entirely on gravity or fall of the water. It is a mistaken notion to take the water on to the breast of a wheel greater in diameter than suitable for the effective height of the fall—nearly 14ft. in this case—or where would be the limit?—M. S.

[62786.]—**Reflector.**—I presume you wish to resilver this? Clean the copper surface with dilute nitric acid, and wash in running water; then rub it with the following: Potassium acid tartrate (cream of tartar), 100 parts; silver chloride, 10 parts, and mercuric chloride 1 part. When silvered, polish.—Principia.

[62789.]—**Foot-Pathway.**—Undoubtedly the highway board has the power to lower the roads in their care. The Acts relating to the powers of highway boards and their surveyors are 5 and 6 William IV. c. 50 (the General Highway Act); 25 and 26 Vict. c. 61 (Highway Act, 1862); 27 and 28 Vict. c. 101 (Highway Act, 1864); 41 and 42 Vict. c. 77 (Highway Amendment Act, 1878). But probably what has been done in "Somerset Lad's" country town is done under the Public Health Act, 1875, which ordains the urban authority to execute all the powers, &c., of surveyor of highways, and also gives the urban authority extensive powers as to regulation of streets and paving.—B.Sc., Plymouth.

[62790.]—**Surgical.**—Of course, total rest would be the first step to restoration. Now, try this: put your hand twice daily in water made as hot as you can bear, morning and evening, then put the suffering part in an indiarubber bag of ice, otherwise in the coldest water you can get. Dissolve camphor in methylated spirit to saturation, get a person to rub this briskly into the seat of injury. Wear a stout leather mitten while you work as a safe guard from fresh contusions. You have lost much valuable time in treatment.—Eos.

[62790.]—**Surgical.**—If "A Joiner" does not rest his wrist now for a short time, he will probably have to rest it for months, if not for life, when the disease advances to suppuration and disorganisation of the joint. Rest and blistering with Corrigan's button would probably cure him now; but it should be perfect rest on a splint if necessary.—Doctor Medicinæ.

[62791.]—**Ingluvin**—is the name applied to a drug prepared from the digestive fluid of the fowl, as pepsine is from that of the pig or calf. It is in some cases much more active than pepsine.—Doctor Medicinæ.

[62791.]—**Ingluvin** is the digestive principle derived from the crop of birds, and is supposed to be more powerful than any of the various forms of pepsine. Preparations of ingluvin made by Warner, Philadelphia, are sold by Newberry, 1, King Edward-street, E.C.—B.Sc., Plymouth.

[62792.]—**Photography.**—Ilford, Britannia, or other plates in the market will do with the camera you have. I fail to see what influence the camera and lens can have on the make of plates. One is quite independent of the other, and the same plate will work in any camera. Each maker of plates sends out with them the formula of developer which gives the best results with his brand. Why not buy a book on photography? You would find in it all the necessary information to enable you to do good work. I find Hepworth's "Photography for Amateurs" most trustworthy. It costs a shilling, and if you follow out carefully its indications, you ought to succeed as I did when I started. You will find in the book the names of all the chemicals you require. There is plenty of information concerning photography in back numbers. It is almost a pity to occupy space with such a query as yours. You are simply asking correspondents to write out for you a complete treatise on photography.—Copper.

[62792.]—**Photography.**—(1) Yes; any plates will do. (2) The makers publish a formula with each box of plates. Should advise you to read a textbook of photography (say, Burton's) before beginning operations.—Aloin.

[62792.]—**Photography.**—Permit me to offer a suggestion to this querist, that is, to procure one of the many useful handbooks or guides, which will give him all the information he requires. There are several to be had at about one shilling. As to the "chemicals," they are invariably mentioned on the packets of dry-plates.—T. P.

[62792.]—**Photography.**—Many sets of apparatus are worse than Messrs. Lancaster's—few better. With them you can use, with certainty of success, any of the standard makes of plates. I use ferrous oxalate, and also pyro. as a developer. Best negative paper, Eastman's. The chemicals you will require are: Pyrogallic acid, ammonia, potassium oxalate neutral, ferrous sulphate, sodium hyposulphite, chrome alum, mercuric chloride, gold chloride, nitrate of silver. But before you do anything, read carefully Lejeune and Perkins' "Beginner's Guide to Photography."—S. Bottone.

[62794.]—**Distilling Whiskey.**—Sulphuric acid is used at distilleries to saccharify unmalted grain, especially maize. The ground grain is put in a brewing tank with plenty of hot water, and is well mixed. About 3lb. of acid to every 164lb. of grain is run into the tank, and the whole is then subjected to steam pressure for from six to eight hours. The mashing rakes are kept constantly working all the time of steaming, to prevent the "setting" of the grain. When the starch of the grain is saccharified, the acid is almost, but not quite, neutralised by chalk or lime; and then the mash is run into the ordinary mash tun, and is mixed with the malt and grain there mashing. There is a natural acidity in an ordinary mash, and the neutralising of the saccharified grain is made to approximate to it as nearly as possible. I take this opportunity of thanking "Armourer" for his reply to my query *re* "Silver solder and flux for silver solder."—W. H., Dublin.

[62794.]—**Distilling Whisky.**—The vitriol is probably used for inverting sugar. All accounts of the kind should, however, be taken with a large pinch of salt, for it is as likely as not that a "vat of vitriol" should be a "vat of alcohol." Amongst a certain class of writers it was years ago a favourite libel to speak of the publican adding oil of vitriol, or sulphuric acid, to his gin in order to produce the "beads." It never occurred to these slap-dash writers to add a few drops themselves and taste! But here's the clincher: If vitriol is added to beer or whisky it does more good than the other portions of the liquor do. And another thing, if there is any truth in the modern hypothesis of the cause of cholera, those who drink sulphuric-acid beer are imbibing a beverage which will effectually destroy any of Koch's bacilli that may have gained entrance to their stomachs. Carry a little dilute sulphuric acid about with you; and when compelled to drink water, the source of which you do not know, put in some of your weak acid, and drink with as much pleasure as you can. Just now all sorts of statements can be found in the papers—or rather the majority of them—for some do seem to take care not to unnecessarily alarm the public. On p. 468 there is a quotation from a paper which nearly every week gets up a sensation, if it can, and the quotation is actually given as an authority. It was that very paper which gravely asserted that oil of vitriol was added to beer. What puzzles me is that these statements should be made without putting them to the test, for it is an easy matter, surely, to try how many drops of sulphuric acid can be added to any beverage without detecting the presence of the acid—and really, it is not a poison.—NUN. DOR.

[62796.]—**Depositing Mercury on Metal.**—If to a solution of nitrate of mercury be added a solution of common table salt, a white precipitate of mercurous chloride is thrown down, and this will give a film of mercury if rubbed on brass; but it is very likely that a solution of nitrate of silver was used when the precipitate formed on the addition of salt was silver chloride, and the metallic coating real silver.—S. BOTTONE.

[62796.]—**Depositing Mercury on Metal.**—If a strong solution of mercurous nitrate is mixed with one of sodium chloride (common salt), the result will be a creamy mass of mercurous chloride with sodium nitrate in solution. If this is rubbed on clean brass or copper, it will coat it with mercury. The solutions are both perfectly colourless. A solution of any soluble salt of mercury may be used for producing a deposit of mercury, either by dipping or rubbing the solution on the article.—PRINCIPIA.

[62798.] — **Sight Adjuster for Martini-Henry.**—It is not clear from this query whether "Corporal" means a vernier or a windgauge, or both; but in any case he will find it much better to buy them than to attempt to make them himself. He will find plenty of advertisements in the Volunteer Service newspapers. An anemometer would show the velocity of the wind, but I do not think it would be of much practical utility. There is a "knack" in estimating the necessary allowance for wind which can only be acquired by practice. The querist should ask for assistance from his shooting comrades, and he is pretty certain to get plenty of hints, for no persons are more ready to help beginners than crack marksmen.—WM. JOHN GREY, F.C.S., Staff-Sergeant, 5th Durham R.V., Hon. Sec. Derwent Rifle Club.

[62799.]—**Potash Oxalate.**—Presuming that you require the neutral oxalate, such as is used in photography in conjunction with ferrous sulphate for developing gelatino-bromide plates, you will require: Potassium carbonate K_2CO_3, 1,383 parts by weight; crystallised oxalic acid $C_2H_2O_4 + 2H_2O$, 1,260 parts by weight. Dissolve each in water, add together, and set aside to crystallise.—S. BOTTONE.

[62799.]—**Potash Oxalate.**—Theoretically, 126 parts of oxalic acid ($H_2C_2O_4 2H_2O$) will neutralise 138 parts of potassium carbonate (K_2CO_3), and this will produce 202 parts of potassium oxalate ($K_2C_2O_4 2H_2O$). Perhaps the best way to form potassium oxalate will be to take the above quantities, dissolve them in water, and mix; if there is an excess of either body, add the other till neutral, evaporate, and set aside to crystallise. PRINCIPIA.

[62799.]—**Potash Oxalate.**—This is made by decomposing carbonate of potash by oxalic acid, not "combining" them, for they will not combine. The equation is—

$$\underset{138}{K_2CO_3} + \underset{90}{H_2C_2O_4} = \underset{166}{K_2C_2O_4} + \underset{44}{CO_2} + \underset{18}{H_2O}.$$

Oxalic acid crystallises with two molecules of water, so 126 parts must be used to 138 parts of dry potassium carbonate. The salt is usually made by neutralising a solution of oxalic acid by K_2CO_3.—WM. JOHN GREY, F.C.S., Newcastle-on-Tyne.

[62799.]—**Potash Oxalate.**—There are two oxalates of potassium—viz., $K_2C_2O_4$ and KHC_2O_4. Querist does not specify which he wishes to prepare. The first or neutral oxalate of potassium is prepared by adding K_2CO_3 to $C_2H_2O_4$. The formula of reaction is: $K_2CO_3 + C_2H_2O_4 + 2H_2O = K_2C_2O_4 + CO_2 + 3H_2O$. From this the necessary quantities of $C_2H_2O_4$ and K_2CO_3 can easily be calculated by substituting in both members of equations the symbols by their atomic weights, bearing in mind that crystallised $C_2H_2O_4$ has two molecules of water, and is therefore $C_2H_2O_4 + 2H_2O$, while $K_2C_2O_4$ has one, and is $K_2C_2O_4 + H_2O$. If "W. R. S." wishes to prepare potassium oxalate for photography, the following mixture will give him at once a solution ready to use: Carbonate of potassium, 1lb.; oxalic acid, 12oz.; warm water, 3 pints. Place the carbonate of potassium in a good-sized vessel and add the warm water in which it is readily soluble. When all is dissolved add by small portions the oxalic acid, waiting after each addition till all effervescence has ceased before putting any more; otherwise you will make the liquid boil over. When the whole of the oxalic acid has been added the solution will be ready for use. Potassium oxalate is sold at 1s. per pound. Is it worth making?—COPPER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

62375. Eight-Wheel Rolling Stock, p. 256.
62378. Medical Battery for Neuralgia, 256.
62403. Speeds for Crank Shaft, 257.

62552. V-shaped Leather Band, p. 352.
62555. Four-Section Induction Coil, 352.
62560. Tap for Wooden Chuck, 352.
62562. L. and N.W., S.E.R., and G.N. Engines, 352.
62567. G.W.R. Slip Arrangement, 352.
62572. View Lens, 353
62581. Engine Query, 353.
62583. Dynamo Design, 353.

QUERIES.

[62800.]—**Neutral Solution.**—I have a solution of zinc sulphate decidedly acid to test paper. How can I render it neutral? I have added heaps of common magnesia, but paper still reddens. I have tried ammonia but it precipitates the zinc oxide while the liquid yet shows acid. If there is free H_2SO_4 why will it not combine with magnesia? On the supposition that the acidity was from CO_2 in solution I tried boiling without success. No better luck in treating acid chloride of zinc with magnesia. What am I to do?—WEALD.

[62801.]—**Dynamo.**—TO MR. BOTTONE OR MR. EAVES.—Having constructed the framework of a dynamo ready for wiring with six-cogged laminated armature, diameter over cogs 5in. by 5in., cogs ⅝in. by ⅝in. deep, and wishing to wind same shunt for incandescent lamps. I should feel obliged to you for a little information in regard to winding same. I propose to use silk-covered copper wire, No. 18, for armature. What precaution should be taken to insure thorough insulation of same? Should I use shellac varnish to each layer of wire or, how? The field magnets are made of rectangular wrought-iron, 8in by 5in. by 1in. with annealed cast-iron pole pieces bored out to 5⅜in. What quantity and size of d.c.c. wire should I put on each, and how wound to insure insulation? What volt-ampère capacity should such machine have when finished, granting same fairly well-made, and what No. of 20c.p. lamps should it light well?—TRY.

[62802.]—**Heating Small Greenhouse.**—Will some of "ours" kindly inform me the cheapest and most efficient way to heat a small greenhouse, 10ft. by 5ft. 6in. by 8in., with paraffin? Would a small stove, say 3s. 6d. size inclosed and with a 2in. metal pipe through the roof to take away the deleterious products of combustion be sufficient to keep up a temperature of say 50° with 5° or 6° of frost outside. Probable cost per day of 24 hours would also oblige with oil at 8d. per gal.—E. S. H.

[62803.]—**Yellow Lacquer for Gunmetal.**—Would anyone please tell me of a lacquer to make gunmetal look like yellow brass and how to apply it?—A. W. M.

[62804.]—**Electric Burglar Alarm.**—I am desirous of protecting a bow window, and shall feel very much obliged if some of my fellow-readers would help me in the matter. I may mention that I am familiar with the usual forms of contact; but what I require is some simple form of contact easily attached to the surface so as to save fitting, and thus do as little harm to the property as possible.—H. E.

[62805.] — **Screw Thread.** — Will some of our readers inform me how many cuts are required to cut a ½in. pitch square thread screw on a 1½ round bar, and the best slide-rest tools to use? Also how to cut a cast-iron boss for the above projecting about 9in. from face-plate, or would it be better to cut with a boring bar on saddle? If so, give particulars. Also how to surface by hand and the best tools to use.—A BEGINNER.

[62806.]—**N.E. Compound Engine.** — Will some railway correspondent please give dimensions and particulars, with sketch, of the compound passenger engine on the N.E.Ry.? Are there more than one of this class, and if so, how are they found to answer in practice as regards economy of fuel and time-keeping with average or exceptional loads? As the question of compound locomotives is now receiving some attention, any reliable information about Mr. Worsdell's engines both on the G.E.R. and N.E.R. as being representatives of the two-cylinder compounds may prove interesting.—EAST COAST.

[62807.]—**Condensing Milk.**—Could any brother-reader kindly give detailed information on this subject? Also what plant would be required, and about the cost, to make a trial in a small way?—NEW ZEALAND.

[62808.]—**Cleaning Stone Floor.**—What is the best and quickest means to clean the stone floor of a weaving shed which has been occupied for a long period, but is now empty. There is a considerable accumulation of china clay, oil, and other refuse which is formed into a dry hard mass, and has become firmly fixed to the flags.—QUERIST.

[62809.]—**Partial Paralysis from the Knee Downwards.**—Will "Eos" or any of "ours" kindly say if there is any cure for the above complaint, and if so, what? An answer will oblige a sufferer.—HOPE.

[62810.] — **Iron Washing Boiler.** — Can any of "ours" inform me how to keep an ordinary washing boiler from going rusty? I have tried greasing, white-washing, &c., but that does not seem to improve it in the least. I think the metal is too soft. Any hints will oblige.—SHALE.

[62811.]—**Water Supply.**—I want to draw water from a river, 150 yards away up a gradual rise of about six feet, in iron pipe one inch bore, and then force the water into a tank 30ft. directly above the pump. Will the pipe require a back pressure valve at the river end of it? And will a simple barrel pump, 3in. bore and from 6in. to 7in. throw, do the work?—WATERLESS.

[62812.]—**Chronograph Governor or Double Conical Pendulum.** — Will some of "ours" please describe, with sketch if possible, the best construction of the ball governor or double conical pendulum to regulate the rotation of a chronograph in the most perfect manner. The drum of chronograph will be one foot diameter, and rotate once every sidereal minute. Best way of applying the friction and the regulation of speed are points I should like made clear. Also some idea of size and best speed governor. The machine will be somewhat heavily built, but can apply any amount of driving weight.—CHRONOGRAPH.

[62813.]—**Engine Queries.**—Will "T. C., Bristol," "Elag," or any other correspondent be so kind as to answer the following? 1. Steam enters a surface condenser at a temperature of 142° F., and is condensed into water at 120° F. How many pounds of circulating water which enters 60° F. and is discharged at 100° F. will be required for every pound of steam condensed? 2. In a Giffard injector if the volume of 1lb. of steam in a boiler be 3·6 cubic feet and the volume of 1lb. of water be ·016 cubic feet, compare the velocities at which steam and water would respectively issue from the boiler, and infer the kinetic energy of steam and water issuing under these conditions in the same time from equal orifices in the boiler. 3. Investigate an expression for the efficiency of a heat engine working in a reversing cycle. Give an example of a cycle which is not reversible. 4. Is it absolutely necessary for one going in for Honours stage in steam and mechanics, should have a knowledge of Euclid and geometry, or is mathematics quite sufficient? I have managed so far with slight knowledge of mathematics, but none of Euclid or geometry. Your advice, or from any reader, will be heartily accepted.—ENGINE ATTENDANT.

[62814.]—**Thermopile.**—Many thanks to Mr. Bottone for his explanation of the thermopile. I shall make a large one if it will do what I require, but I should like a little further information. I want it to light a 10c p. 6 or 8 volt battery lamp (Shippey's) in parallel, so that by regulating the heat I can run one or more lamps up to 4. Will you kindly say how many circles of castings (36in. each circle) I shall want to do this? I propose to heat it by Bunsen gas-burners. Could you say what quantity of gas it will require per lamp per hour? Is each circle of castings separated from the rest by a layer of cement? Should I use thick or thin tinned iron? Will they hold sufficiently to the casting, or should some holes be drilled in them for the metal to run through? Will the castings wear out in time? Can you tell me the probable cost of castings per casting? Is it advisable to let the flame touch the castings or not? Could not the top ring be made solid (without the hole in the centre), so as to retain the heat? Can you tell me where to obtain the antimony and zinc, and the price per pound of each?—THERMOPILE.

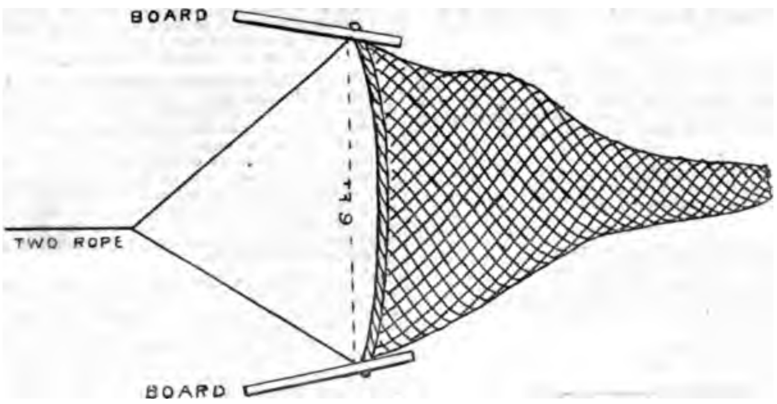
[62815.]—**Tumbling Barrels.**—Is the grinding action of this process a result of friction or of concussion. The only two instances of its application come under my notice are for polishing small malleable iron castings in Wolverhampton, and for reducing the moulders' blacking; in the latter case iron balls were put into the barrel. What gave the name of tumbling to the machine? What should be the speed in feet per minute? I see that a butter churn is exhibited at the R.A. show, the revolving barrel of which is triangular. The action of churning or admixture of the cream with the air being in this case the result of a tumble of the whole or part of the cream For grinding purposes would this shape be better than a cylinder? What is the roller and sifter method which is driving away the present grinding of wheat by mill stones out of Great Britain?—ARCHIBALD FRY.

[62816.]—**Electric Bell.** — Will some electrician kindly explain? I have an electric bell connected by single underground insulated wire between two houses about 200 yards apart, bell at one end, and three large Leclanché batteries at the other end, current being returned by the earth. It ceased to work, and I attributed failure to extreme dryness of earth at present season. I ran a loose wire on surface of ground and on making connections (with metal circuit both ways) the bell rings properly. But if the wire is cut, and the ends put within an inch or two of each other, into a bucket of water, the bell will not ring. Why not? If efficient return of current by earth depends on moisture (and will act for 200 yards), should not two inches of actual water convey the current from wire end to wire end, or where else am I wrong?—T. F. S. T.

[62817.]—**Book-rest.**—TO "SILKE."—Could the useful contrivance figured on p. 367 be so modified as to admit of 1. Its use as a small narrow table for writing or for use with the microscope. 2. The legs being raised or lowered and of folding under so as to pack into a small space. 3. The book-rest forming part of the table top, and, when flat, capable of being used as part of it, and 4. The book-rest being of sufficient strength to allow of large books, such as Ency. Brit., being used. A sketch of a book-rest modified as above would be useful to the writer and probably to many of our readers.—B.

[62818.]—**Book Case.**—A sketch would oblige of a convenient case in which to keep the Ency. Brit., and which will admit of their being carried in the same case. Having regard to the number of vols. probably two cases would be better than one. The case to be substantial, convenient for use when at home, sufficiently presentable to admit of its being allowed to accompany its owner into furnished apartments, and strong enough to answer as a packing case. Probably to keep the books free from damp the case should be tin-lined. Such a case must be much wanted by clergymen and others as well as by—B.

[62819.]—**Drums.**—What kind of skins are used for large and small drums? How are they unhaired and what is the method of preparation to give them that loud ringing clearness of tone when struck, and that transparency indicative of properly prepared ends? What kind of skins are used for vellum? How are they prepared? Can it be prepared, or manufactured on a small scale without expensive plant? Please say how it is done. Is there any work published giving instructions on above-named? Price and name of publisher will greatly oblige.—TIMBRE.



[62820.]—**Trawl Net.**—I am making a small trawl net, 9ft. beam, for use with a steam launch, and do not want to be encumbered with the usual beam. I have heard that by the aid of two boards placed on edge, (as per sketch) the beam and iron runners can be done away with. If so, would someone who knows kindly give the particulars for constructing same with position of ropes, &c. Is this correct in detail?—ROLANDO.

[62821.]—**Removing Hair from Skins.**—Will Mr. Bottone, Mr. Allen, or some other chemist who reads the "E. M." inform me how to take the hair off skins without lime, and also without damage to, or weakening the skins?—TIMBRE.

[62822.]—**Sugar Boiling.**—I should like to understand the general management of a large copper sugar boiling pan, or vacuum pan, as they are called, with separate pumps attached. What are the necessary things an attendant has to do? Also what is the cause of copper pans collapsing as they do sometimes?—ONE WISHING TO LEARN.

[62823.] — **Fret-cutting Machine.** — My fret-cutting machine, which worked as an adjunct to my lathe, being worn out, I am desirous of getting one of the very best construction. Will some of the readers of "Ours" kindly help me with their advice? The subject has been referred to many times in back numbers, but, no doubt, some modern machine may be better than any described therein. The saw must work vertically and without the slightest unsteadiness or side shake, as it will be used a good deal for piercing metal. Are any of the machines that work separately first-class?—FAL.

[62824.]—**Pinhole.**—I tried the pinhole photograph, but found it was not at all clear, but looked like a picture out of focus, all fuzzy, but all there in outline. Can anyone tell me the reason? It says last week that they are always in focus. I gave it 40 seconds on an Ilford plate, and it seemed to develop all right. The pinhole was made through a piece of card with an ordinary household pin.—J. P., Hull.

[62825.]—**Glaze Wheels.**—Will any of your readers refer me to a page in a back volume where I can find directions for making glaze wheels, or, perhaps, as such information would be useful to many, give directions for their construction?—ILAB.

[62826.]—**Organ Pipes.**—Why should some stops be made of metal, and others of wood, when theoretically it is only the vibrations of the air that produce the sound?—ESUD.

[62827.]—**Violin Soundpost.**—Whereabouts should the soundpost be placed, and should it be a solid post glued in?—INUD.

[62828.]—**Camera without Lens.** — Would S. Bottone, "B.Sc., Plymouth," or any other correspondent, kindly give in "Ours" complete instructions for making above? Also the requisite material and mode of operations for taking photographs with above. The above request would be greatly appreciated by many like myself whose means are limited, which prevents us obtaining expensive apparatus.—POOR LAD.

[62829.]—**Boiler Scale.**—Will any correspondent give me a recipe to remove or soften the black crusty scale on boiler plates of portable engine firebox end? I want to clean and japan it.—MIKADO.

[62830.]—**Legal.**—I am paying £50 a year for premises I hold for manufacturing purposes. For the Queen's taxes they assess me at £60. My landlord will not allow me more than on the £50, the actual rental, and tells me the rating is illegal. Will some one who knows tell me how to get this altered?—HOUSEHOLDER.

[62831.]—**Midland Engines**.—The other week I saw a notice in a Sheffield paper that the M.Ry. had turned out some fine single engines, with driving wheels of 7ft. 6in. diam., and a leading bogie. As single engines on the M.R. have not been in vogue lately, some further particulars and sketch would be acceptable. — EAST COAST.

[62832.]—**Bending Zinc Tubes.** — Can any of "ours" inform me how to bend round zinc tubes similar to the handles on French zinc jugs? I have tried several ways, but cannot succeed. If anyone can help me they will oblige.—A TINMAN.

[62833.]—**Photographic Rolling Press.**—Will some correspondent kindly give a drawing, details, and dimensions sufficient to work from of a photographic rolling press, that will take in whole-plate prints?—AN EXILE.

[62834.]—**Heat and Light.**—Can any of "ours" say whether heat would be reflected from a white object in the dark? I cannot see that it would be, without the assistance of light.—ALOIN.

[62835.]—**Telephone Switch.**—I have a telephone in my room downstairs. Can any of the readers of "Ours" *tell me how to* switch on a wire to ring a bell at my bedhead in the night? Will an ordinary electric bell do? What kind of switch will be needed?—FIREMAN.

[62836.]—**Repairing Sofa Springs.**—Will any of our correspondents tell me how to proceed to take out the bottom of a sofa, so as to readjust the springs, as they have got loose at the top, and are leaning down a good bit?—YOUNG JOINER.

[62837.]—**Current Break.**—Could any reader tell me the reason of the hammer of my coil being so unsteady in its vibrations? Sometimes it hammers away and then gets faint or stops altogether. I use the bichromate cell. —REDHILL.

[62838.]—**Siemens Armature.**—Would any reader be kind enough to give me any information how a Siemens armature is wound, where the spindle is a continuation of the centre web piece which runs through the armature? It is not a laminated armature.—W. ROBINS.

[62839.]—**Legal.**—A house in the main street of our village having no back door, so that all the refuse of the house has to be carried out the front, and past several houses, through a lobby, then down the back side of the same houses before the tenant can reach her own w.c—the said house having 290sq.ft. of land at the back. The landlord, wishing to build a back kitchen to the said house, sends in the plan; the kitchen will take 80sq ft., and the amount of land required to be left by the local board is 150sq.ft., the plan has been in three months, and nothing has been heard. If, therefore, I commence operations while the fine weather lasts, can the local board legally interfere?—ALEXANDER.

[62840.]—**Softening Leather.**—Would any reader tell me how I can soften best butt leather, so as to press it into cup shape, such as for pump buckets, &c.? I fail to get it soft enough by steeping in cold water, and in consequence the bottoms give way in pressing. Also how to keep shape, and what liquid dressed leather cups are treated with, that render them so hard. I have seen them like boards, but exposure in the sun makes them quite soft.—CIT.

[62841.]—**Parrots.**—Can any of the readers of "Ours" give, from actual experience, hints for the fullest development of the talking powers of parrots? I have a young grey parrot which I purchased as a talking bird. It will say with tolerable distinctness, but with a marked whistling lisp, "Who are you?" "Pretty Poll," and "Pass," but I do not succeed in making it say fresh words or speak in a natural voice. Advice from competent authorities will doubtless be valuable to others besides—GRADUATE.

[62842.]—**Storm Warnings.**—Why do the sewers give off their bad stinks so much more perceptibly a few hours before it commences to rain, after having a run of dry weather, and what is the cause of the peculiar indigo colour in the electrically inclined clouds at this period? Is the electricity actually floating with them, or does it make its appearance just previous to a discharge of same?—A., Liverpool.

[62843.]—**Petrolatum.**—What is petrolatum? I have seen it recommended as a perfect reviver of a silk hat after it has lost its gloss from rain or other similar cause. Its mode of use is simply to put the petrolatum on a silk handkerchief and to smooth down the silk nap with the handkerchief, and to wipe round the hat until it is dry and smooth. Before applying the petrolatum, the hat should be well brushed to free it from dust. After dressing as above, it is said, a hat looks as well as new.—M. A., Dublin.

[62844.]—**Charging Secondaries.**—TO MR. S. BOTTONE.—Will you kindly say how many secondaries one of the 150c.p. Gramme dynamos (same as described in your pamphlet) would charge for regular lighting? I have been told 22 would be the best number, but feel doubtful. Also please say if the dynamo in question would run six hours without injurious heating—the armature not being laminated?—E. E. B.

[62845.]—**Noisy Organ Bellows.** — In a small organ the bellows reservoir when filled and left to descend very slowly (the blowing lever being firmly held) makes a sort of slight creaking or ticking noise. One feeder also, when worked very slowly makes a similar noise in the feeding stroke—not in returning. The noises are not in the actions. I should be very glad to know the cause and a remedy.—S. O.

[62846.]—**Zeuner's Slide-Valve Diagram.**—Could "T. C., Bristol," or any other of our able correspondents give any information on the above, explaining their practical use? And also say if there is any publication that treats on them, and oblige.—J. C. T.

[62847.]—**Trumpeter Clock.**—Can any one of "ours" instruct me how to make a trumpeter clock, the figure of which emerges from a pair of folding doors, and plays a fanfare and series of flourishes at hours and half-hours? —CHAS. F. FIRTH.

[62848.]—**Red Bronze.**—Can any reader kindly inform me how nitrate of iron is to be applied in red bronzing?—BRONZEY.

[62849.]—**Test for Arsenic.**—What is a simple test for arsenic that anyone can use to satisfy himself as to its presence in, say, wall paper?—M. M. S. G.

[62850.]—**Tar Pavement.**—Can anyone give me directions for making tar pavement and paths? I have plenty of tar and shell gravel.—I. A. O. G.

[62851.]—**Polishing Pebbles.**—Can any reader tell me how to polish pebbles?—L. N. M. B.

[62852.]—**The Polmaise System of Heating Buildings.**—Can anyone tell me what this system of heating is?—L. A. U. E.

[62853.]—**Siamese Temples and Lightning.**—Can our friend "Kos" give us any description of Siamese temples? I read, in a London paper, that in Siam the temples are very high, and "shaped nearly in the form of an inverted (?) cone," and that the lightning, which is "very severe" there, has never been known to strike one of these buildings. What shape are Siamese temples, and what sort of lightning do they have there?—J. T.

[62854.]—**Dynamo.**—TO MR. BOTTONE.—1. I have made a dynamo according to your directions—or, rather, the castings for F.M.'s—but I am afraid they are too hard. Can you tell me how to soften them sufficiently, as there is no malleable casting done here? 2. Would it be an advantage to have pole-pieces cast, and F.M. forged out of wrought-iron and screwed on?—W. J. HOVERD, Wellington, N.Z.

[62855.]—**Electric Bell.**—TO MR. BOTTONE OR OTHERS.—1. I have to fix an electric bell to ring upon anyone treading on doormat. Could you give me drawings, as how to arrange contacts, &c., so as to cease ringing as soon as the person is off the mat? 2. Upon pressing contact in room in which there is a bell and indicator in circuit, I have to press for several seconds before the bell rings. Could you tell me the cause of it? The battery is about 40ft. away.—W. J. HOVERD, Wellington, N.Z.

[62856.] — **Boiler.** — TO "T. C., BRISTOL," AND OTHERS.—I should be pleased if you would give me instructions how to make a boiler suitable for a ½H.P. engine—either a conical flue, or with tubes, size of safety-valve, and other details, as being an amateur it will be a great help to me.—W. J. HOVERD, Wellington, N.Z.

Evolution and Idealism.—Evolution must be regarded as having completely abolished Berkeleyan idealism. If the external or objective universe is only subjective, the evolution of that universe must have been a reflection of that of mind; but as minds have been, and are, in various stages, at any given period of the history of evolution, there must have been many universes at one and the same time. Consider for a moment the metaphysics of the barn-yard. The various domestic fowls, and the mammalia, cat, dog, pig, ox, horse, &c., must each be the author of a different objective environment, all differing from that of man. But the environment is believed by evolutionists to be a very important element in the development of mind. If, however, the environment is the product of mind, there has been no antecedent environment, as understood by evolutionists. These two absurdities must prevent any consistent biologist from being an idealist in the Berkeleyan sense. The services of evolution in explaining the so-called innate ideas have been shown by Spencer to be very great. Innate ideas are seen to be inherited ideas, or the function of inherited structure; but as evolution requires also acquired ideas, the field of controversy between the intuitional and experiential theories is narrowed to these. Evolution stands on the experiential ground; not but that there is some axiomatic truth which the developed human mind is able to grasp without more experience than that necessary to a statement of the proposition; but without evolution by experience, man would never have acquired the power necessary to do this.—E. D. COPE, in the *American Naturalist*.

Preserving Leather.—Most leather articles while in use require the periodical application of a preservative varnish to give them a finished appearance, and protect them from decay and surface wear. Such varnishes go by various names—e.g., "dubbing," "gloss," &c., but are most commonly known as "blacking," being usually intended to give a black polish. Blacking is a pasty compound used specially on the uppers of boots and shoes. There are numerous methods of manufacturing this substance, but nearly in all the base is a black colouring matter, usually animal charcoal, mixed with substances which acquire a gloss by friction, such as sugar and oil. The carbon employed should be in the form of a very deep, finely-powdered black. Since it always contains lime, carbonate and phosphate, it is treated with a mineral acid in order to decompose these salts; a mixture of sulphuric and hydrochloric acids is frequently used, the salts produced being lime, acid, phosphate, sulphate, and chloride. The lime sulphate gives consistency to the pasty mass, and the two other salts being deliquescent help to keep the leather flexible. No more acid should be used than is sufficient to decompose these salts, or the leather will be destroyed. It is probably to prevent this that some makers add a small quantity of alkali to the blacking. Sometimes powdered gall-nuts, iron sulphate, indigo, and Prussian blue are incorporated with the blacking in order to impart to it a good colour.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, July 20, and unacknowledged elsewhere :—

REV. J. O. MAHONY.—J. E. B., Leeds.—Rosario.—Nomoplax.—Quæsitor.—Orderic Vital.—Incog.—Weald.—J. R.—D. Doyle.—Zema.—W. R.—E. L. G.—W. J. R.—S. Bottone.—A. Fellow of the Royal Astronomical Society.—J. S.

H. A. (A good cement for uniting leather and brass is Pront's glue or tire cement; but the metal must be made hot enough to melt the cement, and the leather must be worked down with a warm iron. The usual cement is good glue, to which a little gum ammoniacum and nitric acid have been added. The proportions are 56 parts glue, 3½ parts of gum ammoniacum stirred together to an even mass. When removed from the fire 3½ parts of nitric acid are gradually incorporated, and the cement is ready for use.)—EDWARDS B'HAM. (The question has been frequently answered. Clean them with a little spirit, and expose to sunlight under glass. To prevent them going yellow, leave the instrument open in front of a window while the sun is shining.)—ANXIOUS. (How can we tell? If by 2 you meant two copies or two articles, then the word should be "of.")—J. H. G. (Look on p. 461, last week, and refer to pp. 320, 436, Vol. XLII.)—H. V. B. (The new electric gaslighter was described in No. 1033, p. 403. It is patented, No. 5992, 1883.)—G. HARGEST. (It is all right; but the description is too glowing and rather too depreciatory of the battery. Most of the dealers can supply magneto-electrical bell arrangements.)—JOBBING PHOTOGRAPHER. (Why not procure one of the cheap handbooks published by Piper and Carter, 6, Furnival-street, E.C.? You will find much information in back volumes, and most of the dealers in photographic materials will give you sufficient instruction to start in that way.)—BARNSLEY. (The "blacking" or polishing liquid to which you refer is really a preparation of shellac. Here is the patented recipe. Dissolve 2lb. of shellac in one gallon of methylated spirit with 6oz. of camphor, shaking well; then add 4oz. of lampblack, stir, and add 2oz. of Prussian blue finely powdered. Strain the whole, and put into bottles stoppered or tightly corked.)—OLEO. (If you really desire to make your own French polish, procure 3oz. of shellac and ½oz. of benzoin; crush them up small, and put into a bottle with a pint of wood naphtha. Shake well, and place in a warm (not hot) place. Agitate frequently; when dissolved it is ready for use. 2. As it may be useful to others, we give a recipe for making ginger-beer. Take 1oz. of good unbleached ginger, well bruised, 1lb. of lump sugar, ½oz. of tartaric acid, and one gallon of boiling water. Macerate in a covered vessel until it is barely lukewarm, and then add about 2oz. of yeast. Keep in a moderately warm place for a day or two until a brisk fermentation has set in; then decant and strain, allow it to work for another day or two, then skim and put into bottles, using good corks, wired or tied down.) J. BURNS. (By no means at all. A temporary mixture can be made with the aid of soft soap and violent agitation.)—AN AMATEUR. (You had better procure proper lenses, and not attempt to grind those you have with pumice-stone. That is rather a novel treatment, and it is scarcely to be expected that they should be clear. Full directions have been given in back numbers, even so recently as pp. 349, 394, of the last volume.)—CONSTANT READER, Kidderminster. (Yes, there is such a book, and a review of it appeared on p. 443, No. 1061. We believe it is now published by Whittaker and Co., White Hart-street, Paternoster-square, E.C. The price was 8s. 6d.)—STEPHEN WILLIAMS. (That is merely an article in a cyclopædia. Perhaps the best work of the kind is Davis's "Complete and Practical Treatise on Manufacturing Bricks, Tiles, Terra-Cotta, &c.," published by E and F. N. Spon, 125, Strand, W.C., price 25s.)—W. J. FORD. (We have given the graph composition many times in this column. It is "1 part glue, 4 parts glycerine; whiting to colour." As you want to print 1,000 copies, why not try the cyclostyle or the trypograph. In the former a little wheel makes holes in a piece of prepared paper, which is used as a stencil, and ink driven through the holes; in the latter the prepared paper is laid on a piece of half smooth file, and the writing done with a steel style, thus producing perforations.)—W. J. G. (There is no "oscillating motion" in the question. See some textbook, or Proctor's "Seasons Pictured," published by Longmans.)—A. R. D. (Benzine to remove grease; and carbonate of ammonia dissolved in warm water for cleaning generally; but it will not altogether take the shine out of your coat.)—A JUVENILE. (The rubber is not dissolved, but masticated with sulphur and vulcanised in plaster or other moulds with the aid of steam, which supplies both heat and pressure.)—PHOTOGRAPHY. (Write J. Lancaster and Son, Colmore-row, Birmingham.)—BUTTON. (There is no solution at all. The buttons, as you call them, are indiarubber, and adhere to the glass just as a boy's sucker adheres to the pavement.)

A New Washable Truss.—An Important Invention.—Harness Xylonite Truss is the most perfect appliance ever invented. It gives complete comfort and support without irritation. It has a beautifully smooth, flesh-coloured surface, and is guaranteed to last a lifetime.—Address: MEDICAL BATTERY COMPANY (Limited), 52 OXFORD STREET, LONDON, W.

USEFUL AND SCIENTIFIC NOTES.

Power Required for Flour Mills.—There is a wide diversity in the opinion and practice of millwrights as to the power necessary to drive a modern-built mill on the roller system with the numerous paraphernalia. The old rule of 15 horse-power per run of stone does not apply, and no sufficient numbers of tests have been made to demonstrate conclusively what may be adopted as a general rule. The American *Milling Engineer* says: We have made several careful tests, in order to settle the question, if practicable, within comparatively narrow limits, and have noted other tests. The range so far found has been from 0·5 horse-power per barrel of daily capacity in small mills to 0·35 horse-power per barrel in mills of 250 barrels and larger capacity. These figures we know to be accurate in so far as the individual mills from which they are obtained are concerned, and we believe them to be a safe guide to follow. Yet, in a recent conversation with a prominent mill builder, he remarked that he could not understand how so much power was required, as he invariably used smaller engines than his competitors, and had no trouble. While this may be true, it does not follow that the use of the smaller engines had been profitable for his customers. The rated horse-power of steam-engines, especially automatic engines, is no criterion by which to judge the power developed in use. In an automatic engine, the power developed varies with each change in the load; and if the load increases, or is larger than the rated power of the engine, the power developed will increase, limited only by the conditions of speed of piston and boiler pressure. Take a Corliss engine, for example, rated at 100 horse-power, with steam at 80lb. boiler pressure, and cutting off at one-fifth stroke, and running at 80 revolutions. This engine, according to the recorded tests, would drive a 250 barrel mill under the above conditions. It will also drive a mill of double the capacity, provided the speed or boiler pressure, or both, be increased, or the point of cut-off be carried along to one-half stroke, with the engine every other revolution taking steam full stroke; but when it is doing this, it is developing more than 100 horse-power, and is not doing it economically. If the speed is increased, the engine will wear out quicker; if the boiler pressure is increased, the strain and consequent wear and tear on the boilers will be greater; and if speed and boiler pressure be kept the same, the engine will work nearer like a slide-valve, and the advantage of working the steam expansively will be lost in great measure, with a consequent loss in economy in fuel.

The Lemon Decoction in Malaria.—This remedy has, besides its anti-malarial efficacy, distinct value as a tonic to the stomach. Its preparation is thus given by Dr. Tommasi-Crudeli, who first introduced it to the profession:—Take a fresh lemon; cut it into thin slices, rind and all; boil it in three tumblerfuls of water in an earthen pot which had not been previously used for culinary purposes; prolong the boiling till the liquid contents of the pot have been reduced to one-third—that is, to the volume of one tumbler. Pass the decoction through muslin, squeezing out the residue of the lemon, and let it cool for several hours. Let the whole be taken in the early morning, fasting. "The drink," adds Tommasi-Crudeli, "is rather bitter, but not distastefully so; it is easily taken by delicate women and children, and when it has reached the stomach it induces the pleasant sensation peculiar to tonic remedies." Its use is especially indicated in the tropics.—*Lancet.*

Soldering Aluminium Bronze.—There is at present one great drawback to the use of aluminium bronzes for small manufactured articles—the difficulty of soldering. There is now no cheap and simple method of brazing aluminium bronzes, and they cannot be welded. Pieces, however, can be, Mr. E. D. Self writes, united by the following jeweller's solders: Hard solder for ten per cent. bronze, gold, 88·88 per cent.; silver, 4·68 per cent.; copper, 6·44 per cent. A middling solder for 10 per cent. bronze, is gold, 54·40 per cent.; silver, 27·60 per cent.; copper, 18·00 per cent. A soft solder for aluminium bronzes in general is made by adding brass to the ingredients already given, thus: Brass, 14·30 per cent.; gold, 14·30 per cent.; silver, 57·10 per cent; copper, 14·30 per cent. The brass is composed of copper, 70 per cent.; and tin, 30 per cent.

GIVEN GRATIS to all—I wish to inform all suffering people on the face of this earth, that I, Gould, E. B. P., of Bradford, have for some time past and am now giving the Hop prescription for Bitters to all applicants who send a stamp for postage. Anyone in possession of this valuable prescription can for 8½d. make a bottle of this world-renowned medicine the size of the one usually sold at 2s. 9d.; and for 1s. 5d. can make the 4s. 6d. size. It may be interesting to learn that with this prescription all kinds of hopeless cases have been treated with success when all other remedies had absolutely failed. People who have been partly paralysed, have been relieved or cured with this prescription, others have had their reason restored, others their sight; people who could not sleep have had their sleep restored, others who could not eat have had their appetite restored; people who had suffered for years with indigestion and its consequences have had their digestive powers restored; people who have suffered martyrdom with disordered liver, nervous debility, &c., have been cured; people subject to an accumulation of wind and water have found it disappear under its influence. A gentleman at Lincoln subject to fits fortnightly has not had a fit from the first moment he began taking it. People troubled for years with constipation have had their bowels become regular under its influence. It is a choice, rare, remarkable remedy. The prescription is simple, it is cheap, it is good. Those who haven't sent for it, should. It will be found safe, sure, and reliable in almost all ailments incident to the human frame. It is a tonic, alterative, and an aperient combined of marvellous curative properties. These important facts may seem incredible; but it has done far more than is here claimed for it, proof of which is sent with each Prescription. Thousands are blessing the day the Hop Compound for Bitters fell across their path, and it is given absolutely free of charge to all applicants, rich or poor, who send a stamp for the postage of the same. A mode of self-treatment at home has been a long-felt want by all well-regulated minds, and will be found exceedingly advantageous to sensible persons who desire to know what they are swallowing. How many of the suffering poor there are on the face of this earth struggling hard to buy medicines, with the hope of being restored to a sound state of health, and whose eyes have been opened to bitter dissappointment. They have tried one remedy, then another, none do them any good; and why? because the principal ingredient of many of those patent medicines may be termed the NEWSPAPER ADVERTISING (?).—Address Mr. Gould, E. B. P., 21, Clough Street, Birch Lane, Bradford, Yorks. When writing name this paper.

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Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 4d. each copy, to cover extra postage.

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Advertisements must reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

Holloway's Pills correct all irregularities and weaknesses. They act so kindly, yet so energetically, on the functions of digestion and assimilation, that the whole body is revived, the blood rendered richer and purer, while the muscles become firmer and stronger, and the nervous and absorbent systems are invigorated.—[ADVT.]

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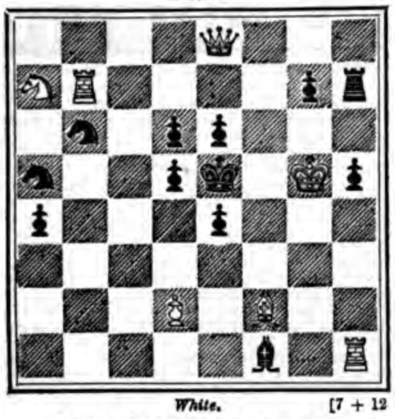
ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MLIV.—BY A. F. MACKENZIE (from his recent work).

Black.



White. [7 + 12

White to play and mate in three moves.

SOLUTION TO 1,051.

White.	*Black.*
1. Kt-Q 5.	1. K takes R.
2. Kt-Q 4.	2. K-B 4.
3. K-K 5.	3. P mates.

IN 1,053 a B P should be at Q-Kt 3 and W P at Q Kt 5.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,051 by Hensing, H. Hosey-Davis, Black Pawn, I. M. Brown, T. H. Billington; to 1,050 by T. H. Billington, Black Pawn, H. Hosey-Davis (very clever position of extended two-move order), J. J. Spence and Hensing (a good problem, though key move inartistic).

I. M. BROWN.—The competition closes with 1,052, as 1,047 did not count on account of its having been published before.

A. DEAN.—In your attempt at 1,050 you appear to have overlooked that 1. $\overline{\text{Kt-K 4}}$ gives (ch) to W K.

WE propose offering the following prizes for those who score the most solution marks in the course of four consecutive months. 1. Mackenzie's "Chess," (value 10s. 6d.). 2. Long's "Peeps at the Chess Openings." 3. Baxter's "Problems." 4. Gossip's "Theory of Chess Openings." 5. "The Problem Art." 6. "Chess Annual," by R. Bland. The following are the conditions: (*a*) There must be at least twelve entries. (*b*) None who have won first prizes in the tourneys just concluded can compete. (*c*) The problems will include two and three-movers only. For this tourney there will be no entrance fee.

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Complete set of **Double Engine Castings**, 2H.P. Cylinders bored and turned, valves fitted. Stamp.—E. A., 2, Alexander-road, Knaphill, Woking.

Dynamo, laminated armature, 4½ by 5½, splendidly made machine, good as new. Exchange. Photo.—E. THORNTON Handpool-road, Barrow-in-Furness.

Cornet, by Wallace, new, two mouthpieces, and case complete, cost £4 4s. Exchange 50 or 52in. Bicycle, or cash offer.—JOSEPH BLAND, Hackenthorpe, near Sheffield.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Estab. 1862.

Mr. With will exchange an exquisite 8½in. **Speculum** for a Browning's 2in. spark Induction Coil, and Bichromate Battery.—The Laboratory, Hereford.

Perambulator Fittings.—Lot of Rubber Wheels, Springs, China Handles, Hood Joints, Rubbers, Bodies, Iron work, &c., for exchange.—LOWE, 86, Kirkwhite-street, Nottingham.

Fletcher's Patent **Gas Furnace**, with two 12lb. pots, bow tongs, casting ring and burner, complete. What offers? Value £2.—A. HANESWORTH, Lyndhurst-street, Bolton.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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"**Beginner's Guide to Photography**," one shilling. Free from abstruse technicalities. Retail of Opticians and Booksellers.

Lathe Castings, &c.—See T. Taylor's advertisement in ENGLISH MECHANIC every other week. Established [illegible].

For improved **Leclanche Batteries**, Bells, Wires, and Fittings, best make, apply, FOWLER, LANCASTER, and Co., Birmingham.

Fowler, Lancaster, and Co., Birmingham, manufacture all Electric Apparatus. Best workmanship only. Lists on receipt of postage.

Trouser Lengths, 5s. Cheap Cloth for Ladies' dresses, jackets, boys. Patterns free.—HEWITT, Winfield Mount, Leeds.

Second-hand **Lathes**, Drills, Planers, &c. Send 2 stamps for list.—BRITANNIA Co., Colchester.

Notice.—Our new address is—100, Houndsditch, London. All letters to BRITANNIA WORKS, Colchester.

We are **Bona fide Makers** of upwards of [illegible] varieties of Engineer's Tools, and constantly adding.

New Inventions or Models of Patents exhibited. Patents disposed of.—BRITANNIA CO.

Prize Medals and repeated orders from the British and other Governments attest the standard quality of our tools.—BRITANNIA Co., Colchester.

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Brass Castings of Model Engines of all classes, in sets or otherwise. These castings are the best in the trade, and have obtained the highest testimonials from amateurs and others in all parts of the United Kingdom for cleanliness of moulding, ease in finishing, and correctness of detail and design; being models of engines of modern construction. Boilers supplied of every type to suit the above from stock or to order. Fittings of all kinds, feed pumps, governors, safety valves, steam gauges, water gauges, &c. Comprehensive price list, post free, two stamps.—LUCAS and DAVIES, 21, Charles-street, Hatton-garden, London.

Eyes in the back of your Head! Spectacles to see behind. Genuine. Improve appearance. Suit anyone. By post, 1s. 2d., from R. GALLAND-MASON, Proprietor of (below)

The "Hambleton and Clifton" Promenade, DOUGLAS, Isle of Man, recognised house for photographers and cyclists, dark room, bed and board, 6s. 6d. per day. Copy this address (above).

Armature Discs.—Best Swedish Charcoal Iron, any size cut. Trade supplied.—FOWLER, LANCASTER, and Co., Birmingham.

Farinaceous Food.—28lb. delivered free to any Railway Station within 50 miles of London.

Wholemeal, coarse or fine, 7lb. bag, 1s.; 28lb., 3s. [illegible] Best food for dyspepsia.

Yendys' **Wholemeal Biscuits**. Three biscuits contain sufficient nutriment for a meal. 7lb. bag, 2s. 3d.

Price List, containing full particulars of farinaceous food, &c., of SYDNEY YOUNG, 29, Mark-lane.

Excellent **Lathe Head Castings**, complete with wheels, &c., heads bored and planed, 3½in., 15s.; 4in., 17s.

Heads, 5in., as above, 21s. per set. Particulars, one stamp.—JARRATT, Short-street, Queen-street, Leicester.

Second-hand **Astronomical Telescopes.**—A. CLARKSON, Telescope Maker, 28, Bartlett's Buildings, Holborn Circus, London.

4½in. **Silvered Glass**, With-Browning, on altazimuth stand, rack, finder, 2 eyepieces, perfect, £7 10s.—CLARKSON.

3in. **Astronomical Telescope**, equatorially mounted, divided circles (Grubb), mahogany case and stand, £1[illegible]—CLARKSON.

3½in. **Astronomical Telescope**—Dollond; very fine object-glass, on firm and convenient altazimuth stand, £1[illegible]—CLARKSON.

Astronomical Eyepieces, first quality: any power, 15s.—A. CLARKSON, Telescope Maker, 28, Bartlett's Buildings, Holborn Circus.

Breechloader, single, central 12 bore, as new, killed sea gulls 75 yards. Price 36s., with 2½ years' warranty, carriage paid.—Woodman's-cottage, Sandgate, Kent.

Safety Bicycle, Coventry Cycle Company's, rear driver; ridden once. Magnificent machine. £8 15s.—CYCLIST, [illegible], Broadway, Sandgate.

Quotations.—If you want anything Scientific write the SCIENCE DEPOT, 32, Corporation-street, Bolton. List free.

Engine, ½-horse horizontal, as new, made regardless of cost, 63s.—A., 12, Great Chesterfield-street, Marylebone.

Models of Patented Articles Exhibited at BRITANNIA CO.'S, 100, Houndsditch, London. Patents Disposed of.

Having secured large and **Central Premises**, 6,000 square feet of floor space, we can let space for exhibiting patterns of manufactured articles, or to work London Agency.—BRITANNIA CO., 100, Houndsditch, London.

On view.—Biddle's Improved Wind-power Motor Balck's Lathe Planer, Patent Ratchet Screw-driver, Patent Saw for Foot, &c., &c.—BRITANNIA CO., 100, Houndsditch.

Send two stamps for **List** second-hand Lathes, &c., &c. BRITANNIA CO.—All letters to Colchester.

Notice.—Easy terms of payment can be arranged to suit customers.—BRITANNIA CO., Colchester.

Minerals, massive, from 1s. dozen. Crystallised from 2s. 6d. doz.—H. NICHOLLS, Mineralogist, 26, West End, Redruth.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JULY 29, 1887.

CABLE TRAMWAYS.*

AS we have recently (p. 259) given an account of what has been done, or is being done, in connection with electric railways, it will perhaps interest our readers if we describe a system which may for the moment be considered a rival. Cable tramways, or road railways worked on what is known as the "endless cable haulage system," are being constructed in three of the principal towns in the kingdom, and in the north of London one of a special character has now been at work on Highgate Hill for more than three years. There are still living many persons who made themselves acquainted with the details of the arrangements adopted for working the railway from Blackwall to the Minories, and some of them might be inclined to regard the modern system as a resuscitation of a method of rope haulage, which, however useful it may be in mines and other places, is not likely to be again employed upon railways proper. The Blackwall railway, as it is still called, was for some time the only line in London—at any rate, the only line which had a terminal station in what is now commonly called the Metropolis. The termini were 3¾ miles apart, the hauling engines being placed respectively at the Minories and at Poplar, the momentum imparted to the train being sufficient to run it as far as Blackwall. The terminal hauling drums were alternately driven at a speed of 40 revolutions per minute, and the trip, with five intermediate stations, was accomplished in about thirteen minutes. The coaches were detached from the hauling rope, and left at their respective stations ready to hitch on for the return journey, a system which it can be readily conceived did not work very well, although to meet the exigencies of the traffic the number of coaches on the train varied from six to twenty-six. It should here be explained, perhaps, that the locomotives of those days (circa 1840) were unable to take such loads—sometimes as much as 200 tons—and the engineers (Stephenson and Bidder) consequently adopted rope haulage. The line had been an expensive one to build, but the traffic obtained was of a remunerative character, and during the year 1844 more than 2,500,000 passengers were carried to the different stations. If locomotives in those days were small and weak, so also were ropes, and it was not until the engineers adopted a cable consisting of a hemp core laid with six strands of wire that they obtained a "rope" which would last without breaking for much longer than a month. The cable haulage system of the Blackwall railway was at the time, however, a decided success; but in 1848, owing to improvements in locomotives, and to the connection of other railway systems rendering a common method of working almost indispensable, the "ropes" were abolished in favour of the locomotive. There are many other interesting instances of the use of the cable system—notably a portion of the Canterbury and Whitstable line (one of the earliest), and wire ropes are still used with economy on sections of some railways. The modern system of cable haulage was undoubtedly developed in the United States, and the honour of the invention seems to be due to a Mr. E. S. Gardiner, of Philadelphia, who appears to have copied the idea of the central slotted tube or tunnel from the devices employed in the early attempts to construct an atmospheric railway. That was in 1858, but although Gardiner laid down the principles on which such systems should be worked, he does not appear to have pursued the subject even to the experimental stage. The first practical trial of a street cable tramway was due to the energy of Mr. A. S. Hallidie, of San Francisco, a city in which there are many gradients too severe to be worked by horses or locomotives with economy. The famous Clay-street line has a gradient of about 1 in 6 at one part, while the average is 580ft. per mile; but altogether there was a rise of about 300ft. in 2,800ft. in the first cable tramway constructed on the modern system. On August 1, 1873, the first trial trip was made, and after the usual little difficulties had been adjusted and small alterations made, it was soon shown that the new system was not only a practical success, but would probably be, as after events have proved, the pioneer of many similar schemes. The selection of the Clay-street site was in reality a bold undertaking, though it is obvious that success in working such a line would carry conviction to those who, knowing little of the difficulties, were yet in a position to supply the means for overcoming them. Although the grade from Kearney to Leavenworth streets is a rather severe rise, the crossing streets cut the road on the level—so that at about every 412ft. there is a short piece of road surface in which the grade suddenly changes. In these portions of the tube it became necessary to use depression pulleys to keep the endless cable from rubbing against the upper portion of the tube, and that also led to the introduction of the "dummy car," an independent car with a short wheel base, which carried the cable-gripping apparatus, and to which the larger vehicles were attached. At first considerable trouble was experienced with these dummies, for they sometimes "jumped the track"; but by experimenting they were after a time made to work satisfactorily. All these details are well shown by the diagrams in Mr. Bucknall Smith's work, and the page plates give perspective views, which will enable the reader to fully comprehend the difficulties and the manner in which they were overcome. The Clay-street line has now been at work for nearly fourteen years with success, both practical and financial, and other lines have been put down, until San Francisco has become the city of cable haulage, with every possible condition well met and the devices employed improved from time to time, so that it may be fairly said every mechanical detail of cable haulage has been perfected. The system having been proved a success in so hilly a city as San Francisco there was no doubt that it could be worked in places where the gradients are moderate; but there was some little hesitation in introducing it to cities which have what is called an old-fashioned winter. In California the climate is warm or mild, rarely frosty; but in Chicago they have extremes—from 100° in summer to 10 or 15° below zero in winter. Rain, hail, and snow fall at times in great abundance, and consequently might be expected to play havoc with the tunnel tube, the pulleys, and even the cables; but despite the promise of difficulties, the cable system was established in the great city on the shores of Lake Michigan, and for nearly six years has worked to the satisfaction of the company for twenty hours per day. If we add further that the system has also worked to the satisfaction of the public, because, when horse or railway traffic was stopped or retarded by snow, the cable trams were run without a hitch, we shall have said sufficient to show that, as the Americans would say, it is a real live invention, and is worth a good deal of consideration by those local authorities who represent the public when the introduction of schemes of the kind are mooted. By careful inspection at midnight, when work for the day is stopped, the machinery and appliances are kept in working order, and, as a rule, it may be taken that the modern cables may be trusted to run for twelve months without a flaw, while the cost in New York and Chicago—representative cities—is about half that of horse traction. As the system has developed, modifications—perhaps improvements—have been introduced into matters of detail, and it is quite certain that, so far as the public is concerned, it is preferable to the tramway locomotives, which not only necessitate a more expensive road-bed, but are not without a certain element of risk peculiar to themselves, as well as being, to a limited extent, something of a nuisance, for if it is possible to subdue the blast there are still the fumes from the fuel to annoy the pedestrians and the passengers on the top of the cars. We are shortly to have the cable system tested in an underground railway in London, and it need scarcely be said that opinions differ widely as to the advisability of adopting that plan in the circumstances, for the tunnel is to be illuminated by electricity, and many think that it would have been better to employ electricity for hauling the cars as well. The idea of cable haulage for underground railways is not new, for it is nothing more than a development of what has been practised for years in mines: even the use of electricity for such a purpose would not be new, although it would have a certain element of novelty in connection with a passenger railway stretching from one of the south-western districts of the Metropolis to the famous Monument of London, and, therefore, passing under the Thames by means of tunnels which modern appliances have enabled engineers to construct with ease. For underground systems, the cable haulage avoids the vitiated atmosphere, which is the natural and unavoidable accompaniment of the locomotive; but if electricity is ever to be employed upon railways with financial as well as practical success, it would seem that a tunnel railway is the very place in which it should be tried, especially as it would supply at once both illumination and motive power. Be that as it may, however, those who desire to know what has been done with the cable haulage system, and to understand the details so far as they can be explained by diagrams and text, will find all they need in this work by Mr. Bucknall Smith. It also contains an interesting and valuable chapter on the manufacture of wire ropes, which have made great strides towards perfection of late years, and in an appendix there is a good description of the City and Southwark Subway—a work as unique as it is promising. In considering the relative merits of various methods of traction it must not be forgotten that it is only those which "pay" that are ultimately successful; so that if the electricians can beat the cable haulage, the sooner they give proof of their abilities the better the capitalists will like it.

MAXIM'S ELECTRO-MAGNETIC SEPARATOR.

SEVERAL attempts have been made to utilise the current generated in revolving electro-magnets for separating mixtures of metallic filings with dirt, &c., and at the Inventions Exhibition an ingenious arrangement was shown at work separating iron from brass filings (see p. 249, Vol. XLI.), the revolving magnets picking up the iron when excited, and dropping the particles when the current was broken. Mr. H. S. Maxim has recently taken out a patent in this country for improvements relating to the application and utilisation of electro-magnetism for the separation of metals, which improvements include some novel features. Two circular series of electro-magnets are mounted on a shaft which is carried in suitable bearings in the frame of the machine. At the top of the machine there is a hopper,

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* A Treatise upon Cable or Rope Traction as Applied to the Working of Street and Other Railways. By J. BUCKNALL SMITH, C.E. London: Offices of *Engineering*, Bedford-street, Strand.

VOL. XLV.—No. 1,166.

and beneath this hopper is arranged a shaking or vibrating tray or chute for feeding the substances to be treated from the hopper into the machine. A spout or chute is provided at the bottom of the machine for the discharge of the sand or other non-magnetic material after the gold has been separated therefrom. Spouts or chutes are also provided for receiving the gold and conducting the same into suitable receptacles. Deflectors or deflecting plates are arranged in proper relation to the magnets to prevent the rotation of the particles of gold with the magnets. A ring or annular piece is attached to, but insulated from, each series of magnets. The coils of the magnets are connected with these rings or annular pieces; and contact springs or brushes, connected with an electric generator, are arranged to bear one on each of the rings. The diaphragms which cover the poles of the magnets are stretched, or otherwise mounted upon stationary frames. The operation of the machine is as follows:—A current of electricity is taken in through one of the contact springs or brushes and out through the other spring or brush; the magnets of each series are thereby excited, thus producing between the two diaphragms a very powerful magnetic field, in which there are many changes of polarity. The shaft and the two series of magnets being rotated at a high speed, the material to be operated upon is placed in the hopper, and fed forward, so that it falls in a continuous stream into the space between the two diaphragms. The material which is affected by the magnetic force of induction will be powerfully impelled or deflected in the direction of rotation and thrown into the chutes provided for its reception. On the other hand, the material which is not acted upon by the magnetic force or induction, or which is very slightly acted upon thereby, falls directly into and through the bottom chute, and is discharged from the machine.

CROOKES'S BEARING PAINT.

WE have briefly mentioned the invention of a bearing paint which will indicate by a change in its colour when bearings and other parts of machines are becoming heated, and we now give the full particulars of the preparation, which has been patented by Mr. H. Crookes, of Westminster Chambers, S.W. The exterior of the bearings or other surfaces are, it will be understood, coated with the paint, which changes from one colour or tint to another as the surface becomes hot, and which returns to its original colour as the surface cools. Preferably the patentee employs in the composition of the paint the double iodide of mercury and copper, and for the sake of cheapness he uses that substance mixed with red lead, white lead, or other pigment, so as to make the paint of any desired tint. The double iodide may advantageously be used with red lead in the proportion of 1lb. of the double iodide to 1lb. of red lead. The double iodide may be made in the ordinary manner, as described in textbooks on chemistry, which is as follows:—Iodide of potassium is dissolved in water, a solution of mercuric bi-chloride ($HgCl_2$) is then added so long as the precipitate, at first formed, is re-dissolved; this solution is then boiled, and while in ebullition a boiling solution of sulphate of copper is added; dense vapour of iodine immediately comes off and the solution must be kept boiling until these fumes have entirely disappeared. The whole is then filtered, and after washing thoroughly, the precipitate, which is the double iodide required, is dried and ground to a fine powder, and is then ready for mixing with oil and terebene, as paint. At any ordinary temperature (below 105° Fahr.) the paint is of a bright red colour; but when gently heated it becomes darker, until at about 140° Fahr. the colour is a dark brown, the first change being noticeable at about 110° Fahr. On cooling, the paint resumes its original red colour, and will therefore serve to indicate a rise of temperature any number of times. This property of changing colour when heated enables us to use the paint in many ways as a heat indicator. For example, if the bearings of any machine are painted with it, the man in charge can tell at a glance whether the bearings are running hot or cold, for if the paint *remains* red, it is a sure sign that the bearings are below 120° Fahr. (tingling heat). If applied to hot water pipes it is equally useful in showing when they get overheated. For painting the handles of flat irons, saucepans, kettles, tea urns, and such like it will be found a great convenience. The best method of applying the paint is to first coat the bearing or other surface with ordinary red paint of exactly the same tint as the heat indicating paint, and afterwards, when the coat of paint is dry, put a few stripes or other marks of the heat indicating paint over it, and then varnish over all. By adopting this plan, there will always be an unchanging standard of comparison, so that the very first change of colour will be easily noticed. Another important application is that of painting coils of wire through which an electric current is to pass. By this means a very simple ampère-meter can be made, for if in an installation of electric lighting a certain maximum current is to pass through any given wire (say 50 ampères), we place in that circuit a coil of wire of such diameter that it will bear 50 ampères passing continually through it without reaching 140°Fahr., but sufficiently small that a slight increase of, say, two or three ampères will almost immediately cause the paint to become brown, thus indicating that the maximum safe current has been exceeded. Coils of dynamos can be protected in a similar manner. By varying the proportion of sulphate of copper used in the manufacture, the temperature at which the change of colour begins to take place can be varied between certain limits—viz., from about 110° Fahr. to about 165° Fahr.

Ordinarily, the patentee employs about 8oz. of sulphate of copper to 17oz. of the iodide of mercury. This gives a yield of about 10½oz. of the double iodide, which commences to change colour at about 110° Fahr. If instead of using 8oz. of sulphate of copper 4oz. are used, a yield of about 7oz. of the double iodide will be obtained, which commences to change colour at about 165° Fahr. If a still smaller quantity of sulphate of copper is used, a double iodide which will commence to change colour at a lower temperature will again be obtained, but the yield will be small. The paint must not be applied direct to iron, brass, copper, zinc, and some other metals, but a coat of ordinary paint or varnish must be first laid on, otherwise the paint is partially decomposed and loses its property of changing colour.

ASTRONOMICAL NOTES FOR AUGUST, 1887.

The Sun.

Day of Month.	Souths.				At Greenwich Mean Noon.								
					Right Ascension.			Declination North.			Sidereal Time.		
	h.	m.	s.		h.	m.	s.	°	′	″	h.	m.	s.
1	0	6	5·85	PM	8	45	13	18	3	3	8	39	6·69
6	0	5	40·61	,,	9	4	30	16	44	4	8	58	49·47
11	0	5	0·77	,,	9	23	33	15	18	19	9	18	32·24
16	0	4	7·32	,,	9	42	22	13	46	25	9	38	15·01
21	0	3	1·11	,,	10	0	59	12	9	1	9	57	57·78
26	0	1	43·09	,,	10	19	24	10	26	49	10	17	40·55
31	0	0	14·84	,,	10	37	38	8	40	30	10	37	23·31

The method of finding the Sidereal Time at Local Mean Noon at any other station will be found on p. 382 of Vol. XLIV.

Sunspots continue to appear at rather less frequent intervals.

There will be an

Eclipse of the Sun

on the morning of August 19th. It will be total across central Europe and Asia; but at Greenwich it will be only seen as a partial Eclipse, taking the form of a very small semicircular notch cut out of the apparent S.E. part of the Sun's limb when he rises at 4h. 53m. a.m. As the Eclipse ends at 5h. 6·7m. a.m., it will be perceived that but little indeed of the phenomenon will be visible in this country.

The Moon

Is Full on August 3rd at 8h. 40·1m. in the evening, and enters her Last Quarter at 11h. 36·5m. p.m. on the 11th. She will be New a 5h. 38·6m. in the early morning of the 19th and enter her First Quarter at 8h. 21·2m. p.m on the 25th.

Day of Month.	Moon's Age at Noon.	Souths.		
	Days.	h.	m.	
1	11·6	10	29·7	p.m.
6	16·6	1	45·5	a.m.
11	21·6	5	18·5	,,
16	26·6	9	28·1	,,
21	2·3	2	10·2	p.m.
26	7·3	6	38·1	,,
31	12·3	10	55·8	,,

The Moon is in conjunction with Mars a midnight on the 16th; with Saturn at 1 o'clock the next morning; with Mercury a 9 p.m. on the 17th; with Venus at 2 o'cloc in the afternoon of the 21st; and with Jupite at 1h. p.m. on the 23rd.

There will be a

Partial Eclipse of the Moon

during the afternoon and evening of Augus 3rd, of which the following details will her suffice:—

	H.	M.		
First Contact with Penumbra	6	11·9	p.m.	Greenwic Mean Time.
First Contact with Shadow	7	35·7	,,	
Middle of the Eclipse	8	48·9	,,	
Last Contact with Shadow	10	2·1	,,	
Last Contact with Penumbra	11	25·9	,,	

The first Contact with the Shadow occurs 130° from the most Northerly point the Moon's Limb towards the East; and th last Contact at 151° towards the West, viewed with the naked eye. Hence it will seen that it is the Southern part of the Moon disc that will be obscured. The magnitude the central Eclipse is only ·419 of the Moon whole diameter. The Moon will rise at Gree wich at 7h. 35m. p.m., just as the first Conta with the Earth's shadow is about to occur.

Mercury

Is a Morning Star throughout August, attain ing his greatest elongation West (18° 36′) 8 p.m. on the 16th. About this time he ma be seen with the naked eye before sunrise little above the horizon at a point between th E. by N. and the E.N.E. His angular diamete decreases from 10·8″ on the 1st to 5·4″ by th end of the month.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	8	18·6	14	50·6	11	39·5	a.m.
6	8	10·4	16	14·4	11	11·7	,,
11	8	12·6	17	28·6	10	54·2	,,
16	8	26·8	18	7·6	10	48·7	,,
21	8	52·1	17	49·4	10	54·3	,,
26	9	25·5	16	20·8	11	7·9	,,
31	10	2·6	13	45·7	11	25·3	,,

The path indicated in the above ephemeri begins in Cancer, through which constellatio Mercury is travelling backwards up to th 7th. Becoming temporarily stationary, h thence retraces his course through Cancer an enters Leo, and will be found about 1¼° N. Regulus on the morning of the 31st.

Venus

Is an Evening Star during the entire mont and is most conspicuous after sunset just the South of West. She attains her greate brilliancy on the 16th, and for a few day about this time may be perceived with th naked eye in brilliant sunshine, whenever th sky is sufficiently clear, by anyone who kno exactly where to look for her. She is no too, a lovely object in the telescope, exhibiti a crescent like that of the Moon when abo four days old. Her angular diameter rapidl

Occultations of (and a near approach to) Fixed Stars by the Moon.

Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
		h. m.		°	°	h. m.		°	°
70 Aquarii	6	1 14 a.m.	Bright	41	35	1 38 a.m.	Dark	7	6
B.A.C. 81	6½	3 53 „	Bright	80	88	4 57 „	Dark	334	353
26 Ceti	6½	11 57 p.m.	Bright	140	105	1 2 „	Dark	268	240
29 Ceti	6½	3 24 a.m.	Bright	178	172	4 5 „	Dark	238	240
8 Tauri	6	2 18 „	Bright	116	76	3 24 „	Dark	281	244
5 Virginis	6	8 34 p.m.	Dark	54	92	‡9 26 p.m.	Bright	269	307
.A.C. 6081	6	5 59 „	Dark	65	51	7 14 „	Bright	279	277
Sagittarii	6	6 54 „	Dark	50	36	7 56 „	Bright	308	304
5 Capricorni	6	12 15 „	Dark	96	108	1 29 a.m.	Bright	307	330
4 Capricorni	6	†12 33 „	N.N.W.	201	216				

Moon has set. † A near approach. A description of the construction and use of this table, illustrated by a diagram, will be found on p. 383 of Vol. XLIV.

ases from 38·2″ on August 1st to 48·2″ on 1st.

Venus.

Right Ascension.	Declination.	Souths.
h. m.	° ′	h. m.
11 31·3	1 16·6 N.	2 51·7 p.m.
11 43·4	0 49·6 S.	2 44·1 „
11 53·9	2 49·2 „	2 34·9 „
12 2·4	4 39·6 „	2 23·7 „
12 8·5	6 17·7 „	2 10·2 „
12 11·9	7 39·2 „	1 53·9 „
12 12·2	8 39·2 „	1 34·5 „

nmencing in the confines of Leo, the path nus thus lies in a particularly barren f the constellation Virgo.

Mars

isible; and

Jupiter

nly be seen immediately after dusk during rst half of the month, as he is now so y approaching the West. For this reason hemeris of him only extends to the 16th.

Right Ascension.	Declination South.	Souths.
h. m.	° ′	h. m.
13 46·4	9 47·6	5 6·4 p.m.
13 48·5	10 0·7	4 48·9 „
13 50·8	10 14·9	4 31·6 „
13 53·4	10 30·1	4 14·4 „

hat during the time the planet remains e he will describe a short arc in the direc- f the 4·5th mag. star κ Virginis.

visibility of the phenomena of JUPITER'S LITES is too dubious to render them tabulating.

Saturn, Uranus, and Neptune

ll invisible.

wich Mean Time of Southing of Ten the Principal Fixed Stars on the ight of August 1st, 1887.

Star.	Souths. h. m. s.
rculis	8 29 1·23 p.m.
iuchi	8 49 9·45 „
conis	9 13 23·46 „
... ...	9 52 25·01 „
ilæ	10 38 58·75 „
... ...	11 4 22·80 „
ricorni	11 30 49·43 „
ni	11 56 33·25 „
hei	12 34 46·16 „
arii	12 44 26·72 „

Method of finding the Greenwich Mean of Southing of either of the Stars in the List for any other night in August, as hat of determining the Local instant of ansit at any other Station, will be found 384 of Vol. XLIV.

Shooting Stars

as almost everyone knows, especially ant on the nights from the 9th to the 11th of August, and very notably on that of the 10th, at which date the shower of meteorites—known as the "Torches" by the ancient Greeks, "St. Lawrence's Tears" by the Mediæval Catholics, and "The Perseids" (from the point whence they appear to radiate) by the modern astronomer—has been noted from hoar antiquity. The connection of these bodies with Comet II. of 1862 has been too often referred to in these columns to need repetition here.

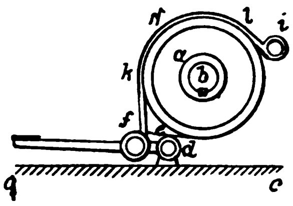
THE THEORY OF MACHINES.—XIV.

By FRANCIS CAMPIN, C.E.

Brakes and Indicators.

FOR cranes, crabs, and similar machines dealing with heavy loads, it is necessary to have means of retarding and stopping the main barrel, which is done by a strap brake, shown in Fig. 56. *a* is a plain pulley with a flat periphery, firmly keyed on to *b*, the shaft carrying the chain-barrel of the crane; *c c* is the foot-plate of the crane, the framework and gearing are omitted for clearness; *d* is a standard, carrying on a pin *e* one end of the treadle *e g*, which at *g* is furnished with a roughened plate, so that the foot may not slip upon it. The brake-wheel *a* is partly embraced by an iron or steel strap *i h f*, held by a stud at *i*, and at its other extremity by a pin at *f*, passing through the treadle lever *e g*.

FIG. 56



Now, it is evident that by pressing upon the treadle at *g* the strap *i h f* will be tightened upon the brake-wheel, thereby tending by friction to arrest its motion. Of course, the larger the brake-wheel the greater will be the effect of the brake. It is necessary now to consider how the power of such a break may be determined by calculation.

The force applied at *f* will be the tangential force in the strap *f h i*, hence (on principles previously explained, see page 116) the radial or normal pressure upon the brake-wheel per inch of circumference will be, if r = radius of brake-wheel in inches, and p = force applied at $f = \frac{p}{r}$, and the total pressure upon the brake-wheel will be, if L equals the length of periphery between *k* and *l* in inches $= \frac{p}{r} \times L$.

Calling c the co-efficient of friction between the dry metallic surfaces of the brake-wheel and the strap, then the moment of retardation at a distance of unity from the centre of the brake-wheel will be $= \frac{P}{r} \times r \times L \times c = p \,.\, L \,.\, c$. In this case, $c = 0·25$.

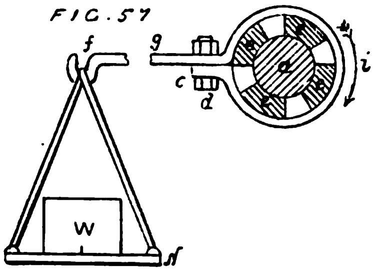
If the pressure applied at $g = W$, then $p = W \times \frac{g e}{f e}$, and calling M = the moment of retardation of the chain barrel at a distance of unity from its axis $M = p \,.\, L \,.\, c = 0·25\, L \times W \times \frac{g e}{f e}$.

To take an example, let the treadle be so proportioned that $g e$ = 30in., $f e$ = 4in., L = 20in., and W (the weight that may be available to place upon the treadle at g) = 150lb. Then the retarding moment will be $M = 0·25 \times 20 \times 150 \times \frac{30}{4} =$ 5,625in.-lb. If, then, the chain barrel is 4in. in radius, the direct retarding force upon the chain will be 5,625 ÷ 4 = 1406·25lb. When very heavy loads are being dealt with, the break can be tightened up by a screw worked by a hand-wheel.

In order to ascertain the actual amount of work given off by any prime mover, a special kind of brake has been designed.

The principle of this contrivance will be understood by reference to Fig. 57. *a* is the main shaft of the prime mover to be tested, *b* is a ring open at *c* and turned up to form a lug at that part joined to an arm at *g*. The lug can be tightened up to the arm *g* by means of the screw-bolt *d*. *e, e, e, e* are blocks of hard wood fitted between the shaft *a* and the ring *b*. At the extremity *f* of the arm *g* is a hook from which is suspended a scale *h*, intended for the reception of weights *w*.

FIG. 57



The mode of using this instrument is as follows:—Block *e, e, e, e* having been prepared of a suitable size to occupy the space between the shaft *a* and the ring, *b* slightly tightened up, the arm *g* being at the same time supported in a horizontal position, the tray or scale *h* is loaded up. The motor being then started so that the shaft revolves in the direction indicated by the arrow *i*, the weights and also the pressure on the shaft are adjusted so that when the machine is running at its normal velocity, the friction of the blocks *e, e, e, e* upon the shaft *a* will just sustain the arm *g* and its load in a horizontal position clear of the support, the shaft revolving the while within the ring *b*. The shaft *a* is then doing work equivalent to overcoming in each revolution a resistance equal to W through a distance equal to the circumference of a circle of which the radius is the distance from the centre of the shaft *a* to the point of suspension of the scale *h* at *f*.

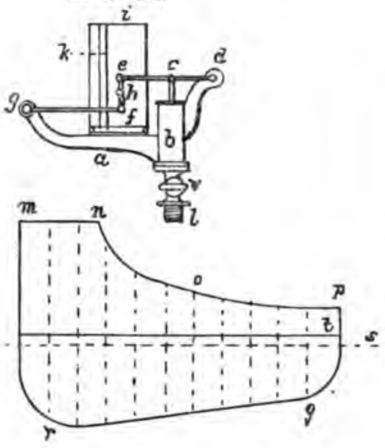
Let R = the effective radius of the arm *g* in feet; then the work given off by the shaft *a* in one revolution will be given by the formula $3·1416 \times 2 \,.\, R \times W$ and from this and the number of revolutions made by the shaft per minute, the power of the machine may be calculated, or the formula can be adapted to give the results in horse-power.

In England one horse-power is taken as 33,000ft.-lb. per minute. Let N = the number of revolutions of the shaft per minute, and H.P. = the horse-power; then $H.P. = \frac{6·2832 \,.\, R \,.\, W}{33,000}$ when the value of W is given in pounds. By the application of this dynamometer the power requisite to drive any machine can easily be ascertained. Let it first be applied to the driving-shaft and weighted until the normal velocity is obtained. Then let the machine to be driven be thrown into gear and reduce the weight W until the normal velocity of the driving shaft is again attained; then the difference between the powers thus ascertained will represent that absorbed in working the machine, and if the actual amount of useful work done can be ascertained, by deducting this, the amount lost by friction will be found.

By running the machine light, that is, without doing any work, the friction due to the weight of its parts will be found, but that is of no practical value, as it bears no fixed ratio to the friction of the machine when in full work.

The amount of power lost by friction in a steam-engine may be ascertained by the simultaneous application of the dynamometer above described, and the *indicator*, which is an instrument for measuring the amount of work actually done in the steam cylinder. It is made in a great variety of forms, one of the most convenient of which is shown in Fig. 58—it is the pattern known as Richards's.

FIG. 58



a is a compact frame or stand, carrying a small steam cylinder *b* which, when in use, is in communication with the cylinder of the engine to be tested, by means of the tube *l*, the whole apparatus being screwed into a plug fitted in the cylinder for that purpose. By means of a short link the head of the piston-rod is at *c* connected with the arm *d e* of a parallel motion *d e f g*, carried by small dead centres at *d* and *g*. At *h* in the link *e f* is a socket to carry a lead pencil. *i* is a metal drum mounted on a vertical bearing, and having at the bottom a grooved wheel for a string to fit in, being at one end secured to it, and then carried round the groove and attached to some moving part of the engine to be indicated that has such an amount of movement as will cause the drum *i* to make about ⅞th's of a revolution at each stroke, its return revolution being made by a coiled spring within it. Care must be taken in selecting the part of the engine to which to attach the indicator cord; in order that the motion of the drum shall agree exactly with that of the steam piston of the engine, it should, if possible, be taken from some part of the piston-rod, (or beam if it is a beam-engine); but in no case must it be taken from any element that the crank-motion affects, for the angular velocity of the crank is not uniform with the linear velocity of the piston, and the object of the instrument is to register the actual pressure of steam in the cylinder during the movement of the piston. *k* is a spring strip attached to the drum to hold thereon a band of paper, on which a diagram will be traced by the pencil held in the socket *h*.

To the piston in the small cylinder *b* is fixed a spiral spring, which when at rest holds it in a position corresponding to the atmospheric line, as it is called, which indicates that there is neither steam pressure, nor vacuum behind the piston. The tube *l* is furnished with a stop-cock *v*, so that the communication between the indicator can be made and cut off instantaneously at pleasure.

It should be mentioned that the drum cord must run from its point of fixture to the engine in a direction *exactly parallel* to that of the motion of the part to which it is attached, being then brought round guide pulleys, if necessary, to the indicator drum.

The instrument being properly screwed into position on the cylinder, and the drum fitted with a paper, the cock *v* being shut, the drum cord is pulled by the engine so that the pencil in the holder *h*, pressing lightly on the paper, *draws a horizontal* line—the atmosphere line—the engine being running at its normal velocity (and the friction dynamometer also applied at the main shaft if loss by friction is to be ascertained), the steam cock *v* is turned, and the piston spring yielding to pressure and vacuum alternately, a diagram is produced, of which the ordinates repreent to scale the steam pressure at every point of the stroke. The general form for a condensing engine taken by the indicator diagram is that shown at *m n o p q r*, where *s s* is the atmosphere line. For a high-pressure, non-condensing engine the typical form is shown by *m n o p t u*. The pressure does not fall to that of the atmosphere quite, as there is always some back-pressure caused by resistances in the exhaust passage, and for similar reasons there will not in the condensing engine be as good a vacuum in the cylinder as there is in the condenser.

It is very evident that the parts of the indicator should be free from friction; hence the steam piston in the cylinder *b* is not packed, but very accurately turned; in fact, so truly that it must be oiled before it can be introduced into its cylinder, and it is made unusually thick, so that the capillary attraction of the moisture between it and the interior of its cylinder may resist the escape of steam around its periphery.

In order to determine the work done in the cylinder the average pressure of steam must be found from the diagram.

Draw a number of ordinates at equal distances and at right angles to the atmosphere line *s s*, as shown by the dotted lines. Add together the dotted ordinates and multiply by 2, then add in the end ordinates *m s* and *p s*, and divide the sum by twice the number of spaces between the ordinates. Thus, in the figure there are 10 inside ordinates and two end ones and 11 spaces. The object of treating the diagram in this manner is to have the ordinates properly distributed, thus we virtually take the mean of *m s* and the first detted ordinate for the first space; the mean of the first and second ordinates for the second space, and so on, and then take the mean of all these mean ordinates for the whole stroke.

But the most exact method is to take the whole area of the figure and divide it by the length for the mean ordinate. The area can be taken by the principle of equalising used by the surveyors, or, better, by a planometer.

The mean pressure per square inch being obtained for both ends of the cylinder, let S = stroke of piston in feet, N = number of revolutions per minute, d = diameter of piston in inches, and p = mean pressure in pounds per square inch in the cylinder, then:

$$\text{H.P.} = \frac{0{\cdot}7854\, d^2 \times 2\,\text{S} \times \text{N} \times p}{33{,}000} = \frac{\text{S.N.}p.d^2}{21{,}009}$$

Deducting from this the horse-power shown as given off by the friction dynamometer, the remainder will be the power absorbed by engine friction.

This method cannot be applied so far as the dynamometer is concerned, to direct-acting pumping engines; but the actual useful work done by such is measured by the quantity of water raised and the height to which it is lifted.

CUTTING TOOLS.*

PROBABLY a majority of lathemen have a very firm belief in that old tradition of the machine shop—viz., that to get any good results from the lathe tools they must always be set "above the centre," and we often see a man carefully set all turning tools so, and then, as if to prove himself consistent, set boring tools the same way, unmindful of the fact that by so doing he secures, in the case of boring tools as usually formed and ground, much the same cutting action as would be secured by setting a turning tool below the centre. This same man will probably take considerable time and pains to grind threading tools exactly to standard gauge, and then "give them plenty of clearance, and set them high," so as to make them cut a smooth thread, never stopping to think that by so doing all his painstaking at the grindstone or emery wheel goes for naught, and that, however nicely his gauge may fit the tool, it will not fit a thread cut by such a tool, as a moment's consideration, or a simple trial, will easily show. The fact seems to be that it is far better for the mechanic to divest his mind of all such arbitrary rules, as far as possible and use his best judgment in each case without much regard to rule or precedent.

So far as the cutting action of any turning tool is concerned, it is safe to say that if it is rigidly supported in all cases, its efficiency will be entirely independent of its position with regard to the centre upon which the work turns, but that everthing depends upon the various angles of the tool, and the angle at which it is set with a line drawn from the centre to the point of the tool, wherever that may be. Figs. 1, 2, and 3 will serve to illustrate the principle. In Fig. 1 we see a tool formed and set in the usual manner; one which most of us will consider to be quite orthodox. In Fig. 2 we will suppose the same tool to have been bent back until when it is set just level with the centre, the same cutting angle is secured, as in the case of Fig. 1, and in Fig. 3 we have the same tool again, but bent back still more, so that to secure the same cutting angle again it must be set below the centre.

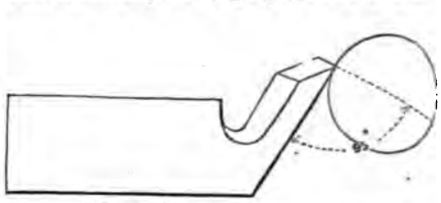


Fig. 1

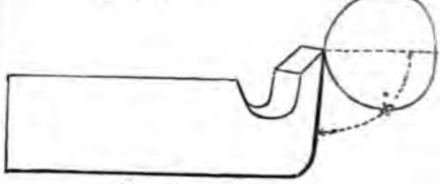


Fig. 2

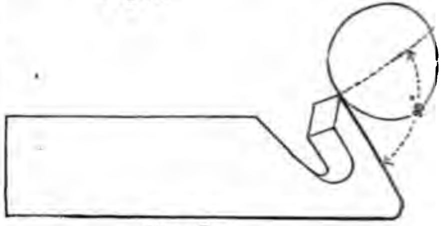


Fig. 3

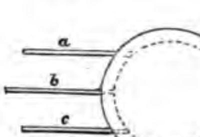


Fig. 4

Now this latter position will seem execrable to many, and of course on some accounts it would be objectionable; but I don't believe it is as bad as it looks, and the point I wish to make is that so far as its mere cutting action is concerned, this tool will be equally effective and satisfactory in any of the three shapes and positions shown, provided, of course, that it is supported with equal firmness in each case.

Now, of course we all know the objections which could be brought against No. 3, but the only point which I can think of in which it would be in any way inferior to No. 1 is the fact that it would have more or less tendency to pull into the work; but so far as its cutting action is concerned, it must be the equal of either of the others, because all angles which influence the cutting action are identically the same in each case.

The shears of most lathes are worn down much the fastest nearest the head, and when turning work a little longer than usual in a lathe worn in this way, the carriage, as it approaches the head, is let down the amount of the wear, and if we are using a tool like Fig. 1 the work is turned smaller. If using a tool as in Fig. 3, under the same circumstances, the work from the same cause will be turned larger instead of smaller, which, of the two evils, would generally be preferred. But with a tool such as Fig. 2 this wear of the shears will have the least possible effect upon the work, and so in this respect, at least, it would seem to be the best of the three. Then if it is to be used in a compound rest or with a taper attachment, it is undoubtedly best because it will cut best when level with the centre, where, for reason, pretty well understood by most lathemen, a tool must be set to do taper or angular work correctly.

Within the last few years tools have been introduced especially for cutting accurate screw threads; not accurate as to pitch, but merely as regards the shape of the thread, and anyone who has tried by means of an indifferent grindstone, and a U. S. standard thread gauge, to produce an accurate thread of that form, will agree with me, that such tools have a value far above their cost. Now, these tools afford a good example of the advantage to the latheman of thinking about what he is doing, and of the best method for accomplishing a given result, rather than blindly adhering to certain rules or traditions. Strange as it will appear to many, it can be demonstrated that in order to produce screw threads of accurately correct shape with these tools, they must be set sometimes above, sometimes level with, and at other times below the centre, according to the construction of the lathe in which they are used.

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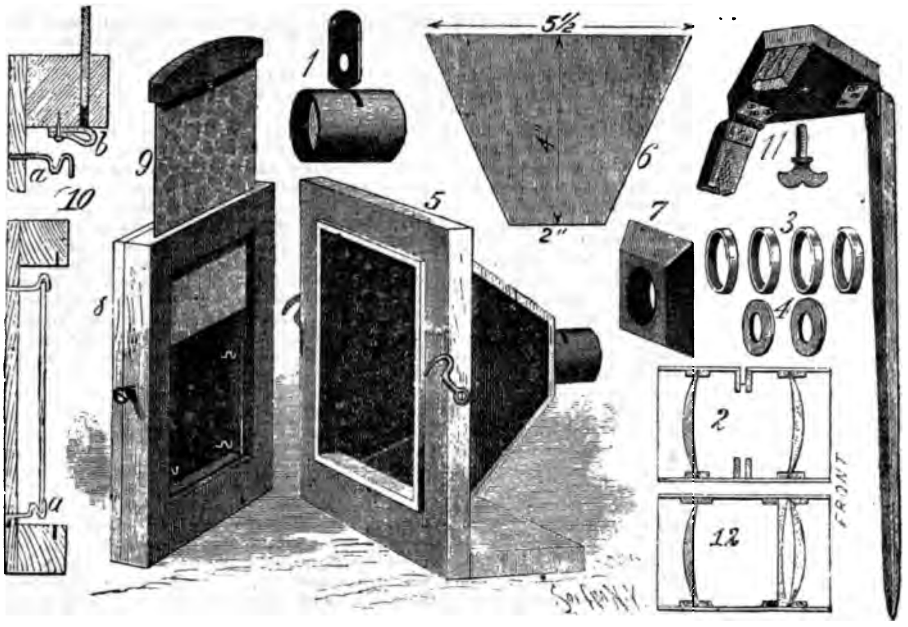
* By Fred. J. Miller, in the *American Machinist*.

To begin with, it may be stated as a fact that where accuracy of form of thread is sought there is nothing to be gained by grinding thread tools so as to have top rake, or in any other way than that known as level. This is so, because in grinding a thread tool the gauge must be applied along the cutting edges of the tool; and then in setting it in the lathe, its top face must always lie in a line radiating from the centre of the work, and to secure this condition it must be set either above or below the centre, according as the tool is ground with its top face having a forward or backward inclination. This is made clear by simply placing the point of a thread gauge between the threads of a properly cut screw, when it will be seen that the gauge fits the screw only when it lies in a radial line, as in position *b*, Fig. 4, and that it will not fit at all in either position *a* or *c*. The fact that the cutting edges or top face of the tool must lie in a radial line being thus proven, we may next consider what effect the peculiar construction of the lathe in use may have upon the method of setting the tool, and its vertical height relative to the centre, when properly set.

A SIMPLE PHOTOGRAPHIC AND PHOTO-MICROGRAPHIC APPARATUS.*

A PHOTOGRAPHIC outfit that will do very good execution may be purchased for a few dollars, but notwithstanding the small expense, many are deterred from making a beginning in photography on account of the first outlay. While first-class photographic instruments can be made only by makers having the greatest skill and large experience, an ordinary camera that will serve the purposes of the amateur may be made by the amateur himself with the expenditure of an insignificant sum for materials. Figs. 1 to 12 show a camera tube, box, and tripod, the materials of which cost less than a dollar. The construction is within the range of anyone having a little mechanical ability. The camera is intended for 4 by 5 plates, therefore the size of the plate holder and the focal length of the tube will determine the size of the camera box. To avoid turning the camera or plate holder, the box is made square, and the inside dimensions of the plate holder are such as to permit of placing the plate either horizontally or vertically, according to the subject to be photographed. The plate holder is 5¾in. square inside, and is provided with a wooden back of sufficient thickness to support the hooks employed for holding the plate. There are four V-shaped wire hooks, *a*, at the bottom of the holder, two for receiving the end edge of the plate, and two farther apart, and arranged higher up, for receiving the side edge of the plate; and near the top of the holder there are three Z-shaped hooks, *a*, one in the centre for engaging the end edge of the plate, and one near each side of the holder for receiving the side edge of the plate. The top of the frame is slotted, and the sides and bottom are grooved to receive the slide, which covers the plate before and after exposure. To the under surface of the upper part of the frame of the plate holder is attached a looped sprip of elastic black cloth, such as broadcloth or beaver, which closes over the slot of the plate holder, as shown in Fig. 10, when the slide is withdrawn, and thus shuts out the light. The interior of the plate holder, as well as the slide, should be made dead black, by applying a varnish made by adding three or four drops of shellac varnish to 1oz. of alcohol, and stirring in lampblack until the required blackness is secured.

The main frame of the camera box is made square, and is secured at right angles to the base board. The frame is provided with a narrow bead or ledge that will enter the front of the plate holder and exclude the light. To the front of the frame are secured four trapezoidal pieces of pasteboard, of the form and size given in Fig. 6. These pieces of pasteboard are secured to each other and to the camera-box frame by tape, glued on as shown. If the box is made of junk board, it may



be nailed together with wire nails. In this manner a pyramidal box is formed which is strong, light, and compact. In the smaller end of the box is fitted the bevelled centrally apertured block shown in Fig. 7. The aperture of this block must be made to fit the camera tube shown in Figs. 1 and 2, after having received a lining of plush or heavy felt.

The camera tube may consist of paper or metal. Paper answers well, and costs nothing. The internal diameter of the tube is determined by the diameter of the lenses. Ordinary meniscus spectacle lenses of 8in. focus are employed. These lenses are secured in place by paper rings, shown in Fig. 3, the inner rings being glued in place, the outer ones being made removable for convenience in cleaning the lenses. The lenses are arranged with their convex sides outward; the distance between them is 1¼in., and in one side of the tube, half-way between the lenses, is made a slot to receive the diaphragms, as shown in Figs. 1 and 2. Upon each side of the slot, within the tube, are secured flat rings, shown in Fig. 4, which together form a guide for the diaphragms, as shown in Fig. 2.

The tube is adjusted at the proper focal distance from the plate by temporarily securing at the back of the box a piece of ground glass or tracing paper, in exactly the same plane as that occupied by the plate in the plate holder. The tube is then moved back and forth until a focus is obtained which shows the image fairly sharp throughout the field. In arranging for a fixed focus, it is perhaps best to favour the foreground rather than the distance. The tube should move with sufficient friction to pevent it from being easily displaced. By using a small diaphragm, it will be found unnecessary to focus each subject separately.

In Fig. 12 is shown a combination of cheap lenses devised by Mr. Henry Mead, which is effective for portraits and for other classes of work when focussing is admissible. It consists of two meniscus lenses, each of 8½in. focus, having their convex sides arranged outwardly, and a plano-concave lens, 16in. focus, arranged with its concave side against the concave side of the outer lens of the system. The plano-concave and the rear meniscus lenses are arranged 1½in. apart. Diaphragms may be used as in the other case, and a box about 8in. deep will be required.

The tripod is formed of a triangular centrally apertured board, to which are hinged three tapering wooden legs, by means of ordinary butt hinges, as shown in Fig. 11. The base of the camera box is secured to the tripod by means of an ordinary thumb screw.

This outfit will enable the amateur to cultivate his tastes, and learn much about photography. Dry plates will, of course, be used. They are procurable almost anywhere, and are inexpensive. As to the treatment of plates after exposure and printing and toning, the reader is referred to the works on the subject of photography. The amateur who possesses a microscope may arrange it for projection, and may insert the end of the microscope tube in the camera box above described, after removing the tube, and project the image of the microscopic object on the sensitive plate, and thus produce good negatives of the objects, from which prints may be made which will be interesting both to the operator and his friends. In photographing microscopic objects, it will be necessary to employ a focussing ground glass, and to focus very carefully by the aid of a magnifier. Slow plates are preferable for this purpose, as they bring out the detail much better than rapid plates. The time of exposure will vary with the object, from fifteen seconds to a minute or more.

In arranging the lantern, microscope, and camera box, the annular space in the end of the camera box around the microscope tube is stopped by a black cloth wound loosely around the microscope tube. This and other precautions are necessary for preventing the light from reaching the plate except through the object and the microscope.—G. M. H.

PHOTO-ETCHING UPON BOXWOOD BLOCKS.

SOME printers believe (as regards the correctness of the belief we offer no opinion) that a boxwood block prints much better than any other substance yet introduced as a typographic printing surface; hence experimenters have endeavoured to produce typographic blocks in this material by photographic agency, and, indeed, with some considerable degree of success. The following method of working is of Russian origin, and is equally applicable to line subjects and to tint subjects, provided that in the case of the latter the negative is broken up into a suitable linear or other grain: The first step is to fill the pores of the boxwood block with insoluble carbonate of copper by means of two separate solutions, in which it is boiled successively; the first solution being strong sulphate of copper, and the second carbonate of soda. It is then soaked in water to remove soluble matter, slowly but thoroughly dried, and a polish is now imparted to its surface; asphalte varnish is applied to its back and sides, and finally a sensitised gelatine film spread over the polished face. To do this the block is adjusted with the face level, and the face is flooded with the following, and allowed to dry in a warm place:—

Gelatine	2 grammes.
Water	16 cubic cents.
Dissolve with warmth, and add ammonium bichromate	½ gramme.

The block is now exposed under a negative, and, by washing in warm water, the soluble and unprinted parts of the gelatine removed. A coating of asphalte is next applied to the raised parts, and the block steeped in strong nitric acid. The portions unprotected are thus partially changed to nitro-cellulose, which, by brushing, is readily removed in the form of a greenish powder. To complete the process, the block is dried, and briskly brushed with a stiff brush. The asphalte is lastly removed with benzine, and the block is ready for press.—*Photographic News*.

THE RESPIRATION OF WATER-BOATMEN.

By Prof. J. H. COMSTOCK, Cornell University.

AMONGST the most common insects found in our smaller ponds are those popularly known as "Water-Boatmen." Of these, the more abundant species pertain to two genera—*Corisa* and *Notonecta*. In each of these genera the insect carries about with it, in its course through the water, a bubble of air, which it uses for respiration. At one time I kept for a considerable period several aquaria containing these insects upon the table where I was working. Some interesting phenomena connected with their respiration attracted my attention. Other duties interfered with the completion of my observations, and I now publish this note merely to call the attention of other observers to the subject. The habits of the two genera are very different. In each the insect comes to the surface of the water at intervals to obtain a supply of fresh air; but in the case of *Corisa*, inhabiting well-aërated water, this does not seem to be absolutely necessary. The favourite attitude of the species of this genus when at rest is clinging to some object near the bottom of the aquarium; here they will remain for long periods, evincing no desire to rise to the surface. The ventral aspect of the body at such times is covered with a film of air; and the space between the head and the prothorax, and that between the prothorax and mesothorax, are also filled with air, as well as a space beneath the wings. But the quantity of air thus carried about by the insect is insufficient to account for the long period during which it remains beneath the surface of the water. By observing a *Corisa* when anchored near the bottom of a pond or aquarium, it will be seen that it clings by means of its anterior legs, and that the posterior legs are extended laterally and are frequently moved as when swimming. The result of this movement is to cause a current of water to pass over the film of air on the ventral side of the body. In this way the air may be purified as if in a tracheal gill. I was confirmed in the opinion that this air-film functions as a tracheal gill in two ways: first, when the water in which these insects were kept was allowed to become impure they became uneasy, and frequently came to the surface for fresh supplies of air; second, in the case of *Notonecta* (the water-boatmen that swim upon their backs) the greater part of the air is carried beneath the wings; thus it comes in contact with the water but little, and is not, therefore, purified to any considerable extent by the free gases in the water. Correlated with this are habits very different from those of *Corisa*. The *Notonecta*, when at rest, almost invariably floats with the tip of its abdomen projecting from the water, in order that it may easily change the air under its wings. In order to demonstrate the necessity for *Notonecta* to come to the surface frequently, I placed specimens in a closed vessel through which fresh water was allowed to run, but so arranged that the insects could not reach the open air. They made frantic efforts to push the tips of their bodies from the water. Failing in this, the air from beneath the wings in some way was accumulated on the ventral side of the body, where it at first formed a bubble of considerable size. This bubble was kneaded by the legs, and thus broken up into many small globules interspersed with water. After this the air was pushed back to the tip of the abdomen, and was again drawn under the wings. Thus it seems that the *Notonecta* can, in an emergency, avail itself of a method of purifying its supply of air, which, with the *Corisa*, is normal. I doubt, however, whether the *Notonecta* could keep itself alive in this way for a long period.—*American Naturalist.*

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* From the *Scientific American*.

THE DURABILITY OF STORAGE BATTERIES.*

By A. RECKENZAUN.

WHEN speaking of the durability of batteries, we have to consider separately the age of positive plates, the age of negative plates, and the age of the boxes or receptacles. As regards the latter, we have to take into consideration the kind and quality of the material of which the boxes are made; if these are of toughened glass which is never exposed to extremes of temperature, and if the same are not roughly handled or knocked, then we may assume that such receptacles are everlasting. For stationary purposes glass cells are generally used. In other cases, however, where the batteries have to be moved frequently, or when the same are utilised for locomotive purposes, then glass is not a reliable material, and wood or hard rubber is substituted. Wooden boxes are easily attacked and destroyed by the acid, therefore it is customary to line them internally with pure sheet lead carefully burned at the joints. Such boxes are generally made of teak, or other hard wood, which is not liable to warping; when boiled in paraffin wax and pitched inside before the lead lining is fixed, wooden cells will last a long time —several years—if kept dry and clean externally. Sometimes hard rubber or ebonite boxes are used; but these are more expensive and less strong than wooden ones. Boxes have also been made of an alloy of lead of tolerable stiffness, and many other materials have been tried with more or less success. In any case, the durability of such receptacles will be found of minor consequence if compared with the durability of the electrodes. The age of plates is the point of vital interest; when we are asked what the life of a storage battery may be, we at once think of the plates and almost ignore everything else; and we feel mostly concerned about the positive plates. We have already explained some of the causes which destroy the positive plates, and we have shown that the treatment of secondary batteries has as much to do with their durability as methods of construction or quality of materials. Thick plates, for instance, are found to last longer than thin ones; this is only natural when it is remembered that corrosion takes place upon the metallic support, which wears out in time. This corrosion proceeds mainly from the surface inwards, and the internal parts of a thick plate are protected to a great extent by the mass of superincumbent material. Thick plates offer an advantage if, firstly, the cost of material is much less than the cost of manufacture, and secondly, if weight and space are of little consequence. The cost of material may, however, exceed the cost of labour, and the value of the worn-out material may have a market value not much less than the original metal; under these circumstances it might happen that it is cheaper to renew the plates frequently rather than increase their volume. Weight and space are of the utmost importance in secondary batteries used for electric cars and boats, and in such cases we make the plates as light as compatible with strength of structure, almost irrespective of the cost of labour and the price of lead. Here we have to take into account the energy continually wasted in propelling the battery along with the vehicle it propels, and the point of economy it reached when the depreciation of the battery equals the cost of the motive power which is spent in this auto-propulsion. By decreasing the weight of material we reduce the activity of the plates, or the rate at which the current is consumed, and the life of the plates is to a great extent proportional to the amount of work done. In every instance we reach a certain limit which has to be considered with reference to any particular application. If the frequency with which plates have to be renewed is such as to cause little inconvenience, then one stage of the durability difficulty has been overcome. Frequent renewals do not cause a deal of inconvenience when systematically carried out, as would be the case with tramways, but in electric light installations much annoyance is likely to result through such a process, therefore it is advisable on several grounds to produce durable and strong plates for stationary purposes.

Durability versus Waste of Energy.—Let us make a rough calculation to show the relative losses which occur in the case of tramcars propelled by means of storage batteries, leaving out the question of small volume, which is merely a matter of convenience. We assume that the tractive force on a level tram line is 26lb. per ton when the car is in motion, and that it takes 100lb. per ton to set it in motion; furthermore, that there are some easy gradients and curves which demand a tractive force of, say, 60lb. per ton; we may get an average of about 52lb. per ton throughout an ordinary track when running at the rate of seven miles an hour. The saving of one ton weight in the shape of secondary batteries would under the above conditions represent a saving of $\frac{5,280 \times 7 \times 52}{60 \times 33,000}$ $= \cdot 97$ horse-power applied at the driving wheels. If we allow efficiencies of 80 per cent. in the gearing, 80 per cent. in the motor, 75 per cent. in the accumulator, and 90 per cent. in the generating dynamo, then we have a total efficiency of about 33 per cent. between the driving wheels and the steam engine; therefore, in order to produce the above tractive force upon the tram rails we require $\frac{\cdot 97}{\cdot 33} = 2{\cdot}94$, or say 3 horse-power from the prime mover.

The value of a horse-power hour varies considerably according to the price of coal, of labour, and especially with the size of the engine; but we may take the cost of a steam horse-power at £12 per annum in large engines, inclusive of all charges, consequently 3 horse-power for, say, 15 hours a day, will be worth £36 sterling a year. For this amount of money we can purchase three tons of new lead at the present prices, or we may employ this sum in paying wages for labour. Fourpence per plate, for instance, paid for casting, pasting, and fixing, may be a fair remuneration, and the amount stated above (£36) would at this rate suffice for the conversion of 2,160 old positive plates into new ones. By saving weight we save power, and the point of economy is reached, as we have hinted before, when the energy wasted in propelling the accumulator of a car equals the cost of replacing worn-out plates. We cannot recover the entire quantity of lead originally put into a plate, although the weight of a worn-out plate is practically the same as that of a new one; there is necessarily some loss in the reconversion of peroxide and sulphate into metallic lead which may be valued at between 30 and 40 per cent. in money, inclusive of labour and fuel used in the furnaces.

All the above figures are approximate only; the exact values can only be ascertained when all the factors are known, and among the principal factors are, firstly, the size and total weight of a car; secondly, the nature of the road and the speed to be applied; thirdly, the number of cars supplied by one charging station; and lastly, the cost of fuel, labour, and all necessary materials.

THE TECHNICAL INSTRUCTION BILL.

THE Government Technical Instruction Bill has been published, and the following is a *résumé* of its provisions:—The "local authority" that is to put the measure in motion is the School Board, or in a borough where there is no School Board, the council. In districts which are outside boroughs and have no School Boards no provision whatever appears to be made for establishing technical schools. The first step is for this local authority to pass a resolution that it is expedient to provide for supplementing by technical instruction the elementary education supplied in its district, and for that purpose to put in force the provisions of the Bill. The protection of the ratepayers consists in the provision that thereupon any 50 persons entitled to vote at the election of members of the local authority, or one-third of the total number of those persons, may require a poll to be taken as to carrying the resolution into effect. This poll will be by ballot, and as far as possible like that of a contested municipal election; the voters being those entitled to vote at the election of the School Board or the town council as the case may be, and each person having one vote only. If the resolution be negatived at the poll, it may not be again proposed until after the expiration of a year. For London a special scheme is promised by Sir W. Hart Dyke, but it is not yet inserted in the Bill. If a resolution is not negatived, the powers of the local authority are to be these:—(1) To provide technical schools for its district; or (2) to combine with any other local authority for the purpose of providing technical schools common to the districts of both authorities; or (3) to contribute towards the maintenance, or to the provision and maintenance, of any technical school; or (4) to make such arrangements as may seem expedient to it for supplementing by technical instruction the instruction given in any public elementary school in its district. As to what is to be included in "technical instruction," that is practically left to the decision of the Science and Art Department. In the Bill it is defined as instruction in the branches of science and art with respect to which grants are for the time being made by that department, or in any other subject which may for the time being be sanctioned by the department; and a "technical school" includes not only a school, but also a department of a school, which is giving technical instruction to the satisfaction of the Department of Science and Art. The conditions under which schools are to be conducted are those specified in the minutes of the Science and Art Department in force for the time being and required to be fulfilled in order to obtain a grant from the department; but a minute which is not now in force is not to be deemed to be so for the purposes of the Bill until it has lain a month on the table of both Houses of Parliament. Thus the working out of the scheme is left almost wholly to the Department of Science and Art.

When once a local authority has started a technical school it cannot discontinue the school at its own discretion. In order to do so it must satisfy the Science and Art Department that the school is unnecessary. It is required to keep its school efficient, and for this purpose it is to have the same powers as a school board now has for providing sufficient school accommodation for its district. But as the administration of the Bill is intrusted to the Science and Art Department, that department is in these matters substituted for the Education Department. With the sanction of the former department two or more local authorities may enter into any agreement which may be necessary for carrying into effect a resolution under the Bill. And the agreement may provide for the appointment of a joint body of managers, for the proportion of the contributions to be paid by the respective authorities, and for any other matters which, in the opinion of the department, are necessary for carrying it out. And where there is an ordinary technical school in the district, the managers are authorised to make an arrangement with the local authority for transferring their school to it, the provisions of section 23 of the Elementary Education Act of 1870 being made to apply.

The expenses to be incurred by a local authority in these matters are to be defrayed out of the "local rate," that is, the school fund where there is a school board, and where there is none the borough fund or borough rate. But no payment is to be made out of the rate in respect of a scholar until he has passed the sixth standard, or an examination equivalent to it. The knowledge required for this standard is, it may be noted, (1) in reading, to read a passage from one of Shakespeare's historical plays, or from some other standard author, or from a history of England; (2) in writing, a short theme or letter on an easy subject—spelling, handwriting, and composition to be considered (at the discretion of the inspector an exercise in dictation may be substituted for composition); and (3) in arithmetic, fractions, vulgar and decimal, simple proportion, and simple interest.

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* Extracted from a series of articles in the *Electrical Review*, London.

PHENOMENA OF ALTERNATING CURRENTS.*

By Prof. ELIHU THOMSON.

THE actions produced and producible by the agency of alternating currents of considerable energy are assuming greater importance in the electric arts. I mean, of course, by the term alternating currents, currents of electricity reversed at frequent intervals, so that a positive flow is succeeded by a negative flow, and that again by a positive flow, such reversals occurring many times in a second, so that the curve of current of electromotive force will, if plotted, be a wave line, the amplitude of which is the arithmetical sum of the positive and negative maxima of current or electro-motive force, as the case may be, while a horizontal middle line joins the zero points of current or electromotive force.

It is well known that such a current passing in a coil or conductor laid parallel with or in inductive relation to a second coil or conductor, will induce in the second conductor, if on open circuit, alternating electromotive forces, and that if its terminals be closed or joined, alternating currents of the same rhythm, period, or pitch, will circulate in the second conductor. This is the action occurring in any induction coil whose primary wire is traversed by alternating currents, and whose secondary wire is closed either upon itself directly or through a resistance. What I desire to draw attention to in the present paper are the mechanical actions of attraction and repulsion, which will be exhibited between the two conductors, and the novel results which may be obtained by modifications in the relative dispositions of the two conductors.

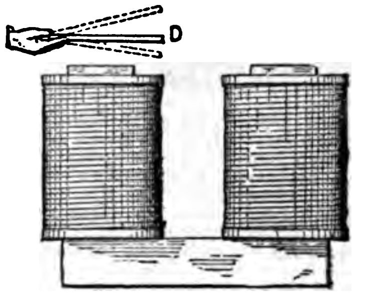

FIG. 1.

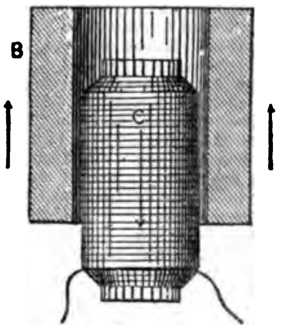

FIG. 2.

In 1884, while preparing for the International Electrical Exhibition at Philadelphia, we had occasion to construct a large electro-magnet, the cores of which were about 6in. in diameter, and about 20in. long. They were made of bundles of iron rod of about $\frac{3}{16}$in. diameter. When complete, the magnet was energised by the current of a dynamo giving continuous currents, and it exhibited the usual powerful magnetic effects. It was found also that a disc of sheet copper, of about one-sixteenth inch thickness, and 10in. in diameter, if dropped flat against a pole of the magnet, would settle down softly upon it, being retarded by the development of currents in the disc due to its movement in a strong magnetic field, and which currents were of opposite direction to those on the coils of the magnet. In fact, it was impossible to strike the magnet pole a sharp blow with the disc, even when the attempt was made by holding one edge of the disc in the hand and bringing it down forcibly toward the magnet. In attempting to raise the disc quickly off the pole, a similar but opposite action of resistance to movement took place, showing the development of currents in the same direction to those in the coils of the magnet, and which currents, of course, would cause attraction as a result.

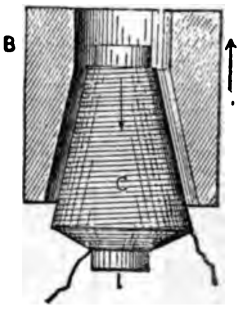

FIG. 3.

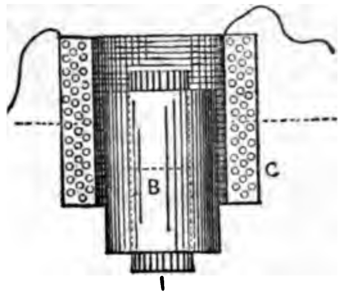

FIG. 4.

The experiment was, however, varied, as in Fig. 1. The disc D was held over the magnet pole, as shown, and the current in the magnet coils cut off by shunting them. There was felt an attraction of the disc or a dip towards the pole. The current was then put on by opening the shunting switch, and a repulsive action or lift of the disc was felt. The actions just described are what would be expected in such a case, for when attraction took place, currents had been induced in the disc D in the same direction as those in the magnet coils beneath it, and when repulsion took place the induced current in the disc was of opposite character or direction to that in the coils.

Now let us imagine the current in the magnet coils to be not only cut off, but reversed back and forth. For the reasons just given, we will find that the disc D is attracted and repelled alternately; for, whenever the currents induced in it are of the same direction with those in the inducing or magnet coil, attraction will ensue, and when they are opposite in direction repulsion will be produced. Moreover, the repulsion will be produced when the current in the magnet coil is rising to a maximum in either direction, and attraction will be the result when the current of either direction is falling to zero, since in the former case opposite currents are induced in the disc D in accordance with well known laws, and in the latter case currents of the same direction will exist in the disc D and the magnet coil. The disc might, of course, be replaced by a ring of copper or other good conductor, or by a closed coil of bare or insulated wire, or by a series of discs, rings, or coils superposed, and the results would be the same. Thus far, indeed, we have nothing of a particularly novel character, and, doubtless, other experimenters have made very similar experiments and noted similar results to those described.

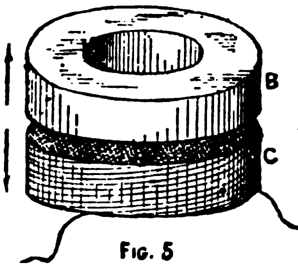

FIG. 5

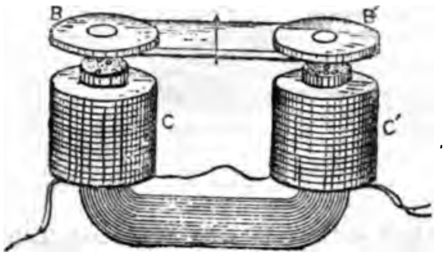

FIG. 6

The account just given of the effects produced by alternating currents, while true, is not the whole truth, and just here we may supplement it by the following statements:—

An alternating current circuit or coil repels and attracts a closed circuit or coil placed in direct or magnetic inductive relation therewith; but the repulsive effect is in excess of the attractive effect.

When the closed circuit or coil is so placed, and is of such low resistance metal that a comparatively large current can circulate as an induced current, so as to be subject to a large self-induction, the repulsive far exceeds the attractive effort.

For want of a better name, I shall call this excess of repulsive effect the "electro-inductive repulsion" of the coils or circuits.

This preponderating repulsive effect may be utilised or may show its presence by producing movement or pressure in a given direction, by producing angular deflection as of a pivoted body, or by producing continuous rotation with a properly-organised structure. Some of the simple devices realising the conditions I will now describe.

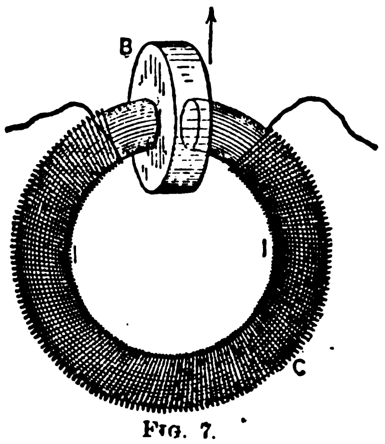

FIG. 7.

In Fig. 2, C is a coil traversed by alternating currents, B is a copper case or tube surrounding it, but not exactly over its centre. The copper tube B is fairly massive, and is the seat of heavy induced currents. There is a preponderance of repulsive action, tending to force the two conductors apart is an axial line. The part B may be replaced by concentric tubes slid one in the other, or by a pile of flat rings, or by a closed coil of coarse or fine wire insulated or not. If the coil C, or primary coil, is provided with an iron core such as a bundle of fine iron wires, the effects are greatly increased in intensity, and the repulsion with a strong primary current may become quite vigorous, many pounds of thrust being producible by apparatus of qnite moderate size.

The forms and relations of the two parts, C and B, may be greatly modified, with the general result of a preponderance of repulsive action when the alternating currents circulate.

Fig. 3 shows the part B of an internally tapered or coned form, and C of an externally coned form, wound on an iron wire bundle, I. The action in Fig. 2 may be said to be analogous to that of a plain solenoid with its core, except that repulsion, and not attraction, is produced, while that of Fig. 3 is more like the action of tapered or conically-wound solenoids and taper cores. Of course, it is unnecessary that both be tapered. The effect of such shaping is simply to modify the range of action and the amount of repulsive effort existing at different parts of the range.

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* From a paper read before the recent meeting of the American Institute of Electrical Engineers, New York.

In Fig. 4 the arrangement is modified so that the coil C is outside, and the closed band or circuit B inside and around the core, L. Electro-inductive repulsion is produced as before.

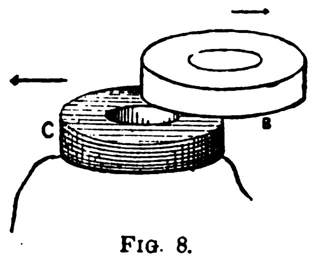

FIG. 8.

It will be evident that the repulsive actions will not be mechanically manifested by axial movement or effort when the electrical middles of the coils or circuits are coincident. In cylindrical coils in which the current is uniformly distributed through all the parts of the conductor section, what I here term the electrical middle or the centre of gravity of the ampère turns of the coils will be the plane at right angles to its axis at its middle, that of B and C, in Fig. 4, being indicated by a dotted line. To repeat, then, when the centres or centre planes of the conductors, Fig. 4, coincide, no indication of electro-inductive repulsion is given, because it is mutually balanced in all directions; but when the coils are displaced, a repulsion is manifested, which reaches a maximum at a position depending on the peculiarities of proportion and distribution of current at any time in the two circuits or conductors.

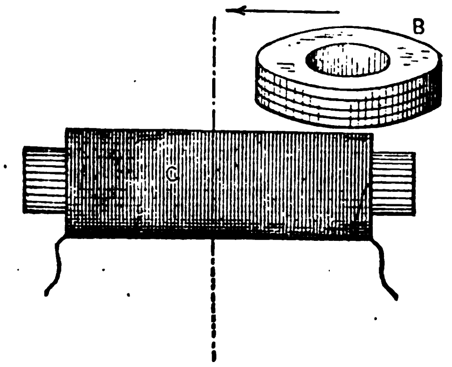

FIG. 9.

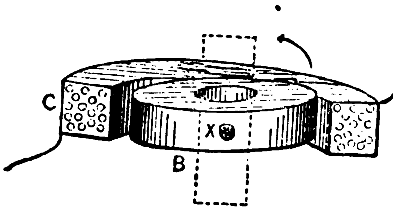

FIG 10.

It is not my purpose now to discuss the ways of determining the distribution of currents and mechanical effects, as that would extend the present paper much beyond its intended limit. The forms and relative arrangement of the two conductors may be greatly varied. In Fig. 5 the parts are of equal diameter, one, B, being a closed ring, and the other, C, being an annular coil placed parallel thereto; and an iron core or wire bundle placed in the common axis of the two coils increases the repulsive action. B may be simply a disc or plate of any form, without greatly affecting the nature of the action produced. It may also be composed of a pile of copper washers or a coil of wire, as before indicated.

An arrangement of parts somewhat analogous to that of a horseshoe electro-magnet and armature is shown in Fig. 6. The alternating current coils, C C′, are wound upon an iron wire bundle bent into U form, and opposite its poles is placed a pair of thick copper discs, B B′, which are attracted and repelled, but with an excess of repulsion depending on their form, thickness, &c.

If the iron core takes the form of that shown by I I, Fig. 7, such as a cut ring with the coil, C, *wound thereon,* the insertion of a heavy copper *plate, B, into the slot or divided portion of the* ring will be opposed by a repulsive effort when alternating currents pass in C. This was the first form of device in which I noticed the phenomenon of repulsive preponderance in question. The tendency is to thrust the plate B out of the slot in the ring excepting only when its centre is coincident with the magnetic axis joining the poles of the ring between which B is placed.

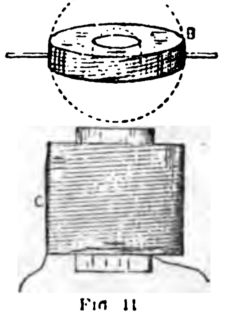

FIG. 11

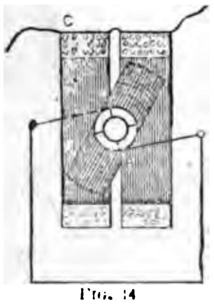

FIG. 14

If the axes of the conductors, Fig. 5, are not coincident, but displaced, as in Fig. 8, then, besides a simple repulsion apart, there is a lateral component or tendency, as indicated by the arrows. Akin to this is the experiment illustrated in Fig. 9. Here the closed conductor B is placed with its plane at right angles to that of C, wound on a wire bundle. The part B tends to move toward the centre of the coil C, so that its axis will be in the middle plane of C, transverse to the core, as indicated by the dotted line. This leads us at once to another class of actions—i.e., deflective actions.

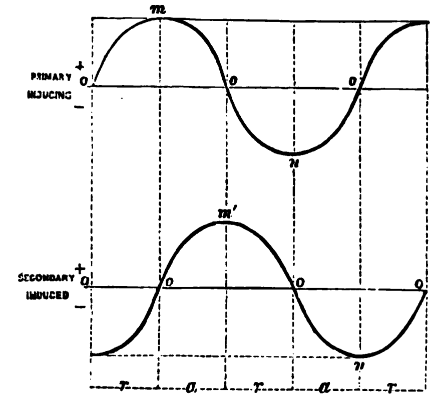

FIG. 12.

When one of the conductors, as B, Fig. 10, composed of a disc, or, better, of a pile of thin copper discs, or of a closed coil of wire, is mounted on an axis, X, transverse to the axis of coil C, through which coil the alternating current passes, a deflection of B to the position indicated by dotted lines will take place, unless the plane of B is at the start exactly coincident with that of C. If slightly inclined at the start, deflection will be caused as stated. It matters not whether the coil C incloses the part B, or be inclosed by it, or whether the coil C be pivoted and B fixed, or both be pivoted. In Fig. 11 the coil C surrounds an iron wire core, and B is pivoted above it, as shown. It is deflected, as before, to the position indicated in dotted lines.

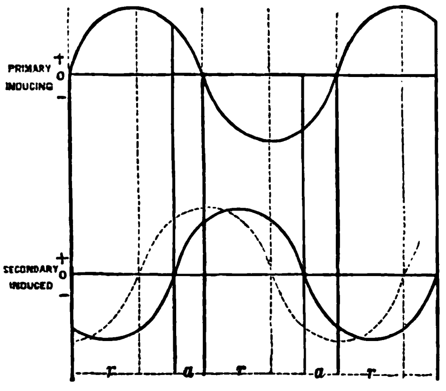

FIG. 13.

It is important to remark here that in cases where deflection is to be obtained, as in Figs. 10 and 11, B had best be made of a pile of thin washers or a closed coil of insulated wire instead of a solid ring. This avoids the lessening of effect which would come from the induction of currents in the ring B, in other directions than parallel to its circumference.

We will now turn our attention to the explanation of the actions exhibited, and afterwards refer to their possible applications. It may be stated as certainly true that were the induced currents in the closed conductor unaffected by any self-induction, the only phenomena exhibited would be alternate equal attractions and repulsions, because currents would be induced in opposite directions to that of the primary current when the latter current was changing from zero to maximum positive or negative current, so producing repulsion; and would be induced in the same direction when changing from maximum positive or negative value to zero, so producing attraction.

This condition can be illustrated by a diagram, Fig. 12. Here the lines of zero current are the horizontal straight lines. The wavy lines represent the variations of current strength in each conductor, the current in one direction being indicated by that portion of the curve above the zero line, and in the other direction by that portion below it. The vertical dotted lines simply mark off corresponding portions of phase or succession of times.

Here it will be seen that in the positive primary current descending from m, its maximum, to the zero line, the secondary current has risen from its zero to m^1, its maximum. Attraction will therefore ensue, for the currents are in the same direction in the two conductors. When the primary current increases from zero to its negative maximum n, the positive current in the secondary closed circuit will be decreasing from m^1, its positive maximum, to zero; but, as the currents are in opposite directions, repulsion will occur. These actions of attraction and repulsion will be reproduced continually, there being a repulsion, then an attraction, then a repulsion, and again an attraction, during one complete wave of the primary current. The letters r, a at the foot of the diagram, Fig. 12, indicate this succession.

In reality, however, the effects of self-induction in causing a lag, shift, or retardation of phase in the secondary current will considerably modify the results, and especially so when the secondary conductor is constructed so as to give to such self-induction a large value. In other words, the maxima of the primary or inducing current will no longer be found coincident with the zero points of the secondary currents. The effect will be the same as if the line representing the wave of the secondary current in Fig. 12 had been shifted forward to a greater or less extent. This is indicated in diagram, Fig. 13. It gives, doubtless, an exaggerated view of the action, though from the effects of repulsion which I have produced, I should say it is, by no means, an unrealisable condition.

It will be noticed that the period during which the currents are opposite, and during which repulsion can take place, is lengthened at the expense of the period during which the currents are in the same direction for attractive action. These differing periods are marked r, a, &c., or the period during which *repulsion* exists is from the zero of the primary or inducing current to the succeeding zero of the secondary or induced current; and the period during which *attraction* exists is from the zero of the induced current to the zero of inducing current.

But far more important still in giving prominence to the repulsive effect than this difference of effective period is the fact that during the period of repulsion both the inducing and induced currents have their greatest values, while during the period of attraction the currents are of small amounts comparatively. This condition may be otherwise expressed by saying that the period during which repulsion occurs includes all the maxima of current, while the period of attraction includes no maxima. There is then a *repulsion due to the summative effects of strong opposite currents* for a *lengthened period*, against an *attraction* due to the summative effects of *weak currents* of the *same direction* during a *shortened period*, the resultant effect being a greatly *preponderating* repulsion.

It is now not difficult to understand all the actions before described as obtained with the varied relations of coils, magnetic fields, and closed circuits. It will be easily understood, also, that an alternating magnetic field is in all respects the same as an alternating current coil in producing repulsion on the closed conductor, because the repulsions between the two conductors are the result of magnetic repulsions arising from opposing fields produced by the coils when the currents are of opposite directions in them.

Thus far I have applied the repulsive action described in the construction of alternating current indicators, alternating current arc lamps, regulating devices for alternating currents, and to rotary motors for such currents. For current indicators, a pivoted or suspended copper band or ring composed of thin washers piled together, and insulated from one another, and made to carry a pointer or index has been placed in the axis of a coil conveying alternating currents whose amount or potential is to be indicated. Gravity, or a spring, is used to bring the index to the zero of a divided scale, at which time the plane of the copper ring or band makes an angle of, say, 15° to 20° with the plane of the coil. This angle is increased by deflection more or less great, according to the current traversing the coil. The instrument can be calibrated for set conditions of use. Time would not permit of a full description of these arrangements as made up to the present.

In arc lamps the magnet for forming the arc can be composed of a closed conductor, a coil for the passage of current, and an iron wire core. The repulsive action upon the closed conductor lifts and regulates the carbon in much the same manner that electro magnets do when continuous currents are used. The electro-inductive repulsive action has also been applied to regulating devices for alternating currents, with the details of which I cannot now deal.

For the construction of an alternating current motor which can be started from a state of rest the principle has also been applied, and it may here be remarked that a number of designs of such motors is practicable.

One of the simplest is as follows: The coils C, Fig. 14, are traversed by an alternating current, and are placed over a coil B, mounted upon a horizontal axis, transverse to the axis of the coil C. The terminals of the coil B, which is wound with insulated wire, are carried to a commutator, the brushes being connected by a wire, as indicated. The commutator is so constructed as to keep the coil B on short circuit from the position of coincidence with the plane of C to the position where the plane of B is at right angles to that of C; and to keep the coil B open-circuited from the right-angled position, or thereabouts, to the position of parallel or coincident planes. The deflective repulsion exhibited by B will, when its circuit is completed by the commutator and brushes, as described, act to place its plane at right angles to that of C; but being then open-circuited, its momentum carries it to the position just past parallelism, at which moment it is again short-circuited, and so on. It is capable of very rapid rotation; but its energy is small. I have, however, extended the principle to the construction of more complete apparatus. One form has its revolving portion or armature composed of a number of sheet iron discs wound as usual with three coils crossing near the shaft. The commutator is arranged to short-circuit each of these coils in succession, and twice in a revolution, and for a period of 90° of rotation each. The field coils surround the armature, and there is a laminated iron field structure completing the magnetic circuit. I may say here that surrounding the armature of a dynamo by the field coils, though very recently put forth as a new departure, was described in various Thomas-Houston patents, and to a certain extent all Thomson-Houston machines embody this feature.

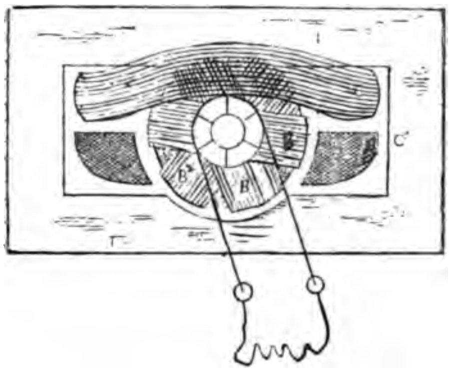
FIG 15.

Figs. 15 and 16 will give an idea of the construction of the motor referred to. C C¹ are the field coils or inducing coils, which alone are put into the alternating current circuit. I I is a mass of laminated iron, in the interior of which the armature revolves, with its three coils, B, B², B³, wound on a core of sheet iron discs. The commutator short-circuits the armature coils in succession in the proper positions to utilise the repulsive effect set up by the currents which are induced in them by the alternations in the field coils. The motor has no dead point, and will start from a state of rest and give out considerable power; but with what economy is not yet known.

A curious property of the machine is that at a certain speed, depending on the rapidity of the alternations in the coil C, a continuous current passes from one commutator brush to the other, and it will energise electro magnets, and perform other actions of direct currents. Here we have, then, a means of inducing direct currents from alternating currents. To control the speed, and keep it at that required for the purpose, we have only to properly gear the motor to another of the ordinary type for alternating currents—namely, an alternating-current dynamo used as a motor. The charging of storage batteries would not be difficult with such a machine, even from an alternating current line, though the losses might be considerable.

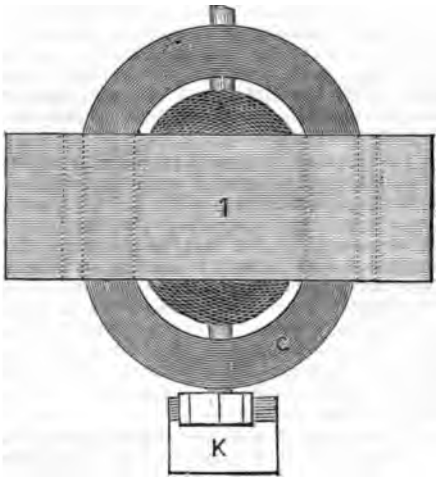

FIG 16

PLEASANT NEWS OF AN OLD AND VALUED CORRESPONDENT.

THE *Every Evening*, published at Wilmington, Del., U.S.A., says:—Prominent among the practical Americans known through the excellence of their workmanship and the delightful scientific symposium which finds expression in the columns of the ENGLISH MECHANIC, as well abroad as at home, is John A. Brashear, of Allegheny, Pa. There is much encouragement in Mr. Brashear's career for thousands of others who, through stress of circumstances, are labouring in fields where they cannot put their heart in their work, while conscious of their ability to do something else much better if the opportunity to "reach the place they were created to fill" ever comes to them. A few years ago he was working in a rolling-mill by day and experimenting at his home by night in the grinding of specula for reflecting telescopes. He found that he could make good telescopes, and it was not long before others found this out also. Then there came a time when he could cut loose from the rolling-mill and devote his entire attention to the more attractive work in which he took the delight of the true artist. He began on a very small scale, but he laboured zealously, studied hard, and has within seven or eight years conquered both prosperity and fame. His new factory in Allegheny has 4,100 ft. of floor space, he employs seven assistants, and he writes, in a manner thoroughly characteristic of the straightforward man all who know him have found him to be: "Here I am with an amount of work ahead almost appalling and still growing. Don't know what I shall do unless I hire more men, decline the work, or raise the prices. I want to do the honourable only, and hence I guess I'll have to get more help." In addition, Mr. Brashear is building a small glass factory in which to make his own optical glass with more care and nicety than he can procure it from others. Mr. Brashear's Wilmington friends will be glad to hear that he is doing so well, but the lesson of his progress is one not to be measured by dollars and cents. He has shown to the world what an American artisan with his whole heart in his work can do. He has supplemented the achievements of Alvan Clark and Co., in making American optical surfaces famous everywhere for excellence of workmanship. Brashear's prisms, diffraction plates, specula, flats, telespectroscopes, and kindred productions of high class are as well known in Berlin, St. Petersburg, and Melbourne as they are at Washington and Cambridge. The extreme accuracy of some of this work may be appreciated by the result of a test made at Melbourne of one of his optically flat surfaces in which it was demonstrated that the upper and lower surfaces of the comparatively thin glass were so nearly parallel that the lines bounding [illegible] would not come together if prolonged for [illegible] miles.

SCIENTIFIC SOCIETIES.

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THE LIVERPOOL ASTRONOMICAL SOCIETY.

BY the permission of the President and Council of the Royal Astronomical Society the annual general meeting of the Liverpool Astronomical Society was held on the 8th of July, at the rooms of the Royal Astronomical Society at Burlington House. There was a large attendance of members. The president, the Rev. T. E. Espin, took the chair at 8 p.m. The minutes of the preceding meeting having been read and confirmed, Mr. Wesley read the report of the auditors (Mr. W. H. Wesley and Mr. H. Sadler) from which it appeared that the society has a small balance in hand. In reading the annual report of the Council the secretary, Mr. W. H. Davies, stated that very satisfactory progress had been made during the past session, no fewer than 231 members and 11 honorary associates having been elected, making a present total of 440 members and associates. A most important branch had been formed by the constitution of the Pernambuco Branch of the Society, consisting of 111 members, including the Emperor of Brazil as honorary associate. Associate branches in Western and Southern Australia were also in course of formation. Upwards of 150 valuable books and pamphlets had been presented to the Society during the past session, and a catalogue of the library is in process of formation. Special acknowledgement was due to the valuable work performed by the sections. The Lunar Section has undertaken the systematic study of some of the most remarkable formations on the moon, with a view to map and catalogue the details they include. It is hoped that before long it will be practicable to undertake the mapping of portions of the lunar surface on a much larger scale than has as yet been attempted. A second section has undertaken the systematic study of star colours, and the colours of some 750 of the brighter stars have been examined with that end in view, while Birmingham's "Red Star Catalogue" is in course of revision. In the variable star section a close watch has been kept on suspected variables, and it is proposed to examine double stars in which a variation of light is suspected. In the Double Star section measures of some 50 pairs have been published, and it is hoped that the remainder of the first series of measures of 200 double stars will be ready for publication by the end of the year. The work of the Meteoric section has been very actively pushed forward, and upwards of 300 observations have been recorded. It is hoped that by the end of the year a catalogue of about 1,000 radiant points will be ready for publication. Owing to the scarcity of sunspots during the last year, the Solar section had but little to report. A set of discs had been published for determining the positions of sunspots. The Planetary section has been subdivided, two subsections, one devoted to the study of the planet Jupiter, and the other to that of Saturn, having been created. The red spot and other markings on the planet Jupiter are at present being carefully watched, and a report embodying the results obtained will be drawn up for the Society at the first meeting in the autumn. A series of illustrated papers on the subject will be published throughout next session. It is intended to devote special attention to the apparent rapid changes in the details of the ring system and the shadow of the ball on the rings of the planet Saturn. The Comet-seeking Section will commence systematic work in August. An Educational section has been formed for the purpose of relieving the strain upon the other sections, by assisting the beginner until he becomes sufficiently advanced to take a satisfactory part in the work of some particular section. This department will include instruction in the general outlines of astronomy, and in elementary optics so far as relates to telescopic and spectroscopic work. The report concluded by tendering the warmest thanks of the council to the Council of the Royal Astronomical Society for their courtesy in permitting the Annual Meeting to be held in their rooms.

The Rev. T. E. Espin read the Observer's report. He said that a large number of members had availed themselves freely of the means of verifying observations afforded them under sections 1 and 2 of By-law XI., and the correspondence had been heavy; in every case, however, the large aperture of the telescope had enabled him to verify the observation. The work done under section 3, which states that the Observer shall undertake some systematic work for the Society, has been chiefly searching for red stars, and reobserving those already known, with a view to the new edition of Birmingham's "Red Star Catalogue," which is now well in hand. Up to the present time over 220 new red stars had been detected. In November last a spectroscope was devised capable of showing star spectra to the 9th magnitude, and now every new red star detected was observed with the spectroscope as well. During the past year 87 stars with remarkable spectra of Type III. and 23 of type IV. were detected. A description of the spectroscope had been published in the ENGLISH MECHANIC. Some of the results of the work done had been published privately, and most of the results of the late observations in the pages of the *Astronomische Nachrichten*. The usual variable star observations had been forwarded to Harvard College, and are now in print. Two long-period variables had been detected, and a new star of the 7th magnitude in Cygnus, which has now faded to below the 10th magnitude.

It was resolved that the reports of the Council and Special Observer should be printed in the *Journal* of the Society.

A somewhat desultory conversation ensued on the question of the abolition of the post of Special Observer and the adoption of a seal for the Society, and both questions were deferred for the further consideration of the Council.

Thanks were voted to the auditors, contributors to the *Journal*, Directors of Sections, the President, the Scrutineers of the Ballot, and to the Council of the Royal Astronomical Society for the use of their rooms. The following members and honorary Associates of the Society were declared elected as officers and Council for the coming year:—President, Mr. Denning; Vice-Presidents, Mr. Elger, the Rev. T. E. Espin, Mr. Gore, and Mr. Newall; Special Observer, Mr. Gill; Editor, Mr. Sadler; Librarian, Mr. Defieux; Secretary and Treasurer, Mr. W. H. Davies; Council, Miss E. Brown, Majors Markwick and Watson, Messrs. Backhouse, Calver, Deane, Gill, Higgs, Lynn, Monck, Oliphant, and Tarrant; as representatives for the Pernambuco Branch, Messrs. Elger and Franks. Directors of Sections: Solar, Miss Brown; Lunar, Mr. Elger; Meteoric and Comet-Seeking, Mr. Denning; Coloured Star, Mr. Franks; Double Star, Mr. Tarrant; Variable Star, Mr. Gore; Educational, Mr. Gill; Planetary (Jupiter), Mr. Denning. Mr. Wassell read a paper, illustrated by diagrams, on "Methods of Working and Testing Specula." The meeting adjourned at 5.30 p.m.

Carbon in Iron.—Herr A. Ledebur has been making experiments on the behaviour of pig-iron when heated in wood charcoal, which are described in *Stahl u. Eisen*. In earlier experiments the samples of pig-iron employed contained but little manganese and phosphorus, and were comparatively rich in silicon. He has therefore made experiments with low silicon metals, with varying amounts of the other elements. Nine test pieces of various kinds were packed separately, amidst small fragments of charcoal, in a pot such as is used for making malleable castings. They were then heated to about 1,000deg. C. for 108 hours. On examining the samples, it was found that in all malleable irons the percentage of carbon had increased; thus in—Fibrous wrought iron from 0·10 to 0·58 per cent. Thomas steel from 0·11 to 0·26 per cent. Cast steel from 0·40 to 0·65 per cent. Similarly in a manganiferous (2·75 per cent. Mn) cast iron for the Thomas process the carbon had increased from 2·63 to 3·27 per cent., whilst in a refined Lowmoor iron, with but a trace of manganese, it was constant at 3·5 per cent.; in all the other specimens there was actually a diminution in the amount of carbon. Thus although confirmatory of previous experiments, no further light is thrown on the cause of the decrease noted with so many samples of cast iron. The silicon and phosphorus percentages alike remain unchanged. With the alteration in composition was a corresponding change in the appearance and in the physical properties: all specimens with less than 1 per cent. of manganese having become granular, soft, and comparatively tough, whilst the manganese Thomas cast iron, above alluded to, remained unaltered in fracture and in brittleness.

The Value of the Sunflower.—It is stated on the authority of a Cuban journal that since the sunflower has been cultivated in certain swampy districts on the banks on the river Potomac malarial fever has almost ceased to be endemic there. Similar beneficial results appear also to have followed the cultivation of this plant in the neighbourhood of the mouth of the Scheldt in Holland. The editor of the *Monthly Journal of Pharmacy*, who has been engaged in observations on sunflowers, found that during the month of June, 1885, a quarter of an acre of sunflowers exhaled, with a mean temperature of 70° F. at midday, exactly 1,950 gallons of water in the form of vapour, or sixty-five gallons a day. He attributes the antimalarial action of the sunflower therefore not only to its properties of absorbing and destroying the malarial miasm and of emitting an abundance of pure oxygen, as taught by other writers, but also to its great capacity, owing to its rapid and vigorous vegetation, of absorbing and utilising the moisture of the soil in districts which are unfit for human habitation. He likewise suggests that the aromatic odour of the flowers may perhaps be possessed of antiseptic virtues.

SCIENTIFIC NEWS.

IN connection with the Congress of the Sanitary Institute of Great Britain, to be held from September 20th to October 15th at Bolton, there will be a "Health Exhibition," which will include sanitary apparatus and appliances, heating and cooking apparatus, articles relating to personal hygiene, domestic economy, foods, clothing, electric apparatus, telephones, life and labour saving appliances, &c., provided exhibitors come forward and make applications for space.

It is proposed to form a museum of objects of ethnological interest in connection with the Anthropological Section of the British Association at the forthcoming meeting at Manchester, of which section Prof. Sayce is president. This exhibition will include a remarkable series of casts taken from squeezes recently obtained by Mr. Flinders Petrie during his work in Egypt on behalf of a committee of the British Association. The casts are of much value in enabling the anthropologist to determine the racial characteristics of the people represented on the Egyptian monuments.

The "present" weather always appears to those who find in it a subject for conversation either the worst or the best season known; but in connection with the dry season we have, let us hope, seen the end of, Mr. Symons says in his magazine:—"Probably every one is prepared for the statement that the six months of the present year, already elapsed, have been unprecedentedly dry, and June especially so. But this is not the case as regards the British Isles generally, and for England we do not have to look far back to find a month as dry as, or drier than, June, and only about ten years to find the corresponding six months much drier. To consider June first: The really remarkable—and, we believe, almost unprecedented—phenomenon is the long spell of absolutely rainless weather, for of the 150 stations whose results are printed in this magazine, there are scarcely twenty at which the absolute drought did not extend to fourteen days. This has been put into tabular form on the rules laid down in *British Rainfall*, 1884, p. 166, the 'Absolute Droughts' being periods of fourteen or more days absolutely without rain, and the 'Partial Droughts' periods of twenty-eight or more days with not more than ·25in. of rain. We may, perhaps, summarise by saying that the absolute drought of June appears to be unprecedented, and perhaps the smallness of the rainfall over the whole of the United Kingdom is the same; but that, taking the counties individually, we can find for each, at no distant date, months with a rainfall almost as small. This exceptionally dry month, coming after several others with a rainfall below the average, has naturally tried the resources of water works all over the country; some of them have apparently failed, others are expected to do so, and there is a general cry of unprecedented drought. How far this cry is justified is open to question, though there is no doubt that, in some districts, the deficiency of rainfall is considerable."

At a recent meeting of the Royal Society of Edinburgh, Prof. Tait communicated a paper by Mr. A. C. Mitchell on the thermal conductivity of iron, copper, and German silver. Mr. Mitchell's investigation was undertaken in order to settle a question which arose in connection with the experiments made some years ago by Prof. Tait and Prof. Forbes independently. The results agree very closely with those of Prof. Tait, and it may now be accepted that the thermal conductivity of iron is practically the same at all temperatures, while that of copper and German silver is augmented by increase of temperature. At the same meeting Prof. Tait in a paper on "Glories," alluding to those previously noted at Ben Nevis, maintained that the phenomena were produced by very much the same sort of process as that in coronæ, though the working of it out might be a matter of excessively greater mathematical difficulty.

The Government of India have undertaken a topographical survey of the native states of Travancore, Padukota, and Cochin. The last survey was made 70 years ago. Some of the mountainous tracts of Travancore and Cochin are still absolutely blank on the maps.

The Government Technical Education, or rather Technical Instruction Bill, has been published, and has met with anything but a favourable reception, for it is evident that the control of technical instruction will be left practically to the Science and Art Department, while the ratepayers will find the money.

Some serious cases of poisoning amongst children occurred recently at Greenock, through eating, it is supposed, the roots of Œnanthe crocata, which resemble those of the parsnip, under the impression that they were "ladies' nuts." Real technical education would do much to prevent such cases, though children will eat or taste almost anything, as has been recently witnessed at Pollokshaws, where two children out of eight attacked died from arsenical poisoning, having picked up in the street some arseniate of soda.

An interesting volume relating to the "Grand Concours International des Sciences et de l'Industrie," which is to be held at Brussels in the year 1888, has just been issued. It consists of reports drawn up by the Committee which have been appointed to make preparations for the Exhibition. From a circular issued under the authority of M. Léon Somzée, the president of the Executive Committee, we learn that the success of the Exhibition, from the point of view of exhibits, is already assured, France, Italy, and England being well represented.

Prof. Helmholtz has been appointed president of the Kuratorium of the Physical and Technical Imperial Institute of Berlin, which is to be opened on April 1 next year. Dr. Werner Siemens, whose donation put the establishment on a working basis, and Prof. Förster, Director of the Berlin Astronomical Observatory, will also be curators. The Physico-Technical Institute has not been devised for teaching purposes, but purely to facilitate research, in which the curators will be always at hand, as experts and consultants, to assist the investigator. It will be under Government protection and control, the authority ultimately responsible for its success being the Minister of the Interior.

At a recent meeting of the Entomological Society, Mr. M'Lachlan reminded the Fellows that at a meeting of the society in October, 1886, he exhibited a number of the so-called "jumping seeds" of Mexico, containing larvæ of the *Carpocapsa saltitans* (Westwood). The seeds have long ceased to jump, which proves that the larvæ are dead, have become quiescent, or have pupated. In June, Mr. M'Lachlan opened one of the seeds, and found therein a living pupa, which turned into a moth on July 4.

The use of poisonous colours in the preparation of articles of food or confectionery is prohibited in Germany by an Act which has received the Imperial assent. The substances indicated are colours and colour preparations containing antimony, arsenic, barium, lead, cadmium, copper, quicksilver, uranium, zinc, tin, gamboge, coraline, or picric acid. The coverings used for holding or wrapping articles are subject to the above general regulations; but exceptions are made for sulphate of barium, coloured baryta lacquers (free from carbonate of barium), chrome oxide, copper, tin, zinc, and their alloys (when used as metallic colours), cinnabar, oxide of tin, sulphuret of tin (when used in mosaic gilding), and colours burnt into the glass, glaze, or enamel of receptacles, as well as those used in painting the outside of packages, &c., composed of impermeable substances. The prohibition of the first-named group of noxious ingredients extends (with exceptions generally corresponding with those already named) to cosmetic preparations, or dyes used for the skin, hair, or mouth, as well as to toys, picture books, flowerpot frames, &c. Special restrictions against the use of arsenic are made with regard to printing and lithographic work, as well as with respect to wall-paper, carpets, furniture stuffs, paints, &c.; a small maximum quantity being permitted in textile articles.

M. Sambuc contributes to the *Revue d'Hygiène* a note in which he calls attention to the danger arising by the distribution of hydrogen from voltaic batteries. Besides the danger of shattering of the vessels, the hydrogen spreading in the air may form an explosive mixture; and it may have a cooling effect through its great conductivity for heat. It also deadens the voice and alters its timbre. Further, if, as may be, the hydrogen is charged with sulphur, arsenic, phosphorus, carbon, or silicium, there are other and greater dangers. These facts are not cited against the use of the electric light, but to induce proper care in those who use it. It does not appear to have occurred to the new alarmist that no sensible person would keep such batteries in the house, unless in a cellar ventilated to the outer air.

M. Letang has described to the Paris Academy of Sciences a new regulator for the electric arc, which is simple and without delicate parts liable to get out of order. An electro-magnet, attracting an armature, is excited by a shunt current from the two carbons, and attracts the armature when the shunt current reaches a certain strength; that is to say, when the arc reaches a certain length. The armature breaks the shunt circuit, and being drawn back by a spring makes the shunt circuit again, and so on. A vibratory movement is thus produced, which is caused to act upon a brake, maintaining the carbons a little apart and allowing them to approach regularly. The employment of a small arc gives a very steady and intense light of about 114 standard candles for a current of 3 ampères at 50 volts. This is at the rate of 1·3 watt per candle. The efficiency is greater when the regulators are worked in series, and is about 1·1 watt per candle.

A new incandescent electric lamp has, it is said, been devised by the electrician of the Julien Power Storage Company at Brussels. The filament is made of a new material, and gives a discharge of electricity in the hydrogen-filled bulb which produces an aureole of light. It is claimed that the illuminating power is one-third greater than in the Edison lamp for the same expenditure of energy.

Electric lights were measured recently by Prof. Henry Morton, of the Stevens Institute of Technology, in the city of New York, and he found that the best of what were called 2,000 candle-power lamps gave only a power of 800 candles. He assumes that the term "2,000 candle-power" has become a technical expression with the electric light companies to denote a lamp of from 500 to 1,000 actual candle-power.

The University of Göttingen will celebrate the 150th anniversary of its foundation on August 7 next.

The Swiss National Assembly has determined to incorporate a law for the protection of patented inventions. The voting was three to one.

What can be done by judicious efforts in the artificial rearing of fish is well shown by the statement that the number of shad hatched in the Hudson this year through the efforts of Seth Green, backed by the State of New York, is 3,800,000. The catch of shad this season is larger than ever before known, and the price has fallen very low, 5dol. to 10dol. per hundred being the ruling rates. Some who contracted early to take all the shad offered at 15dol. per hundred have been obliged to repudiate their contracts. Shad hatching in the Hudson has been in progress a number of years, and the supply of shad increases every year. They come up the Hudson only at spawning time, and when artificial shad hatching was begun it was all the managers could do to get female shad to supply half a million spawn. Now the supply is practically inexhaustible. The shad has this peculiarity, that it lives and grows mainly in the ocean, getting its food from the millions of insects that swarm in its depths. But every year the instinct of the shad teaches it to return to its birthplace for spawning. Thus any State that has a river running into the ocean needs only to get some shad spawn, and start a colony of shad from its waters, to secure a supply of this important article of food after a few years.

The Acting-Consul at San Francisco reports that the vintage of last year, though not so large as that of 1885, was most satisfactory, while the quality of the wine produced shows great improvement upon that of late years. 757,600 gallons were exported by sea, and about 4,500,000 gallons went by rail to New York. It is estimated that in the whole state there are now 180,000 acres bearing vines. Increased attention is paid every year to the practice, which is found to be useful, of grafting foreign cuttings on the Missouri grape; those of the Bordeaux and Sauterne type are specially selected for the purpose. It would perhaps be found more advantageous to endeavour to raise new varieties.

At the meeting of the San Francisco Microscopical Society on June 8, an ingenious device, called the "Quimby Mounting Cabinet," was received for inspection from the society's indefatigable corresponding member, E. H. Griffith. Its purpose is to facilitate the illumination of objects by transmitted light during the process of mounting, and this object is very satisfactorily attained by the apparatus referred to, both by daylight and artificial light. Dr. Selfridge brought a sample of the Oakland water supply, which upon examination was found to contain large nnmbers of the interesting infusorian, *Ceratium longicorne*. Some four years ago the water supply of this city contained enormous numbers of the same little organism. At the meeting on June 22 it was announced that Mr. A. J. Doherty, of Manchester, would visit the city in a few months, and that arrangements had been made with him for a series of demonstrations of the most approved methods used in the preparing and mounting of objects for the microscope. The useful little device known as "Griffith's Focus Indicator," was shown by Mr. Riedy. Its object is to enable an approximate focus to be obtained almost instantly, and to prevent the accidental crushing of a slide or cover-glass by the objective, in focussing. Mr. Norris announced that through the kindness of Mrs. Ashburner he had come into the possession of a number of exquisite slides, mounted by the late Prof. Ashburner, comprising preparations of the celebrated "original Santa Monica" find. No better disposition could be made of these, Mr. Norris thought, than to distribute them among the members of the society, which he proceeded to do. Specimens of rich diatomaceous earths from near San Pedro, and from near Santa Monica, collected by Mrs. Bush of San José, were also handed in by Mr. Norris.

USEFUL AND SCIENTIFIC NOTES.

A New Grain-Drying Machine.—At Castlebank Mills, Dumfries, recently, a trial took place of a machine which promises to revolutionise the system of grain-drying. Though small, in this case, it dries at the rate of about forty bushels per hour. It takes the form of an iron case, 14ft. long, 10ft. high, and 2ft. wide; while the interior is occupied by a system of four wire cylinders, with a screw on the outer surface of each, extending its entire length. The heated air from the furnace enters at the basement, and the grain, which is supplied at the top, is carried by the screws from cylinder to cylinder, and discharged after a journey of about an hour's duration, perfectly dry and hard. Above the uppermost cylinder there is a chamber 2ft. deep, where an exhaust fan is fixed to maintain a continuous current of hot air, and expel the steam as it rises off the grain. Among the other advantages claimed for the machine is that the drying is more equal than is effected by a kiln, that the heating can be done at 50 per cent. less cost, and that the machine can be, if so desired, shifted from one locality to another. The machine was invented by Mr. James Black, Dumfries, formerly a kilnman, and the cost is stated by a local contemporary to be £200.

THE following is given for a lecture experiment by C. Schall:—The specific heat of zinc is nearly twice as great as that of tin, and this, taken in conjunction with the fact that both metals have nearly the same specific gravity, renders them suitable for demonstrating Dulong and Petit's law for lecture purposes. Rods of the two metals of similar section and equal weight are heated to 150—170deg., and then placed on paraffin-wax; the paraffin melted by each can be weighed, and is proportional to the specific heat of the metal in question.

THE new contact apparatus of the Westminster clock was brought into action on May 22nd, 1886, and the automatic signals from the clock have been received at Greenwich regularly from that date, except on three days following the snowstorm of December 26—27. The error of the clock was insensible on 25 per cent. of the days of observation, 1sec. on 40 per cent., 2sec. on 22 per cent., 3sec. on 11 per cent., and 4sec. on 2 per cent. On one day the signal was 15sec. late, and on another day 10sec. late.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE SEYBERT COMMISSION ON SPIRITUALISM—THE "BIBLIOGRAPHIE GENERALE DE L'ASTRONOMIE"—MANUAL LABOUR VERSUS GENTEEL OCCUPATIONS—TECHNICAL EDUCATION AND THE STATE—POISONING CATS—SHOWING BUT LITTLE "CLEMENTSY"—SALT—BEER AFFECTED BY THUNDER—OPTICAL EFFECTS OF SATURATED AIR—PAST PHASES OF MOON—THE SECTIONAL FIGURE OF THE MOON—"SUN BEFORE (OR AFTER) CLOCK"—CELESTIAL PHOTOGRAPHY WITH AN ORDINARY CAMERA—DIAMETER OF MARS AND OTHER PLANETS—UNIFORMITY OF NATURE—FIVE AND SEVEN FIGURE LOGARITHMS.

[27650.]—THERE is nothing more curious in the history of psychology than the fact that, despite the manner in which medium after medium has been detected and exposed, a sufficient number of fatuous idiots should remain in this country to support a (so-called) "spiritualistic" journal. But for this remarkable illustration of the intellectual depth to which otherwise sane people may descend, I should fain hope that the Report of the Seybert Commission on Spiritualism (of which you give a précis on p. 453) would rouse some of the few remaining believers in this exploded imposture to investigate the grounds of their own faith—an investigation which, if honestly carried out, can lead but to one possible result. I say advisedly "if honestly carried out"; for when, to take a single illustration, we find such a man as poor Mr. Sinnett still professing belief in that highly respectable person, Madame Blavatzky, after the crushing and unanswerable exposé of her barefaced imposture made by Mr. Hodgson (vide part IX. of "The Proceedings of the Society for Psychical Research"), it is abundantly evident that the spirit which dictated the utterance of Tertullian, "Credo quia impossibile est," is not yet thoroughly extinct. Certainly if the Society for Psychical Research had done no other service, it would be entitled to public thanks for the way in which it has shown up the sorry cheat of spiritualism. It, in common with the Seybert Committee, has been recently investigating slate writing as practised by a fellow called Eglinton, and very charmingly Eglinton is exposed in the May number of its Proceedings. It is needless to reiterate my own experiences with media here. Such shallow impostors did I find them, one and all without one single exception, that I was lost in a kind of dumb amazement to see other people taken in by them. I trust that you will favour your readers with a *résumé* of the concluding part of the Report of the Seybert Commission.

I can heartily endorse the praise you bestow (in your "Scientific News," on p. 457) upon the really marvellous "Bibliographie de l'Astronomie" of MM. Houzeau and Lancaster. To every working astronomer who has not access to the largest libraries this astonishing monument of patient research is indispensable. To him who is fortunate enough to be able to use such a library, the "Bibliographie" furnishes a catalogue raisonné of every book he can possibly require. The whole book must shed honour and lustre on Belgian scientific literature.

I hail with satisfaction the admirably common-sense and suggestive letter (27592) of Mrs. Ethelinda Hadwen on page 460. Her remarks, although primarily having reference to the inhabitants of cities and large towns, might, mutatis mutandis, be as equally well applied to our rural as to our urban population. Domestic service as an occupation for the daughters of labourers is at an utter discount, while their brothers who used to furnish our ploughmen, carters, stockmen, &c., are nowadays quite above doing manual labour. To be pupil teachers is at present the idea of scores and hundreds who twenty or thirty years ago would have carried off prizes at agricultural shows for dexterous ploughing, well-made butter, and so forth. Hence the teaching market is getting glutted, and by-and-by wages in it will come down with a run. In their burning desire to be "genteel," these deluded people never seem to foresee the inevitable and stupendous crash that must sooner or later come when everybody follows their silly and evil example. It is not the occupation that makes the man. An artificer who respects himself may be a gentleman in one of the best senses of that much abused term. A clerk (even in a Government office) may, on the other hand, be an unmitigated "cad." "I think," with Miss Hadwen, "there is too much snobbishness abroad."

Let me recommend "Shaper" (letter 27593, p. 460), who looks to the State to provide technical education, to obtain and read carefully through Herbert Spencer's brochure, "The Man versus the State," published for a shilling by Williams and Norgate.

If "Œdipus Rex" (letter 27610, p. 467) will consult section ii. of 27 and 28 Vict. c. 115, he will find it recited that "Every person who shall knowingly and wilfully set, lay, put, or place, or cause to be set, laid, put, or placed, in or upon any land, any flesh or meat which has been mixed with or steeped in or impregnated with poison or any poisonous ingredient, so as to render such flesh or meat poisonous, and calculated to destroy life. Penalty not exceeding ten pounds." So that your correspondent's cat is as much protected as his dog by this statute. I must, however, add the expression of a grave doubt if simply fried star-fish could be included in this category. On the other hand, a man may lawfully set a rat-trap in his private garden to catch cats and dogs, for a conviction under 24th and 25th Vict. c. 97, s. 41, for doing so (in the case of Bryan v. Eaton) was quashed on appeal. It is a matter of feeling. Some people are not sufficiently fond of cats to sacrifice their choice seeds and plants to them.

Before paying the slightest attention to Mr. Clements's curiously-cooked statistics in his letter (27612) on p. 468, I would invite my brother readers to turn back to p. 587 of Vol. XXXIX. of the ENGLISH MECHANIC, and compare Mr. C.'s prediction there with Mr. Symon's "British Rainfall" for 1885.

I must crave Dr. Allinson's pardon for pointing out that whomsoever he answers in letter 27614 (p. 468), he does not answer me. He made a perfectly definite and categorical assertion in his article, which I copied in letter 27476 (p. 365), and which I here repeat: "Animals," said Dr. A., "in a natural condition will not usually eat salt, nor will the untutored savage." In reply to this I showed that wild animals always eat salt (or drink saline water), and that many African savages will actually sell human beings—nay, the natives of Sierra Leone their sisters, wives, and children—for this most necessary article of diet. To quote *Tit-Bits!* as a reply to this is—well, let us say, just the least shade irrelevant.

The reply (62543) of "Nun. Dor." on p. 469 reminds me that I once heard that lightning turned beer sour because it didn't know how to conduct itself. But it struck me that this rather failed as a strictly scientific explanation.

"Bryn" (query 62758, p. 472) will find that refraction increases with atmospheric pressure, and becomes greater as the barometer rises. Now, in this country such rise takes place from an influx of heavy dry air; hence it is obvious that it is not rain or atmospheric vapour that causes it. The whole subject of abnormal refraction is obscure. I have seen a range of cliffs on the South Coast of England apparently suspended at a considerable height above the horizon. Contiguous strata of air differing greatly in temperature must have a large share in producing these phenomena.

"P. R." (query 62771, p. 472) must simply hunt through old almanacs for his lunar phases, and through the *Nautical Almanac* since 1801 for the data necessary to compute the times of moonrise and moonset, the actual calculation of which, by the bye, is a very operose matter. I fancy that I myself gave a sketch of the process years ago in these columns. It is the rapid change of place of the moon in the sky which renders the computation of the times of her rising and setting so difficult. In the case of a star whose R. A. and Dec. remain sensibly constant during the time of description of its diurnal arc the formula for finding its hour angle is simplicity itself. The sine of the arc which turned into time is to be added to—or subtracted from—6 hours (according as the star's declination is north or south) to get the time from the star's rising to its transit = tan. star's dec. × tan. of the latitude.

In reply to "B." (query 62793, p. 473), his seeming protuberance of 50 miles on the moon is a simple optical illusion. Hansen, to explain certain inequalities in the moon's motion, propounded the hypothesis that her centre of gravity is 33 miles beyond the middle of her longest diameter—a conclusion which Adams refuses to accept. Newton calculated that the moon should be 178ft. longer than she is wide, but there is a wide difference between 178ft. and 66 miles. No direct measures of the lunar ellipsoid have yet been made; in fact, I gravely doubt if we have any instrument delicate enough to take them. Gussew's measurements (R.A.S. *Monthly Notices*, Vol. XX. p. 210) were of De la Rue's well-known stereoscopic photographs, and he found—like "B."—that the greatest deviation from the spherical form was something like 0·05 of the radius. But no importance is attached to this result by astronomers in its numerical aspect.

I would enter a protest against the vagueness and misleading character of the method employed in many almanacs to indicate the equation of time: I mean that of heading the column containing it, "Sun after Clock"—or "before Clock," as the case may be. If the phrase "Equation of time" + or − be considered too technical, it would be much better, and more intelligible to the ordinary user of the table, were it headed "Add to Sundial Time," or "Subtract from Sundial Time." He would not then, as he has at present, have to think seriously what time his watch should show at apparent noon, and perhaps as often as not think wrongly.

In reading of some recent triumphs in celestial photography, it is difficult to dissociate them from the idea of the employment of large and costly telescopes fitted with the most elaborate apparatus and contrivances. M. Prinz, then, of the Royal Observatory at Brussels, has done wisely and well in showing, in his brochure "La Photographie Astronomique par les Petits Appareils," how the possessors of ordinary portrait or landscape lenses (and notably of the latter), have it in their power to produce photographs of the heavenly bodies of a very considerable degree of merit, and of undoubted scientific value. The pamphlet now lying before me, published by the Belgian Institut National de Géographie, is a reprint from *Ciel et Terre*, and is illustrated by several plates taken from clichées of M. Prinz's own negatives. He warns his readers that, with two exceptions, these fail to do justice to the originals; but, even with this qualification, they are remarkable illustrations of what may be effected by such apparatus as is in the possession of every practical photographer. Everyone who can read elegant and fluent French, and who is interested in the photography of the heavens, should procure this pamphlet straightway. I should think that it ought to be obtainable through any foreign bookseller in London.

It seems very probable that the value given by Le Verrier of the equatorial semidiameter of Mars at the Earth's mean distance from the Sun (and repeated on p. vi. of the *Nautical Almanac*) is too great. Taking a mean of the measurements of Bessel, Johnson, Kaiser, Schmidt, and Engelmann, I find that it comes out 4·7″, as against Le Verrier's 5·5″, adopted in our national ephemeris. This would make the diameter of Mars 4,210·6 miles, instead of upwards of 4,900 as calculated by "Tria" in letter 27617, on p. 484. By the way, I think that your correspondent should have warned his readers that his methods are only fairly approximate ones. If we are to accept the semidiameters of the planets which appear in the *Nautical Almanac*, remembering that they are computed on the supposition that the planets are all separated from us by the mean distance of the Earth from the Sun (92,392,450 miles), then they simply become the sines of the angles they subtend, with the mean solar distance as radius. Hence all that we have to do is to multiply 92,392,450 miles by the sine of the angular semidiameter of any planet—in other words, to add their logarithms together—to get such semidiameter in miles. Take Venus for an example. Her semidiameter is given as 8·305″, of which the log. sin. is 5·6049145, and if to this we add the log. of 92,392,450—i.e., 7·9656365—we obtain 3·5705510 the log. of 3,720·07 miles, the equatorial semidiameter of Venus; and, of course, twice this—or 7,440·14 miles—is her equatorial diameter.

Once again, in letter 27637 (p. 488), have we the *petitio principii* in all its nakedness. Suppose that six comets per annum have fallen on the earth during the last 50,000,000 years. If they exercise no influence upon it, how can such encounters in any shape or way affect "catastrophes"? In all this there is covert reference to Whiston's crazy trash about a comet having caused the mythical Noachian Deluge.

I willingly accept Mr. Woodward's explanation, given (in letter 27643) on p. 490. I rather imagine that ordinarily the power of writing down a sequence of figures is one derivable from constant practice rather than from any innate faculty; albeit such faculty does undoubtedly exist to a far greater extent in some people than in others. As I happen to have obtained a copy of Mr. Woodward's logarithms myself, it may not perhaps be out of place here if I express my o[illegible] of their compactness and valu[illegible] chemical tables I have no use for; but (of course, in addition to the logs. of numbers) there are several others which will be found useful by the physicist. The mode of indexing the logarithms of numbers is a most excellent and ingenious notion.

A Fellow of the Royal Astronomical Society.

OCCULTATION OF ALDEBARAN.

[27651.]—IN anticipation of the occultation of Aldebaran on Sunday morning last, I began to compute the local times of disappearance and reappearance, the *Nautical Almanac* giving the limiting parallels of 76° N. and 6° N. I had, however, not proceeded far, until I saw there would be no occultation here (nearly 55° N.)—only a near approach. In fact, the star at the time of nearest approach was about 2′ from the moon's limb. Now, I think it will be admitted that in this case the limiting parallels of the *N.A.* were rather wide of the mark. Perhaps this may come under the notice of "F.R.A.S."

July 18. **J. R.**

ASTRONOMICAL.

[27652.]—PERHAPS some reader can identify some of following pairs, or say if faint *comes* referred to are new.

β 377. Very faint *comes* at 50″, 340°. Scarcely worth mention, only that the small 3″ pair seems as distant from principal star, and also there seems a considerable change in angle of small pair. Originally 30°, it now is about 308° or 310°.

Near θ Herculis. 2° S. a little *p.*, a pair, 8½ and 11″, 85° 2½″ ±.

Near Σ 2022. 1¾° *f.* a little S. is a similar star to Σ 2022. 4′ ρ a little S. which is a neat pair 8½—9½, 12° 3″ ±.

δ′ Lyra. Star 30′ N. has *comes* 8th and 10th, 160° 8″.

Σ 1990. The 8½ mag. at 59° has a *comes* 260° 28″.

Σ 2059 Herculis has three faint *comes* 313° 50″, 145° 45″, and a third closer, too faint to get position.

Near μ Cephei two small pairs in line nearly, one pair 44′ from μ, 8th and 9th, 295°, 4″ ±, the other 44′ distant from this pair, 8th and 10th, 360°, 4″ ±. Each of these pairs is one of two stars, the four being nearly in a straight line ρ μ.

Can any one give present distance of Σ 2107? It seems very close and difficult. I am quite unable to divide ζ Böotis this year. The best I can do is two discs squeezed together slightly; even with 900 there is no separation.

I can assure "Tria" that he need not doubt his division of η Coronæ. It is easily divisible now with such aperture as 9″ or 8″ on a decent night; but the definition latterly has been of the poorest. At any rate, in London, the finest telescope ever made would be condemned if tried on any night this summer. I have found it impossible to focus stars to discs at all, and therefore high powers have been quite useless.

γ Coronæ I have tried on the best occasions; but never get image good enough. I fail to see any trace of elongation. M. Gaudibert is to be congratulated on his superior position; but far more for his evidently much superior mirror, and very much keener vision. **Edwin Holmes.**

ETA CORONÆ.

[27653.]—I SEE that "Tria" refers to the above star in the last MECHANIC.

It is now well divided with about 800 in my 10in. refractor (dialyte). I should say the dist. is 0·6″ ± P = 185° ± est. It is easier than ζ Böotis, which is almost in contact at 110° ±.

Herbert Ingall.

HOT-AIR ENGINE.

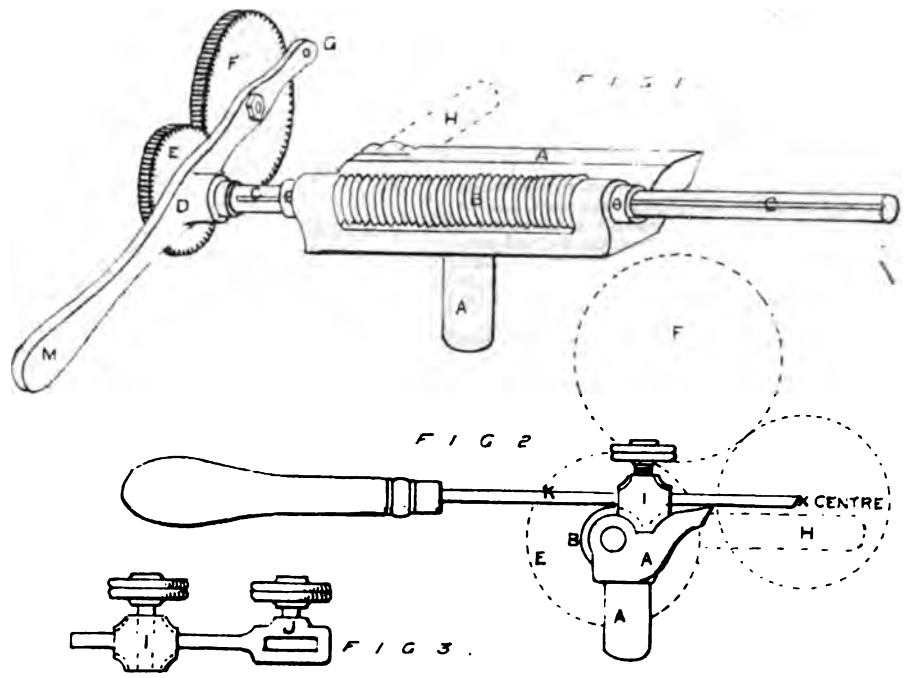
[27654.]—I AM much interested in the remarks of "F. A. M." and J. Seal on the hot-air engine. I am about making such an engine for my own use, and would like their opinion on some points. I had always supposed, as does "F. A. M.," that the working cylinder should be kept as cool as possible. In fact, that the theory of the engine was to make the lower part of engine hot and the upper part cool; as, however, J. Seal has much experience here, perhaps he is right. Will he write further on this point? I should also like his and "F. A. M.'s" opinion on the necessity of the regenerator either of wire gauze or thin plates, between the displacer and working cylinder.

B. R. W.

SCREW-CHASING DEVICE.

[27655.]—THE following device is now offered to the readers of the ENGLISH MECHANIC as a contribution to the notions for screw-cutting and as a substitute for the traversing mandrel.

In this invention the guide screw is fixed to and rotates in a hand T-rest. The guide screw is [illegible]iven by a pinion with intermediate gearing



wheel rotating on an arm attached to the spindle of the guide screw, and the intermediate wheel gears with a pinion on the mandrel or lathe chuck. The guide screw may drive a point tool direct, resting in the groove of the screw, or a chaser be held in a clamp which has part of the pattern screw on one of its faces, and so traverses the hand tool. A series of guide screws and rubbers may be used or different pitches be got by change-wheels from one or more guide screws.

In the sketch, AA is the casting of the T-rest, Fig. 2 an end elevation. The spindle *cc* is fitted with collar and lever arm M D G rotating freely on it. Pinion E is fixed to the spindle, and wheel F runs loose in gear with E. The spindle *cc* is key slotted, and made long and stiff enough to give plenty of range for adjustment of the rest longitudinally, and wheel F is sufficiently large to give ample cross adjustment when lying over, under, or between the driving pinion on the mandrel or chuck. The guide screw or series of guide screws B have a feather, and the spindle can be set by end collars with set screws when adjusted for the work in hand. The clamp I is made to traverse along the recess seat on the top of the T-rest, and its four corner faces may each be a portion of a nut to gear with corresponding guide screws. The apparatus can at once be thrown in or out of gear by the lever M, and a spring or weight be attached at G to keep it in gear with the mandrel. The tool and clamp can also be taken on or off the work without stopping the lathe, and will traverse the length of the guide screw. For inside work a supplementary bar rest H may be screwed on, and the clamp (Fig. 3) fitted to the inside tool will convey the traverse.

J. A. Armstrong.

THE EDMUNDS MANDREL.

[27656.]—ONE more point remains to be discussed with regard to the *form* of our model mandrel-head. It is the screw-thread.

There are practically three forms of thread for us to choose from. There is the angular thread, more or less truncated and rounded off as in the Whitworth bolt, or merely truncated, with a flat top and bottom, as in the Sellers screw. Then there is the square thread as used in Whitworth planers of vast size and power; also in screw-presses; in the motorial and measuring screws of our slide-rests, vices, and other small tools. Lastly, we have the buttress-thread, which is virtually a square thread cut diagonally in half, so as to give all the advantages of the perpendicular face on one side, while double the number of threads can be cut upon the same length of screw-stem. Now, for work in which only a one-sided action of the screw-thread is required, the buttress-thread affords that vast advantage of a perpendicular working face which is given by the square thread; while with that it combines the advantages given by the angular thread in the way of larger area of thread-base, and consequent greater strength against stripping. Therefore, the buttress-thread, for such cases as are suitable, actually combines all the advantages of the angular and square threads while it excludes the disadvantages of both. It gives us the strength of the angular thread *plus* the freedom from abrasion and waste of power which is afforded by a perpendicular working face. The only question, then, is whether our cylinder-face mandrel-head is a proper tool for the application of the buttress-thread.

Practically, the square thread must be rejected. 1. Because of its liability to strip unless the nose be unduly lengthened so as to make up for the fact that its pitch is more than twice its depth. 2. Because the square thread is a most difficult one to execute in the interior of chucks. 3. Because the thread when executed in wooden chucks has inadequate strength.

As to the angular thread, the slope of its face really constitutes the surface of a cone cut up into a riband and wound round the stem of the screw. Therefore, the angular thread has the same centring power as the cone-chuck. This thread is really a circular wedge, and on each diameter of the screw the two sloping sides of the thread bring the chuck irresistibly to its bearing upon the virtual axis of that diameter. Just so with all the diameters, and the axis upon which the chuck centres is determined by the compounding of these radial wedging actions all round the screw, actions which tend to burst the nut, and which actions are the principal cause of the abrasion and deterioration which take place in a working screw. Scientific mechanics know this so well that they never think of using an angular thread where continual working and the transmission of great force are required. The angular thread, therefore, is demonstrably *not* the ideal thread for the mandrel-nose; but, destitute as the mandrel-head has hitherto been of any other centring agency, there has been no alternative but to use the angular thread.

The square thread—or the half-square thread known as the buttress-thread, the resistance-thread, &c., and which may be seen in the breech pieces of Whitworth cannon—is not destitute altogether of centring power, but its centring action is entirely destitute of that most strenuous factor—the radial wedging of the angular thread; its last instalments of centring action also are but sluggishly and feebly exercised. The buttress-thread, therefore, in an ordinary lathe-nose would fail by reason of its lack of centring activity. But in the mandrel-head furnished with our centring cylinder-base we need to exclude the strenuous centring action of the angular thread. Here, therefore, we have the mandrel-head which can afford to avail itself of the vast advantages of the buttress-thread, so as to get a straight pull up to the mandrel-face without waste of power, and without that abrasion which is caused by the wedging action of the angular thread.

Convinced of this guiding principle, Mr. Gray and myself have cut a number of model threads, and we have both come to the conclusion that the buttress thread, one face perpendicular to the axis of the mandrel, and the other face at an angle of 45°, truncated $\frac{1}{4}$ both at top and at bottom, is the most perfect thread for our model lathe-nose, and also a thread to be recommended for general use in numerous cases where similar functions are to be discharged.

As to the thread-rate, we find that a thread of five turns to the inch makes a beautiful nose-thread, and one whose properties are at once all before the mind. This five-turn thread has, of course, a pitch of one-fifth of an inch. Truncated one fourth top and bottom reduces it to one half its normal height, and, therefore, this thread incises the bolt one-tenth of an inch, and affords a perpendicular working face one-tenth of an inch in radius, and of a length which is the diameter of the bolt multiplied by 3·1416. Not only does the truncation of one-fourth take one-twentieth of an inch off the height of the working face of the thread, both at top and at bottom; but it also leaves a flat in each case, which is one-twentieth of an inch in width. In fact, the depth of this thread is half its pitch; the flat top on the thread, and the flat bottom on the stem, are each one quarter of its pitch. No data could possibly be simpler; no form could be more enduring and less liable to injury in steel, cast iron, metal, or wood, than this thread. And, if the square be cut up into sixteen smaller squares, by ruling four intersecting parallels each way, this interesting fact will be made manifest that, if the obtuse corners of the thread and of the tool which cuts the groove be rounded down, we practically get two reversed sectors of parabolas whose bases are twice the length of their heights. In fact, we get in this thread, when worn, a sinuous curve which represents a pair of parabolas whose bases are each the semi-latus rectum.

I think that we cannot do better than adopt this buttress thread—five turns per inch, truncated by a flat to the extent of one quarter both at top and bottom.

If, now, we agree to the wide face, the cylinder-base, and this buttress-thread, our model is settled so far as its *form* is concerned. But we have still to settle its *dimensions*, as, without identity of dimensions, we cannot get interchangeability. The precise width of the mandrel-face, and the precise length of the threaded portion of the mandrel-nose may be left as variables. The same chuck would set perfectly upon different mandrel-heads, though the width of the mandrel-faces and the length of the screwed portions of the nose varied within considerable limits. But it is essential that the diameter and length of the nose-base, the diameter of the nose, and the form and rate of the screw-thread be the same in all cases. Having settled our screw-thread, it remains only now to settle the size of the nose-base and the diameter of the screwed nose. Now, it is important for many lathes, in which multiple noses upon ornamental chucks are accumulated, to keep the nose *short*. With our wide-face and tubular mandrel we no longer deal with our mandrel-nose as a screw bolt, but as *a tube*. On the one hand width is of little inconvenience, while, on the other, width gives great solidity and great resistance to the leverage which is exerted with work upon the margin of a face-plate. It is, therefore, wise to give our mandrel-nose width rather than length, and by giving our mandrel-nose *width*, the addition of another turn of the screw-thread (i.e., ·2in. to the length) makes a large and massive nose for an amateur who may occasionally wish to do heavy metal-turning. Width, moreover, gives us the scope we want for development of design in the way of making the interior of the mandrel-nose a chuck-hole to receive miniature chucks, very accurate centres, &c., &c. Without now submitting further suggestions in this direction, I think we may not do better than adopt a nose whose total projection from the mandrel-face is 1in., and whose diameter is $1\frac{3}{8}$in. outside the thread, and whose cylinder-basin is ·2in. in clear length and $1\frac{7}{16}$th in diameter. The inch nose thus affords ·8in. for the screwed portion which, with five turns per inch, gives three turns of a massive thread, with a perpendicular face about 12in. in length and ·1in. in radial measurement. This thread will be ample both for strength and endurance of wear; but another turn of the thread may be added by lengthening the nose, and the bore of the mandrel may be cut down from $\frac{5}{8}$th to $\frac{9}{16}$th, or to a full $\frac{1}{2}$in. If we cannot agree to so wide a nose as $1\frac{3}{8}$th, we shall have to reduce it to $1\frac{5}{16}$th.

The nose-base must afford its ·2in. in length clear of the rounding out at the base, and in order to get this we turn out the inner half of the mandrel face about ·05in. or more in depth, so that the projection-figure of the mandrel-head shows this as a sharp rectilineal angle, yet without committing that fault in design which would be involved by a real sharp angle in hard steel work. Then I should give a very slight taper ($\frac{1}{100}$) to the nose-base—a taper such as would be given by a slide-rest set to turn up a cone 10in. in length, and ·1in. smaller in diameter at one end than at the other. The chuck recess would of course be tapered out to the same angle, and in this way we should secure an easy entry and a close fit without material abrasion. With absolute cylinders this would not be practicable.

Now that the whole of our proposals are before the readers of the ENGLISH MECHANIC, we hope that free and strenuous criticisms may be afforded. If friends would turn up an accurate box-wood model of the mandrel-head now proposed, they would find such a practical study of the question suggestive and helpful in criticism. The front bearing of the mandrel-shaft will be $1\frac{3}{16}$th or $1\frac{1}{4}$, with a collar whose outside length is only 1in. The chuck recess would best be finished out to gauge by an accurate reamer, or the bell-mouthing left by an ordinary tool must be avoided by finishing with a very solid tool, and by leaving $\frac{1}{16}$ on the face of the chuck to be taken off after the recess is worked out to gauge.

Since writing the above I see that in a recent letter (27631) Mr. Gray argues against tapering the nose-base. Further consideration will probably bring Mr. Gray over to the view that the nose-base must be slightly tapered. Mr. John A. Newall, whose "standard steel mandrels" ground up to gauge are well known in workshops, writes thus of mandrels in his catalogue :—

"They are made of a special hard steel, the ends carefully centred and hardened, and the bodies ground in a special machine, truly round to standard size, so that the purchaser gets not only a first-class mandrel, but a standard gauge and a pair of limit gauges all in one tool. The part between the two lines scribed near the middle of the mandrel is the exact size, while the ends give the largest and smallest sizes respectively that can be allowed to pass. The usual taper is $\frac{1}{100}$th of an inch per foot."

Now, the taper here adopted by Mr. Newall is $\frac{1}{1200}$—i.e., his mandrels diminish $\frac{1}{1200}$th of an inch in diameter for each inch of length, and although the taper of $\frac{1}{100}$ upon our nose-base is twelve times as quick, it must be recollected that our nose-base will be only ·2 or ·25in. in length, and $\frac{1}{100}$ gives a difference of only ·001in. for each ·1in. in length between the diameter of the cone base and the end of the chuck recess. This does not amount to too much to secure an easy entry. As to reproducing and matching such a rate of taper, it can be done with great accuracy by setting the slide-rest so as to turn up a long taper, and then gauging the two ends of the work. The pair of gauges, button and washer, will amply suffice to gauge these tapered surfaces. Every workman can now take his tools up and test them by the splendid series of gauges kept for public use by the Board of Trade, and therefore there is no difficulty in working to gauge. I have been using, with great satisfaction, one of Mr. Newall's "standard steel mandrels" for my work on these lathe-nose models, and find that it quite answers the description given of it in his catalogue. As to the great cost which some of our contributors imagine to be involved in working to gauge, I may perhaps say that Mr. Newall's $\frac{5}{8}$th standard steel mandrel 5½in. in length costs 4s. 2d., and, if hardened all over, 25 per cent. more.

The remark which Mr. Gray quotes from my last letter is true in relation to wide cones, such as those of 45° to which I was then referring. But it does not apply to cones tapered so slightly as $\frac{1}{100}$. These are, practically, cylinders with only such taper as to secure an easy entry, prevent abrasion, and give a close fit when home. A long cone is almost a micrometric measure of diameter, and by sliding within the washer gauge will determine its diameter very closely by the point at which it is arrested. This is shown at once by sliding any such object along one of Mr. Newall's steel mandrels.

If further argument were needed in favour of this slight tapering of our nose-base, I should derive such arguments from the "transfer-chuck" of rose-engine and ornamental-lathe men. In this "transfer-chuck," the "cylinder-fit" is always tapered about $\frac{1}{20}$. The ENGLISH MECHANIC of July 25th, 1884 (No. 1,009), contains a paper by myself which fully explains, and as I believe for the first time, the action and principles of this "transfer-chuck." In that paper it is shown that the "transfer-chuck" consists essentially of a small face-plate accurately fitted to its own mandrel, and then turned up so as to present a wide, flat face, combined with a cylinder, or rather taper fit. By that combination, and two counterpart surfaces upon the chuck to be transferred, chucks with partly-executed work upon them may be accurately transferred from one nose to another. Now, the ornamental lathe may have as many as ten or more repetition noses, and each of these transfer-chucks has to be engraved for the particular nose to which it belongs. The chuck is spoiled if forced on to the wrong nose. The "transfer-chuck,"—when made and reserved without blunder for its own nose, is a rickety, spoilable contrivance. Now, what I propose in our interchangeable mandrel is, to put this cylinder-face-fit upon the mandrel itself, and so give to all important chucks this extreme accuracy in fit—such accuracy that consecutive fittings upon the same mandrel, or tranferences to other standard mandrels will all be as perfect as the best results of the "transfer-chuck" of the ornamental-lathe now are. There is only one objection, and it is this. Part of the business of ornamental lathe-making seems now to be to provide contrivances for killing the time and using up the funds of those unhappy people who have more time and more money on their hands than they know what to do with. This benevolent section of the ornamental lathe work will undoubtedly be crippled by my proposal to put the cylinder-face-fit upon the mandrel itself, instead of first making a set of mandrels amongst which the chucks will not transfer, and then making the "transfer-chucks," in order to make them run true when transferred. The cost of adding the cylinder-face-fit to the mandrel is certainly not more than that of making a single "transfer-chuck." This seems to be its only real objection. To say that it will not answer cannot be said without asserting that the "transfer-chucks" always prescribed by the ornamental lathemakers have not answered the purpose for which they have been sold, and for which they have been regularly used by such workers as Mr. Perigal, General Clarke, and hundreds of other eminent mechanics. Perhaps Mr. Gray will refer to the engravings which illustrate my paper on the "transfer-chuck," and reconsider this question.

There is another chuck which must not be confounded with the "transfer-chuck" which we have been discussing: I mean the *adapter chuck*. The adapter chuck adds to the mandrel on which it is fitted a second mandrel-head of another size or different screw-thread, and thus enables a second set of chucks to be occasionally used upon a larger lathe than that to which they belong. In this case the blank adapter is bored out, screwed, and faced up to fit the mandrel-head on which it is to work; its free end is then made into the second or duplicate mandrel-head—the duplicate copied so accurately from the other lathe that its chucks run true upon it. This, though a kind of "transfer-chuck," should be distinguished as the adapter chuck. One objection to adopting the large nose lately proposed for our model mandrel has been that the costly old apparatus belonging to our present ornamental lathes cannot be fitted to it. But all such apparatus may be utilised by the simple expedient of a steel adapter chuck. The adapter chuck does not run well upon the ornamental lathe mandrels because of their puny size and want of strength. But upon the large nose and wide face of our model mandrel, adapter chucks can abundantly carry all the old ornamental apparatus now in hand.

James Edmunds.

8, Grafton-street, Piccadilly.

CENTRING BITS FOR LATHE WORK.

[27657.]—I TRUST that "Eos" (letter 27630, page 487) will excuse my pointing out that he has not explained the true use of these bits. Any taper rosehead used in an ordinary brace would accomplish what he describes much quicker and equally efficient. My method of making and using a centring bit is to take a suitable piece of cast steel, forge it so as to turn up the same as the usual centre in the moving headstock. Having turned it precisely to correspond with same, I file four squares upon it. Now I heat it to a dull red in a dusky corner, and dip perpendicularly down—down—down into the water, and no after-lowering of the temper. Now, then, to use this tool, we first drill the small hole in proportion to the weight of the job, then we stick this centre into the moving headstock; the other end of the rod may be in a self-centring chuck, or else against the dead centre and a driver put on. Now comes its true function, because we now bring the blunt end of any slide-rest tool, being fast in said slide-rest, gently to bear upon the end of the rod in that place which we want said centre to correspond with, and simultaneously screwing forward the bit and the slide-rest, we bring the hole central at the same time as we make it to correspond with the lathe centres. Note.—Keep the centre and the flat end of the tool well oiled during this operation, and go to work at screwing up very canny, or there will be a smash, which will throw the operator "off his centre."

A., Liverpool.

PINHOLE PHOTOGRAPHS.

[27658.]—THE unsatisfactory photographs are probably due to the raw edges of the pinhole made in the card. Would it not be better to drill a fine hole in a thin ivory plate and attach this to the centre of the card, having first cut out of the latter a piece rather less than the size of the ivory? A pinhole seen through a microscope presents a very ragged and ill-defined outline, with hairs across and about it that would interfere much with the rays of light.

O. J. L.

ON WATERING OUT-DOOR PLANTS.

[27659.]—J. S. BOWLEY (letter 27640) seems to ignore the important fact that the roots of vegetation in searching for water would, under his system, not only enter, but completely fill and block up the pipes of under-drainage, let these pipes be constructed of and in whatever form they may. I can give him ocular demonstration thereof.

As to his sentence, "The more the farmer can assimilate his system of cultivation to that employed by the gardener the more he will command success," I would suggest that J. S. B. should attempt with his own hands the whole of the actual manual labour required in digging, manuring, marketing the produce, &c., of a single acre for one whole year, and live upon the nett proceeds of his said labour and of his cash expenditure for fertilisers, rent, taxes, &c.

That vegetation can progress favourably even in such a dry season as the present, I see plenty of evidence in the promising crops of mangolds around me on the dry sandy soil (new red sandstone formation) of this district.

Lydney. **Archibald Fry.**

MECHANICAL EDUCATION.

[27660.]—IN my ardent youth I spent one year in an export merchant's warehouse in Birmingham, a portion of my duties being to make extracts from the order sheet, and to distribute these orders amongst the manufacturers. By this means I had great opportunities for gaining an education in manufactures, since I was invariably given every facility for inspecting the works, process, &c.

At that time the great lamp-makers were Salt and Lloyd, whose price for the similar plain opal shade only was then four times that of the beautiful, excellent opal paraffin lamps now imported in immense quantities from Bremen, and sold retail in our village grocers' shops as low as 2s. each, and known in the trade as "the Victoria Reading Lamp."

I take this lamp as a specimen involving every scientific principle in combustion and in reflection, while the machinery producing its numerous parts must be actually perfect in principle and in execution. Viewed as a specimen resulting from trade competition, I learn much as to what awaits Great Britain in the immediate future.

The Lydney Dispenser.

TECHNICAL EDUCATION.

[27661.]—"W. A. S. B." by his letter advances the matter no further. Like most advocates of this education, he deals only in platitudes and generalities, and does not go into the subject or suggest the necessary details, or how they are to be carried out. In this he only follows the lead of the principal advocates of the movement, who at present seem to be "blind leading blind." These and they who follow them constantly throw the practice of foreign nations in our face, but give us no information how the subject is dealt with there, what class of people are taught, what subjects are taken up, or what the actual results of the teaching really are. They forget also that Englishmen are very differently constituted from foreigners, and have a greater self-reliance and independence, with a free, popular spirit to back them, and a great jealousy of interference in what they consider their personal rights. Some of the foreign correspondents of the "E. M." would confer a great favour by letting us know the scope of this movement with them, and there is no doubt but whatever is really practical and useful in it will very soon be taken up here.

I fear "W. A. S. B." would find that "the drilling of the rank and file of the industrial army" by the proposed method would only add to the mass of incompetent labour that already swamps and overpowers the competent workman.

To understand the muddle the L.S.B. have got themselves into, it is only necessary to read the following extract from their proceedings on the 21st inst.:—

"TECHNICAL EDUCATION.—The Rev. Charles Lawrence asked Sir Richard Temple, M.P., whether he was correctly reported as having said on the introduction of the Technical Instruction Bill, that he desired to confirm what had been said by the Vice-President of the Council, that the arrangement made by the London School Board would be such as would absolutely impose no extra burden whatever on the ratepayers of the metropolis; and, if correctly reported, to what arrangement he referred.—Sir Richard Temple said that the report in question was substantially correct. He certainly said that he had the pleasure to confirm all that was said by the Vice-President of the Council in respect to the metropolis generally, and that he hoped and expected that the arrangements made by the Board would be such as absolutely to impose no extra burdens whatever on the ratepayers of the metropolis. Of course he did not say that any arrangement had been made, but he expressed his hope and expectation that, in accordance with a plan he had submitted, that the extra fees they proposed and hoped to collect from the students who benefited by the instruction would cover all the extra expense that might be incurred by the Board."

Now, what right have any public body to build on "hopes and expectations" in asking for popular indorsement for their scheme? Why is not the "plan that he (Sir Richard Temple) had submitted" placed before us? Once caught, twice shy. The ratepayers have not forgotten that the leaders of the School Board movement "hoped and expected" that all their expenses would be covered by ½d. in the pound. The ratepayers are entitled to something more than hopes and expectations, and unless something definite is put before them, they will hardly let matters go on as they seem to commence. Will the L.S.B., in the first place, state what they consider technical education to be? Through the darkness of their immature conceptions will they let us see some ray of light, or some definite goal to their proceedings? In the first place, when we ask who is to pay, they answer us, "the students." If that is the hope and expectation of the L.S.B., let them take their pens and strike out nine out of every ten of their scholars. This admission kills their scheme; it absolutely excludes all the poorer and those who require it most. Is it proposed that technical education is to be limited to boys? There are about 100 different trades and specialities of trades carried on in London which are mostly followed in after life by School Board children, and in, at least, 40 of these girls are employed. Is the L.S.B. prepared to teach the technics of all these? If not, which of them are they prepared to leave out? Where are they to get the plant and teaching staff for their mass of schools?

"W. A. S. B." admits that "nobody supposes that capable mechanists will be turned out of the Board Schools." Of course, nobody does suppose it; but we have a right to ask what is "hoped and expected" to be turned out? Should any lad enter a trade from such a school, he will discover that most of what he has *paid to learn* at the school is useless to him in his trade, and that what he has acquired from many terms of evening classes he could have easily learnt in a month's daily work at his shop. Many advocates of the movement admit that some of these boys will follow no trade. Then why should they waste time which at their age could be more profitably spent? As long as their teaching costs nothing, no one can object; but let it once touch the pocket of the ratepayer, they will show their objection to the production, at their expense, of any amount of infantile amateurs.

It is high time that the L.S.B. wrote "Ne sutor ultra crepidam" across their board-room wall. Let them limit themselves to teaching thoroughly the three R's, and the merest elements of various sciences, and, as "W. A. S. B." suggests, make their schools "ladders to the workshop" by giving a good general education, and leaving technicalities to trade workshops, and they may be convinced that the education so given, if faithfully pursued, will be of more after advantage to the scholar in following any trade than such technicalities as could be taught in Board School workshops, supported only by the pence of the comparatively few who would be able to use them. **Shaper.**

SHOULD WE EAT SALT OR NOT?

[27662.]—DR. ALLINSON'S statements with regard to salt being injurious (perhaps also on some other subjects) require to be taken with the proverbial grain of that useful condiment. Regarding the case of gastric catarrh he mentions, I should say it was at least doubtful whether the disease was caused by the salt, or whether the desire for the salt was caused by some gastric irritation, or not improbably may, like many of our troubles, have been brought on by a chill.

With regard to horses, even when fed properly—plenty of grass, and if in work a fair allowance of grain—they still usually, as far as my experience goes, retain their liking for salt.

Pigs, as far as I have noticed, do not require cinders as long as they are not prevented by rings in the nose from rooting about at their own good pleasure. Probably they pick up with their food the grit they require. If they are not allowed to, they like a little cinder or chalk to help them to digest. Birds require sand or grit to help digestion, so why should not pigs? Perhaps they see their way to develop a gizzard.

About forty years ago I was some time in the forests of Western India, and came across a race of men who were ignorant of the use of money and salt, lived mostly on a grain called ragee, vegetables, and milk, and were much in the open air, so that they ought, on Dr. Allinson's theory, to have been most healthy. They were not so, and, in addition to most ordinary diseases, they were many of them subject to a kind of fit which, like the case of demoniacal possession mentioned in the New Testament, oftentimes casteth them into the fire and oftentimes into the water. Many cases of severe burns resulting from these fits were brought in to our detachment hospital, in some the flesh being quite charred to the bone; and I also heard of many cases of drowning from the same cause during the three years I was there. Before I left they were beginning to become more civilised, and doubtless soon learned to value the rupee and eat salt like other people.

There may be amongst your readers some who have been recently in that part of India which is between the Nilghery hills and the south of the Coorg country; if so, they might be able to inform us whether, with the change of diet and a more civilised life, they have become more healthy, and the remarkable disease I have mentioned has ceased. If it has, it would render it very probable that it may have been caused by want of salt. The name of the race of men was Corumba, the small villages they lived in being in the forests of Wynaad. **Lavant.**

[27663.]—WITHOUT laying down the law as to whether everyone should or should not eat salt (in the ordinary sense), I will give my own personal experience. I gave up the use of salt about a year and a half ago, and find that—

1. I keep my usual good health.
2. I require much less liquid than previously.
3. Having once given it up there is not the slightest desire to return to the old habit, although on first leaving off taking salt my food did seem somewhat tasteless.

I do not know whether it is at all general, but I have frequently observed that children do not care for salt, and only take it when bidden to do so. **Ampersand.**

G.W.R. (SO-CALLED) EXPRESSES.

[27664.]—I QUITE agree with "Viator" in his remarks about the unpunctuality of G.W.R. trains. It is a universal failing on this line. There is a slackness and "laissez-aller" air pervading trains and officials alike. There are, however, exceptions to this rule, and I inclose details of a really creditable effort to make up time I witnessed the other day on this line. The train was the 4.45 p.m., Paddington to Birkenhead, which I joined at Oxford. We left Oxford 29 minutes late, and arrived at Chester (cutting) only 13 minutes behind time, having made up 16 minutes.

Miles.	Stations.	Time.	Speed.	Remarks.
	Oxford dep.	6.37		
66¼	Brmghm arr.	7.50	54.6	Gained 5m. to Birmgham, lost 1m. at Birmingham. Left 24m. late.
	dep.	7.54		
77¾	Wolverhmpton arr.	8.11	40	Gained 2m. to Wolverhampton, lost 2m. at Wlvrhmpton. Left 24min. late.
	dep.	8.16		
107¾	Shrewsbry. arr.	8.48	56.2	Gained 12min. to Shrewsbury, lost 4min. at Shrewsbury. Left 16m. late.
	dep.	8.55		
	Chester (cuttng.) arr.	9.43	51.8	Gained 8m. to Chester.

The last 1¾ mile on Gresford Bank was covered in 1min. 32sec. (3 miles 1 in 80 down).

The load was 12 coaches (10 bogies and 2 vans) from Oxford, one being slipped at Leamington, train after Leamington being equal to fifteen 12-ton coaches. Engine to Wolverhampton "Sir Alexander," from there No. 578, both 7ft. singles. **Zulu.**

GREAT WESTERN (SO-CALLED) EXPRESSES—EXPRESS TRAINS.

[27665.]—"VIATOR" complains that so easily timed a train as the 5.45 Paddington lost ten minutes to Swindon. It is extraordinary; but I believe the "Dutchman" and "Zulu" are as bad, rarely keeping time on the down journey, and constantly losing up to five and even ten minutes to Swindon. However, I made the run with the 5.45 in 95½ minutes in March last (12 coaches), and on July 14 travelled by the up train due at 5.45, which gained a minute or two from Swindon with No. 1131 and 18 coaches.

Some of the G.W. "expresses" seem to me to be the slowest trains in this country. To take an hour to run the 36 miles to Reading is absurd; an ordinary stopping train has to develop a much higher speed than this. Reading to Oxford, 27 miles, in 45 minutes is another example of preposterously slow timing; the train might stop at nearly all the intermediate stations and do it in this time.

Of the July improvements, the new Midland 2 p.m., Manchester 6.20, is the best, running viâ Nottingham. St. Pancras to Kettering in 83 minutes gives 52 miles an hour, and thence to Nottingham in 59 minutes is 52½ miles an hour. The Great Northern take a minute off the famous 4.17 (now 4.18) Grantham, so that the average speed for over 105 miles is 54 miles an hour. A relief train to the 8 p.m King's Cross will run till Aug. 10, reaching Edinburgh in 8h. 38m., and Perth in 10h. 50m.

The quickest N.W. timing is now Bletchley to Willesden in 47 minutes, 52¾ miles an hour, and the 4.48 Midland from Garston is booked to reach Stockport (32¼) at 5.24, or 53¾ miles an hour. The 11.0 a.m. from Waterloo now runs to Salisbury, 83½ miles, without stopping—the longest run in the West of England. I travelled by this train a few days ago, and reached the ticket platform at Salisbury in about 111 minutes.

July 22. **Kappa.**

L.N.W. COMPOUND GOODS TANK.

[27666.]—I VENTURE to send you a few details of the compound goods tank for L.N.W. Ry, now at the Manchester Exhibition. It is carried on four pairs of wheels, of which three are driving-wheels, 5ft. 2½in. diameter. The hinder pair are coupled together, and are driven by the h.p. cylinders, 14 × 24in.; the front pair of drivers has a single throw crank, to which is attached the connecting-rod of the l.p. cylinder, 30 × 24in. The valve-gear is Joy's; but owing to the small size of the wheels the steam-chests are placed under the h.p. cylinders. The leading-wheel is 3ft. 9in., with radial axle boxes; total wheel base, 21ft. 6in., of which the driving-wheels occupy 14ft. Grate area, 17·1ft.; total heating area, 1,090ft.; working pressure, 160lb. **Reymond.**

ARSENICAL WALL-PAPERS — COUMARIN OR CUMARIN: TOBACCO SCENTING.

[27667.]—IN the extract given from the *Lancet* last week attention is called to the prevalency of arsenic in wall-papers, and two tests are mentioned for its detection.

The first is the very useful and well-known Reinsch's test, the second depends upon the stain given on a cold surface by burning arseniuretted hydrogen. It is, however, necessary to point out a defect in the details for performing the second test, where directions are give to boil the suspected paper with pure hydrochloric acid. The defect consists in the fact that by this treatment some considerable amount of the arsenic is converted into the chloride, which is volatile, and would pass off with the steam and be lost. It is by reason of the volatility of the chloride of arsenic that we obtain a ready way of freeing sulphuric acid from its frequent contamination by arsenic, as by adding some hydrochloric acid and heating we can distil off the arsenic chloride before the acid itself passes over.

As an alternative test, and free from the above objection, I would strongly recommend Fleitmann's test. This consists in boiling the paper with a strong solution of caustic soda and pieces of aluminium foil. Both caustic soda and aluminium are rarely contaminated with arsenic, whilst zinc and hydrochloric acid usually are.

If arsenic is present in the paper, arseniuretted hydrogen is evolved, and on a cap of filter paper, moistened with a drop of solution of nitrate of silver placed over the mouth of the flask, a black stain will be produced. This stain is *not* produced by antimony and its compounds.

I may add, as an antidote to the alarmist's article in the *Lancet*, that in the last two years, out of scores of wall-papers examined by me, arsenic has only been present in one or two, which were, moreover, invariably of the "green flock" type.

And this is what might be expected, as aniline colours, which are now so extensively used in paper colouring, are easily obtainable from Germany, guaranteed "arsenfreid," and many manufacturers will use no other.

The question has been asked, What is Coumarin? Coumarin, or Cumarin, is the crystalline odorous principle of the Tonka bean. It has been found also in several other plants, and lately prepared artificially. It has a very fragrant and lasting odour, and is soluble in alcohol. If a few grains be dissolved in rectified spirit, and this be dropped over tobacco, allowed to dry by exposure for a short period, the tobacco will be found delicately scented, and on burning to give off a very fragrant odour. The chief drawback to the use of Coumarin for this purpose is that it is expensive. A somewhat similar result may be obtained by dissolving a little of the oil of cascarilla in alcohol and treating the tobacco as above with it. Tobacco thus treated has a very aromatic odour on burning.

20, Ivanhoe-road, S.E. **E. J. Millard.**

OPTICAL MATTERS—TO MR. BOTTONE.

[27668.]—THE use of the terms "positive" and "negative," alluded to by my esteemed friend, "Prismatique," is inseparable from the analytic geometry of optics. But it must be distinctly understood that their use in this way is solely with reference to the *position*, and not to the *character*, of the foci. The focus of a concave lens is as real, geometrically, as that of a convex, because in each case it governs the direction of the issuing rays. But apart from the mathematics of optics, it is most unadvisable to use the terms "positive" and "negative" otherwise than as relating to the *character* of the foci. Much confusion will be avoided if we speak of a convex real focus as being a positive focus, and a concave virtual one as being a negative focus.

Has the orthoscopic lens in question been replaced by a more modern form? as I observe it is spoken of as the "old" Voigtländer.

May not the effect spoken of by Mr. Hunt (letter 27576) arise in the following way? The quotation, it must be observed, refers to an "object which is not very distant." Now the conjugate focus of such an object cannot be exactly the same as the principal focus for parallel or stellar rays for which an astro. o.g. is corrected. It must be a trifle *behind* the latter, and this change will also affect the balance of spheric error. Evidently the marginal rays where the refraction is greatest will suffer the most change; they will be thrown further back than the central ones, and will thus cause an appearance of over-correction. Now, by reducing the aperture, we cut off most of this over-correction, and therefore shorten, it appears perceptibly, the conjugate focus. It would be interesting to examine the inner and outer focal appearances, under a high power e.p. using an artificial star "not very distant," of an o.g. known to be well corrected for astro. objects.

I am glad to notice the letter (27615) of Mr. Boys. My paper was not written with special reference to the method of finding the curvature by reflection; I merely mentioned it as a sequence of the formula previously given. If I remember correctly, Mr. Boys' interesting paper was reprinted in the "E. M." soon after its appearance in the *Phil. Magazine*. The method is an old one; my first acquaintance with it was, I think, a note at the end of Barlow's paper on the object-glass, published in the *Phil. Trans.* for 1827.

May I, in conclusion, be allowed to notice an interesting feature in last week's impression. An able correspondent has started a series of letters on electrical measuring instruments. Might I suggest that they be extended to telegraph instruments, both needle and printing or sounders? I am not much interested in the matter myself; but such a series with carefully dimensioned working drawings like those in letter (27596) would be exceedingly valuable to the many electrical students who read these papers.

TO MR. BOTTONE.—Some little time ago a friend informed me that a book had lately been published in Italian, giving detailed instructions, both theoretical and practical, for the construction of achromatic object-glasses, &c. Has Mr. Bottone seen this new volume; and if so, will he kindly say whether there is anything really new and useful in it? I am not able to give the title of the book, neither the name of the publisher.

Orderic Vital.

CARBOLISED OIL FOR BURNS.

[27669.]—THE carbolised oil for burns and scalds as reported upon by "Eos" and "Sozedus" is certainly the best of the oil appliances; but like all the others, it fails to give that real and needful relief from pain so much to be desired, especially in the case of children, as well as those cases of extensive burning where the shock is so great as to endanger the patient's life, said shock being in reality exhaustion of the life-power from the awful pain.

Now there are two preparations within easy reach of every-day life that give entire relief from pain and shock the moment either of them is applied—viz., a solution in water of washing soda, and the other a solution of Epsom salts. The salts are the best application for the face, head, and neck. Soft cloths dipped in the solution are carefully wound round or fixed upon the burn or burns, and *kept constantly wet* with the solution. A perfect cure, with no mark or scar of any kind, will be had in from two hours to two or three days, according to the nature and extent of the burn or scald; but the principal thing is *the instant and real relief from pain*, provided attention is paid to *keeping the cloths always wet* with solution.

Dens.

CANE SUGAR IN BEER.

[27670.]—PLEASE let me thank "Nun. Dor." for his reply to my query, and please allow me to say I do not agree with this gentleman in his statement that there is no satisfactory method known of detection and estimation of cane sugar in beer, or that there is ever likely to be.

His remarks are decidedly not creditable to analytical chemists, to whom this matter is of some interest; nor are his statements respecting the recent Excise prosecutions complimentary to those whose duty it is to see that the law is not disobeyed or the revenue cheated.

Surely "Nun. Dor." does not wish it to be known as his opinion that the Excise authorities prosecute on mere suspicion, or depend on the confession from the publican?

Indeed, there are few magistrates—I hope none—who would convict or fine a man on mere suspicion by the prosecuting parties.

The Somerset House analysts have a method of detection and estimation of cane sugar, by which it can be ascertained with certainty how much sugar has been added to beer, and water too.

Duty was formerly charged on the quantity of malt, or malt and sugar, used. Now, however, duty is charged according to the specific gravity of the wort before fermentation. If sugar be added after the density has been taken by the Excise officials, or if it be added after fermentation is complete, then obviously in these cases it becomes a punishable offence.

In the prosecutions I referred to, cane sugar had been added to the beer, in some cases with the object of giving a "head" to the beer—that is, a frothy top when drawn from the barrel; in others for a different reason.

Many of those who transgressed—according to evidence—appear to have done so in ignorance.

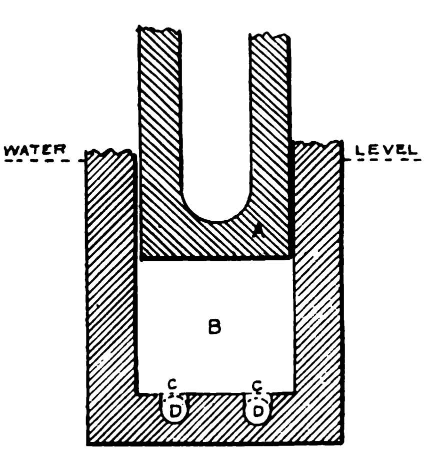
I should like to add, although it has nothing to do with the matter directly under discussion, that a letter from a friend just to hand tells me he has just finished analyses of over 200 samples of beer from different localities. In no sample is there anything of an injurious nature to the health of those who consume the beers from which these samples were obtained.

Chemical Student.

PROPULSION OF STEAMSHIPS.

[27671.]—LIKE Mr. Hillier (letter 27607), the writer also had an idea analogous to that of Mr. Marshall's; but not having the means to realise, or even attempt to realise it, let it lie fallow in his mind. Mr. Marshall, however, has raised the question in a practical form, and with your permission, Mr. Editor, I will submit my notion to the readers of the "E. M.," who will soon discern what practical value it possesses.

Many years ago I interested myself in the propulsion of vessels, believing that the methods adopted, paddle and screw, wasted too large a proportion of energy, and the first idea that suggested itself was that of employing pistons to push out the water, which Mr. Marshall is about to patent; this I dropped as impracticable, and which I still believe will prove to be so when tried. It struck me that, instead of using a number of pistons working horizontally, the water itself could be made into pistons by having pipes below water-level leading from each side of helm to a central cylinder amidships, and (as per annexed sketch) having a hydraulic ram piston fitting into this cylinder, so that, the steam being turned on, the ram would be pressed down, and force the water through holes in the floor of the cylinder into the pipes against the resistance of the external water (proportional to the depth below water-line), and so produce motion of the vessel. It will be seen that the columns of water in the pipes act just like solid pistons.



A, ram piston descending into cylinder B, filled with water, and pouring the latter through holes C C in floor into pipes D D running aft to each side of helm, and placed as far below water-line as possible.

If we suppose the area of the face of hydraulic ram piston to be 16 circular feet, and having a stroke of 3ft., and the area of mouths of pipes to be 1 circular foot each, then with two such pipes opening out at each side of helm 24c.ft. of water would be forced through each by a single stroke of the hydraulic piston—equivalent to a 24ft. stroke of Mr. Marshall's pistons!

There would, of course, be pipes running forward to each side of bow, and to stop or reverse the vessel all that would be necessary would be to turn off the after pipes and turn on the forward ones, there being no change necessary in the motion of the machinery, and therefore [illegible]heck or strain upon it, as at present.

It would be better to employ two such hydraulic cylinders in centre of vessel, dividing the pipes between them, so that the one ram would be ascending as the other descends, and so maintain a constant and steady pressure against the resistance of the external water.

Trusting that I have made my idea sufficiently clear, and that it may prove practicable in the hands of those who have more time and means at their disposal, I subscribe myself

Nomoplast.

SOME OF THE PROBABLE USES OF PAPER.

[27672.]—BY the term "paper" in this connection is meant a material made from those substances which now enter into the composition of commercial paper worked up into forms suitable for the purposes intended. Paper is more extensively utilised than is thought by some people, for in America it forms the largest portion of railway wheels, and after having been used for mouldings, &c., in houses, is now actually employed in the construction of the house itself. Large quantities of refuse sawdust and other substances suitable for compacting into "paper" products are available in the United States, and it is in that country that invention in this direction has been most successful. The Illinois Association of Architects has recently taken up the subject, and a number of papers have been contributed by its members, extracts from which may be of interest to your readers. For one thing "paper" will stand the climate under even the severest tests, and will scarcely need painting more than pine, while it can be decorated to the designer's fancy. It can be moulded, stamped, cut, nailed, and handled more easily than any other material. As in exterior use, so within; each part may be of paper, and sometimes the wall and ceiling, plain or ornamental, in relief, the bases, the architraves, the mantels, even the doors themselves, will be made of paper. Recent accounts have been received of the French use of paper as complete doors and complete piano cases. The material for this purpose is very highly spoken of. Remember that paper, like wood, may be treated with paints for ornament or preservation. Economically considered, the free use of paper for lining walls and the double thickness of glass in windows will in a very short time pay large dividends in the saving fuel. One architect claims for an 8in. wall properly lined with paper, a greater resistance to the cold of winter and the heat of summer than is usually obtained from a wall built 16in. thick in the old method.

Another speaker, in prophesying the future development of such a material as paper, remarks that we class a great variety of substances under the general name of paper, but his main idea is a flexible sheet made of vegetable or other fibre, which has been reduced to a pulp and then spread out and pressed and dried. Its most obvious qualities are—1. Continuity of surface. It can be made in rolls of almost any width and length. It is flexible or by gluing several layers together may be made stiff. It will stop the passage of air because there are no joints. 2. It has no grain like wood, and will not split. 3. It is not affected by change of temperature, and hence has an advantage over sheet metal as roofing material. 4. Whereas in its natural condition it is affected by moisture, it may be rendered waterproof by saturating with asphalte or by a variety of other treatments. 5. It is non-resonant and well fitted to prevent the passage of sound. 6. It is a non-conductor of heat. 7. It can be made of incombustible material like asbestos, or rendered fire-resisting by chemical treatment. We can, therefore, produce large sheets either flexible or stiff that will not conduct sound, heat, or cold, and that will prevent the passage of air, moisture, and fire. Paper pulp is now made of such a variety of substances, each with its special qualities, that it is reasonable to suppose that we have not reached by any means the limits of its usefulness as a building material. By combining paper pulp with other substances, and solidifying the mass by pressure, we may produce a material that will replace wood for many purposes. The commercial success of the paper cottage will depend upon the discovery of some very cheap material for the pulp, and also a cheap process for compacting the same and rendering it waterproof. It would seem that there was wood enough in the country to make cheap pulp, but no compound has yet been placed upon the market that will fully meet the above conditions.

Paper may be used for the deadening of floors. The curling up of matched flooring where applied to wet mortar has its disadvantages, and when buildings must be finished in a hurry the passage of sound may be stopped by paper, perhaps combined with mineral wool, without introducing moisture into a building already too damp.

Another architect suggests that something may be built in the following manner: The frames of the houses to be of wood, the siding to be of building paper laid to break joints and weather, the lower edges to be cut into scallops, waving lines, or other shapes to suit. Around the openings the paper to fasten into rabbets and the joints to be made tight. The roof is to be made much the same way, leaving the effect of tiles, shingles, or whatever the designer may choose. Gutters, exterior architraves, or other parts may be stamped or moulded in papier-maché, some for ornaments and details around porches, bay windows, or to ornament exterior features. The entire exterior may be either finished with varnish or other paint to make the same impervious to weather and to decorate at the same time. The interior features, even the walls and ceilings of a house, to be much the same as the outside, and decorated in much the same way. The floors thus may be made of stiff pasteboard where carpets are used, and it is possible even to leave them bare, if finished with a varnish or other preparation hard enough to preserve them from the ordinary wear and tear of the floors. All of the above may be done now, and probably at a saving over the usual methods. Of course the practical application requires careful and thoughtful investigation. It may not be possible to make the sash, stairs, or blinds of paper at present, although it would seem to be an easy problem to solve. Paper is practicable for all parts of a house except the constructional details. A house thus built can be erected quicker, cheaper, and in a more cleanly manner, and, moreover, fitter to live in, on account of the absence of moisture.

There is also another use for paper which will probably tend to its use in tropical climates, and that is by the very process of manufacture it is possible to introduce chemicals and other substances which will protect it from the labours of the white ants and other insects, and also preserve it from the effects of the weather. Furniture for tropical climates may perhaps before long be constructed of paper, the pulp being moulded into the required shape by special machines, which when a quantity of articles are made to one pattern will doubtless be as low-priced as wood, on which the labour and skill of the joiner has to be expended. A good deal has been done in this country and on the Continent, but more remains for the exercise of inventive skill.

J. T. M.

RE-INKING TYPE-WRITER RIBBONS.

[27673.]—THERE was an inquiry in your pages a short time ago about renewing the inking ribbons of type-writers, and as I have tried some experiments, which can easily be repeated, I send an account for the benefit of my fellow readers. Into, say, 2oz. or more of any good writing fluid put a spoonful of thick mucilage of gum arabic and a teaspoonful of raw sugar; warm the mixture, and immerse the ribbon long enough to allow it to become well saturated. When dry, spread the ribbon on a board and brush it well with glycerine. Should there be too much colour in the ribbon, press it out, between papers, with a warm flat-iron; or, if too dry, brush it again with glycerine. The secret of the ribbon giving out its colour is in the glycerine, and if you have body enough in the colour, there is no danger that it cannot work well. Such a ribbon is not affected by the dryness or humidity of the atmosphere, and I consider mine as good as any that can be bought. It may be that I was fortunate in hitting upon just the right proportion of the different constituents, and possibly a second trial might not be so successful; but I think with a little care anyone could do as well with the same or similar means. My object was to get body to the colour, hence the mucilage and sugar. Then it was necessary that the ribbon should retain a certain degree of moisture, for the gum and sugar make it dry or harsh, so the glycerine coat was put on; but there was danger of smearing the paper with too much moisture, or a wrinkled surface, and the ironing obviated this.

J. S. D.

CLOCKS AND GRAVITATION.

[27674.]—MANY able men have discussed the nature of gravitation, the mathematical theory of which is so well established. None of them have been able to suggest any possible mechanical action by which gravitation is produced. The great difficulty has been to account for the mode by which matter in any state could act on every particle of a planet directly.

Sir Isaac Newton showed by a direct experiment that the force of gravity acted on every particle of a mass at the surface of the earth. The indirect evidence and the soundest reasoning go to show that the earth exerts a direct action on every particle of the moon; that other planets by analogy act directly on every particle of their satellites, and that the sun acts in the same way on both planets and satellites.

Here is a conflict of diametrically opposite conclusions. The direct evidence that the force of gravity acts on every particle of matter only applies to masses at the surface of the earth. The reasoning for and against the opinion that every particle of a planet or satellite is acted on directly is equally sound. I beg to suggest a way of directly testing this question in respect of the earth.

If every particle of the earth is not acted upon directly by the force of gravity of the sun, the force of gravity at the surface of the earth will probably be greater at midnight than at midday, and at midwinter than at midsummer in and close about the torrid zone. An expression of this opinion here led to the statement that the evidence offered by observatory clocks was against such variation in the force of gravity with the time of the day and year. This, again, led me to study the mechanism and action of clocks, and subsequently of the modes of adjustment and correction applied at several observatories. From various sources I learnt something of the rates, &c., of the clocks at the observatories of Greenwich, Melbourne, Washington, Pulkowa, and Madras. The information about the clocks at Greenwich and Melbourne was somewhat definite; but about the clocks at the other observatories very indefinite. The observatories at Greenwich and Pulkowa are too far from the tropics for favourable observations, and the observatories of Melbourne, Washington, Sydney, the Cape, and Cordoba are not very favourably situated either. The observatories at Rio Janeiro and Madras are, however, most favourably situated.

I am in considerable ignorance as to the *practice* in adjusting the pendulum for temperature in observatories. I should be most gratefully obliged to you, and to any of your able correspondents, for any information on this point. I will, however, with your kind permission, give some curious facts about the astronomical clock at the Melbourne Observatory—facts which lead me to have some hopes, though small, that the question is still an open one.

Mr. Ellery, the Astronomer Royal for Victoria, states on page 24 of the "Astronomical Results for 1869-70," that "The clock rates from Feb. 1st to Aug. 19, 1870, were discussed for the purpose of finding the variations due to change of temperature and barometric pressure." Shall I be right here in inferring that temperature compensations are made from observations of thermometers hung in an ordinary way within the room in which the clock stands? "The result (of the discussion) showed that an increase of 1deg. Fahr. produced a retardation of 0·039 second, and that 1in. increase in the height of barometer produced a retardation of ·515sec." (Subsequently found to be ·441sec. from Jan. 2 to Aug. 7, 1871.) "To compensate for the former [retardation for increase of temperature] would have required an addition of 1·1in. in the height of the mercury in the pendulum; the cast-iron cylinder, however, was not sufficiently long to permit this."

The assistant astronomer at the observatory, Mr. E. J. White, F.R.A.S., in a paper ("Performance of Some Timekeers," Vol. XIX.), read before the Royal Society of Victoria, Sept. 14, 1882, says:—"The astronomical clock is the celebrated Frodsham 991, which, when its rates were examined by the horological jury of the Paris Exhibition of 1867, was pronounced to be one of the best in existence." Mr. White gives the rates of the clock from February to August, 1882, "which includes the hottest and coldest periods; the gradual change of rate (losing in summer and gaining in winter) is owing to the clock being slightly under-compensated." The jar is 8½in., and at first, apparently, 7½in. were filled (Astro. Results, 1869—70).

It seems strange that so good a clock should actually not have the jars of the pendulum long enough to hold sufficient mercury to compensate in an opposite way for changes in length of pendulum rod due to variations of temperature. As the pendulum should be shortened for latitude when removing from Paris to Melbourne, less mercury should have been required at Melbourne than at Paris. If about 7½in. of mercury were found sufficient at Paris or London (what the actual height was I cannot find), the increase in the amount of the mercury would in effect give a greater range. If the clock went accurately at Paris, after allowing for variations of atmospheric density, then the increase of mercury would shorten the pendulum in summer and lengthen it in winter, and so compensate for a diminution, though very slight, in the force of gravity in summer and an augmentation of this force in winter.

Allow me again to say that I shall be most gratefully obliged to any correspondents for any information and comments on this point.

Melbourne. T. Wakelin.

THREE FAVOURITE FLOWERS.

[27675.]—UNDER this heading I class the outdoor primulas, the auriculus, and the pansies. It is only in North Britain they attain their full perfection; those floricultural amateurs who have never seen them in the cool Alpine climate of Scotland and our northern counties have a treat in the future. In proof of my assertion I can say that I raised most of my present large stock from seeds, bought, saved in my garden, and sent me from the Himalayas. For some time past I have cultivated the common wild primrose with the most pleasing results, selecting stout offsets from the hedgerows and woodsides. In five years they have attained extraordinary qualities; very floriferous, the colours varying from deep golden yellow to creamy white, frequently capitate on tall, thick stalks. Excellent window plants if lifted, put in 4in. or 5in. pots, and placed in moderately shady aspects, where they remain in bloom for a length of time, and give out a pleasant vernal odour. The gaudy border varieties of British primula, polyanthus, and oxlip, in all shades and markings, make a fine spring show in the edges of shrubberies and margins of parterres. Just five years ago I sowed a mixed lot of seeds in the loose soil 50 yards long on north side of a hawthorn hedge, leaving the countless plants to take care of themselves, excepting the removal of weeds. There the collection grew and thrived; when they were two years old they flowered freely, enabling me to judge of their worth. Then I marked off all the best, with the view of removal to their final destination. Provided the weather be rainy, the soil suitable, and the climate a cool one, these pretty plants, if carefully dug with a ball to their roots, can be removed in full bud without injury, the watering-pot being freely used. All seed vessels should be cut out before maturity with a pair of scissors. On this little operation depends the quality of the bloom in the following year; it is important to break up every old clump in the third year. Select the juicy offsets with stringy roots, and throw away the old woody main stock; this should be done in autumn. The soil must be old, rotten, pasture loam; should this become poor by time, decayed cow dung may be freely mixed with it. Any over-manured ground causes primulas to make large leaves and small flowers, besides spoiling their colours.

I have tried these experiments with my surplus stock. I have been writing hitherto on the single varieties only; I have now to describe the double. The former seem to be insect-proof, and exceedingly hardy in cold climates; the latter require much care and attention. I have often lost the double sulphurea, the double lilac, and double white; the last has done the best, from a stock I brought from North Scotland. This is a charming kind, spotless, heavy rosettes of pure white colour, well suited to bridal decorations and funeral wreaths. I must not omit the double scarlet velvet; but it will not live long in a border, is very dear and delicate, even in a pot.

The next section of outdoor primulas as sold by florists, require a very damp, peaty border. Primula sieboldi of all colours, forming wide patches in a few years, though it rarely flowers till well established, as it has to make a quantity of roots, essential to blooming. Primula japonica, which bids fair to be naturalised with me, raised from seeds I saved, which are borne in great quantities when I do not clip them off. I have a great variety of colours, and some of the flowers are spotted. Those who have not a wet spot, as the margin of a lake, a border surrounding a pond, or the boggy edge of a natural spring, will find a good substitute (provided they live in a rainy county) by digging a narrow trench, 2ft. deep, and filling it in with sphagnum, carpet moss, fibrous peat, and decayed vegetation of any kind, filling it over high with pasture loam. This must be done in autumn on a N.W. open border; in the ensuing spring level the hollow, putting in some sand and more loam. My specimens so treated are over 2ft. high, with foliage like old lettuces; a few planted in a dry bed have not flowered in the two years' occupation. I merely mention the two pretty natives of North Britain, Primula Scotica, and the "bird's-eye primrose," which flourish in their natural *habitat*, the moors of my vicinity, but have gradually died out in my garden, as they require wet roots in the growing season.

Now for the rich and rare exotics, the primulaceæ of the Himalayas; time and money can procure these. My packets of seeds direct from the Himalayas taught me patience, and my gardener a lesson in horticultural learning. I had to wait eighteen long months for the first sign of germination. About ¼oz. of seeds in the cases of Primula purpurea, P. Stuarti, and P. obtusifolia gave a very small percentage of growth. Probably these seeds were stale and too long stored. I have, however, some grand clumps of the P. Stuarti flowering somewhat shyly—a damp-loving species, with very luxuriant leaves. I had some very strong specimens of P. purpurea, but the last wet winter did some damage to them. P. obtusifolia is almost unknown; I cannot find it in any modern books or catalogues—a small species with sky-blue flowers, having golden-yellow eyes. P. capitata, P. Cashmeriana, and P. denticulata require a more dry climate, with plenty of snow, and do not succeed unless on elevated positions

Nearly all I have enumerated are becoming cheaper and more common from year to year; they may be obtained from Ware, of Tottenham, and Hartland, of Cork. The charming Primula rosea of the N. Himalayas attains great perfection in the Northern counties. I gather seed from my plants annually, which produce plants quite equal to the parent stock; it loves the edges of bogs and springs; hence I grow it in the artificial soil above described with P. japonica. Late in spring this Alpine gem makes a very gay patch of roseate hue, a number of plants being clumped together.

The Auriculas of my large stock of an unusually fine strain were raised by me from seeds received from two different florists. I sowed them in boxes during those two icy winters of '79 to '81. These boxes were tilted to a sloping position facing the North, were continually buried in snow, and gave a very large percentage of return in vigorous plants. We always put out the best on raised beds when the tulips and hyacinths are in flower. Having played their parts in decoration, the auriculas are dug up and removed to a north border, where they remain till again required. They give the least trouble of anything I grow; though frequently uprooted by snowstorms, they never die in this congenial climate. I have seen some which were accidentally dropped from a basket on a garden-walk remain green for months, and grow well when planted. They do not like a drought or a midsummer sun—a high temperature causing them to shrivel up. A rich, gritty loam, on a shelving spot, suits them well. In early spring I scatter peat dust among their roots. I think this addition deepens the colour of their flowers, as it generally does with many other things. Pansies I have grown largely for eight years, both from seed and select cuttings. A cold, damp, sub-alpine climate brings them to wonderful perfection with very little trouble, beyond the continual renewal of all good flowers, by the annual operation of making cuttings; otherwise they rapidly degenerate. From a mixed packet of seeds raised by an amateur I got hundreds of handsome specimens—not very large blooms, certainly, but with great properties, capable of being grown into prize flowers; indeed, several growers in the trade and private individuals came to see this many-coloured collection. The "black crape," as a stranger here, excited much interest.

My best bedders this season have come from Paisley, long—long renowned for its A1 strain—snow white, golden yellow, and dark striped, nearly as large as any known kinds, are now in great profusion. The offsets on arrival in the late autumn are pricked into a raised bed of sandy loam. This is covered with a frame till the following April or May. The rooted plants are then lifted, and put out in the flower border. Seeds are only sown to obtain novelties; the produce requires time to develop any desirable qualities.

Eos.

Waterproofing Textile Fabrics.—A Belgian inventor has devised a process for tanning textile fabrics which renders them waterproof, and at the same time, it is said, proof against decay, while their suppleness is not diminished, and their weight not appreciably increased. Arguing from the high state of preservation in which the bands which surround the heads of Egyptian mummies are found to this day, and which are impregnated with a kind of resin, the inventor had recourse to the substances extracted from birch bark and which are now used to perfume Russia leather. When the fine, white bark of the birch tree is distilled it yields a light oil, nearly a fourth part of which consists of the special phenol, or carbolic acid, which gives the well-known odour to Russia leather. It is now found that the residue, or green tar, of the birch, which is obtained from Kostroma, yields neither acid nor alkaloid, and forms, with alcohol, a solution of great fluidity, which, however, when once dried is not acted upon by alcohol. It is this substance which will unite with the most brilliant colours that are used by the inventor for treating textile fabrics.

AT a recent meeting of the Physical Society a paper was read on "Sounding Coils," by Professor W. Stroud, D.Sc., and Mr. J. Wertheimer, B.Sc. The paper describes experiments on coils and helices of wire, which emit sounds when variable electric currents are passed through them. The pitch depends on the frequency of the current variations. The authors believe the sounds due to the attractions of adjacent parts of the wire, which cause shortenings and lengthenings as the current increases or decreases. To prove this, two identical coils were made, and one of them imbedded in plaster of Paris. This gave no sound when the variable current was passed, whilst the other emitted the usual note. It was also found that no sound could be got from a single turn of wire, whilst one and a quarter turns gave an audible *sound under the same* condition.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[62387.]—**Current Break.**—The screw of contact pillar is probably loose, and the constant striking of the spring gradually unscrews it. It seems to me that the bichromate current is a very fluctuating one. I have had the same trouble myself with a coil that I built. I have a medical coil now which has a spring in front of the armature to press it well back in contact, and this goes very steadily with the bichromate.—PRINCIPIA.

[62502 and 62784.]—**Electromotor.**—TO MR. BOTTONE.—The following is reproduced from Prof. Silvanus Thompson's "Dynamo-Electric Machinery":—"Profs. Ayrton and Perry have devised an ingenious motor, which is extremely compact and of considerable power in proportion to its weight. To this motor the armature is fixed, and within it the field-magnet rotates. This construction, which permits the frame being made both light and strong, had been previously attempted in a dynamo, the so-called 'Jopf maschine,' exhibited by Siemens at Paris in 1881. The field-magnet of A. and P.'s motion shown separately at Fig. 1 *a* is of the simple shuttle-wound type (like Siemens H armature). The armature is a ring of the Pacinotti type, having protruding teeth, between which the coils are wound, and is built up of flat, toothed rings of sheet charcoal iron. Fig. 1 *b* shows its construction. The brushes rotate with the field-magnet, and the commutator or collector is fixed. Fig. 1 *c* shows the complete motor, with drill affixed.—S. BOTTONE.

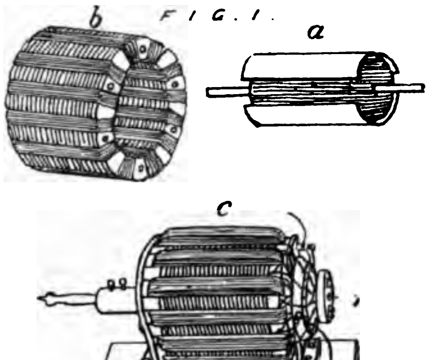


FIG. 1.

[62523.]—**Harmonium Vibrators.**—It was not my intention to take any further part in the present discussion in respect to this query; but I consider it my bounden duty to reply to the infamous falsehoods displayed by "G. L. B." on p. 491. That gentleman has the presumption to state on p. 491 that I have "learned all I know of harmonium making and American organ building from the pages of the ENGLISH MECHANIC." So far is this from the real truth, that I may say that there are many back volumes of "Ours" which I have never had the pleasure of perusing, and very little do I remember of any of the "information" on these subjects which has appeared in the pages of the "E. M." I have attained my knowledge of reed organs from practical experience alone. "G. L. B." does not seem to know what to say to make himself appear right in his assertions. It is exceeding mean and despicable on the part of any man to have to resort to the writing of deliberate falsehoods in order to defend his arguments. He has never given any information of any value to any of your readers, but assumes to know a great deal about reed organs, without giving one atom of proof that he really does know. If I may measure his knowledge of reed organ construction by that of his knowledge of prices and qualities of reeds, I am bound to say his knowledge is but small. For instance, on p. 491, he says that "reeds sold at 6s. a set are 'usually' rubbish." This word "usually" comes in very nicely in explaining his doubt about the 6s. reeds being always rubbish. As I have used these reeds (6s. per set) more than once, I can confidently state that they are not rubbish; and also that as good a tone can be produced from these reeds (under certain conditions) as that produced from the best reeds. I am not at present acquainted with the reeds which "G. L. B." says "an amateur worthy of the name would scorn to own." I suppose that such reeds do exist, that is, such as a person would be able to make after receiving "instructions" from "G. L. B." I sincerely pity any reader of "Ours" who has to depend on "G. L. B." for "useful" information. They will never get any "information" from that gentleman, unless he changes his present disposition. If the querist would like to see a specimen of the reeds sold at 6s. per set, I will send him one free of charge if he will send me his address. If he is any judge of reeds, he will then at once see that these reeds at 6s. per set are no rubbish, and that they are as carefully made as the best reeds. The difference between the former and the latter is in the quality of the metal. I can safely and truthfully assert that I have gained no knowledge whatever from the pages of "Ours" with regard to reed organ matters. I may also add that I am frequently in receipt of letters from various correspondents who ask for information about reed organs. Most of the correspondents who write to me privately possess all the volumes of the "E. M.," and if I did not know more about these matters than what has appeared in the "E. M." I should be unable to reply to those who send me letters. I should advise "G. L. B." to show us a good example by giving practical answers to queries on reed organ matters, and not bother his head about knowing how to make a "tuning bellows." He will have his desires gratified shortly, and no doubt the instructions I shall send will be found fault with by him; but facts still remain stubborn.—G. FRYER.

[62560.]—**Tap for Wooden Chuck (U.Q.)**—As this query remains unanswered, I would just observe that in most toolshops may be seen taps and oblong pieces of, say, beechwood, containing a cutter for cutting the screw to correspond to the tapped hole in any piece of wood which is hard and tough; all the difference between a tap for wood and one for metals is, that if for wood it is deeply undercut, as it were, with a saw file, so as to make it much keener than would be practicable if used upon metal of any kind. I should suppose that you would have to make one yourself in order to match the thread upon your mandrel.—A., Liverpool.

[62589.]—**Gas-Lighter, Electric.**—"A. G." will find an illustrated description of Clarke's gas-lighter, on the principle of the influence machine, in No. 1,033, p. 403, Vol. XL. I should think that he will be able by studying those diagrams to see how to connect up the machine; but, if not, the patent specification will instruct him: it is No. 5992 of 1883.—J. T. M.

[62591.]—**Welding Hot and Cold Iron.**—This query seems to have escaped the attention of our old friend, "J. A., Liverpool." I don't think a satisfactory weld can be made to cold iron; but shall be glad to hear what "A." has to say about it.—SELIM.

[62595.]—**Water Filtration.**—The proportion adopted varies in the practice of the engineers; but the querist may take as an average one square yard of sand filtering bed to 670 gallons of water per 24 hours. It would help in purifying water impregnated with peat; but no system of filtering can be considered adequate which does not provide for the aëration of the filter beds—that is, if a bed is used for a week it should be left "dry" the whole of the next week, and it would be better, perhaps, to alternate every 24 hours.—NUN. DOR.

[62602.]—**Carbon Wire.**—Will "E. L. G." give a correct reference to the page? "1·00 carbon wire" probably means No. 1 charcoal wire.—E. T. J.

[62603.]—**Seth Thomas Clock.**—It would not be worth while to alter the clock. Stand it on rubber blocks, or put under a glass shade.—HOROLOGER.

[62604.]—**Repairing Cornish Boiler.**—It is to be hoped that such a boiler as the querist indicates will not be worked at any great pressure. The better way would be to put in a new end altogether and a new angle iron ring.—BOILER-MAKER.

[62609.]—**Leaky Flume.**—I am afraid there is nothing that will keep this "flume" tight, as it occasionally runs dry and is exposed to such a temperature as 120° in the shade. Perhaps a composition of pitch and guttapercha would answer; but the better way would be to keep sufficient water in it to swell the wood tight.—J. T. M.

[62615.]—**Electro-Magnet.**—If the wire you have is adapted for the big magnet, it certainly will not give better results if employed for winding two smaller magnets. Why not make up a magnet of suitable size and proportions?—E. G.

[62617.]—**Noise in Gas-Meter.**—It is not easy to get at the interior of a gas-meter, and it would therefore be advisable to send it to the company, and let them exchange it, or deprive it of speech.—C. L. P.

[62621.]—**Fast Paint.**—There is no paint which will long resist the action of boiling soap.—M.

[62624.]—**Tennis Court.**—The relative expense will obviously depend on the cost of materials in the locality; but an asphalte floor (made of gas-tar and fine gravel) is more pleasant to play on than concrete.—OLIM.

[62630.] — **Substitute for Small Glass Bottles.**—There is nothing at once cheaper and less bulky, unless it is the lead tubes used for moist colours. As to the paper bottles, I have an idea that a company is being formed to work the invention.—SELIM.

[62633.]—**Amalgamating Gold.**—Two or three processes were shown at the Inventions Exhibition, and I suppose that referred to by the querist is the process of the Electro-Amalgamator Co., in which the electric current is employed to keep the mercury "lively"; or perhaps it is the Cassel process. "Sona" might find some information by looking up reports of the Exhibition; there are certainly not many books on tho subject.—NUN. DOR.

[62634.] — **Leather Stain on Cloth.**—Try oxalic acid, and after that ammonia. It would have been some guide if the querist had given an indication of the nature of the stains—that is, whether the leather was coloured or natural.—C. KERR.

[62639.]—**Celeste Action.**—The celeste pedal "T. S." has inquired about is, as W. H. Davies states, a very simple contrivance. A piece of celeste felt, 1½in. wide, obtainable at 68, Tottenham Court-road, a light good piece of pine, 1½in. or 2in., a couple of pedal sticks and blocks, and a pair of rockers; this can all be attached to the existing soft pedal. If "T. S." cannot see his way through the job, I shall be very pleased to give him any further particulars. The effect of the celeste pedal is far superior to the ordinary shifting hammer rail; it is sweeter and fuller in tone. Another great advantage, it saves the piano a great deal—i.e., the strings are both struck; whereas in the shifting action, when the pedal is in use, only one string of a bichord and two of a trichord will receive the blow. The weighted blocks to improve the repetition are the greatest injury to a piano, and the surest mark of bungling amateur workmanship. If the hammers return slowly, it is because they are tight in the centre. Take out the centre wire carefully, and run a round broach carefully through the bushing until it feels tight (the tightness necessary depends entirely on the slowness of the return). Then replace the centre wire in the butt. If the butt moves with ease, and yet it must be firm, when the action is again together, and in use, the stiffness in centres will have disappeared; but care must be taken not to get them too easy. If the touch is too light, then weight the keys; but is it too light? I should think it doubtful. It is true all pianos made now with sticker actions have weighted stickers; but this is because the sticker is too short to have sufficient weight in to balance the hammer properly. The less weight there is for the key to move the better a piano will wear. No pianoforte maker would dream of using weights as described, nor would a celeste pedal be called a celeste action—there is no such thing, except in advertisements. "T. S." may easily see the pedal in use, any common piano having three pedals, or in most pianettes. Cottage pianos by Broadwood, Collard, Hopkinson, Brinsmead, &c., &c., having sticker actions have the shifting action for soft pedal.—E. W.

[62694.]—**Distilling Whiskey and Sulphuric Acid.**—"Nun. Dor.'s" remarks "that if vitriol is added to beer or whiskey it does more good than the liquor itself," and that "sulphuric acid is not really a poison" are calculated to mislead or to lead into mischief. I therefore write, saying: "That if long continued, even in a very dilute form, sulphuric acid may cause death, surely, but slowly, from a peculiar organic disease of the stomach and intestines." In modern medicine, taking the symptoms caused by semi-poisonous dosings as guides, sulphuric acid, so dilute as to just retain a perceptible sour taste, has, in one drop doses taken ten minutes before meals, effectually remedied acidity and acid risings of many years' duration.—THE LYDNEY DISPENSER.

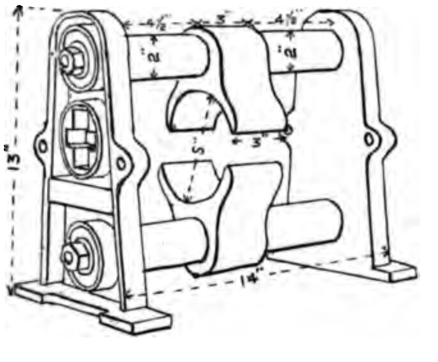
[62699.]—**Locomotives.**—(1) L.S.W., Nos. 28, 151, and 302 all belong to the class of six-coupled goods engines, built by Neilson, of Glasgow, about 1835. They have inside cylinders, 18in. by 24in., and 5ft. coupled wheels, inside bearings. I cannot be certain even of these dimensions. The following belonging to the same class are on my list:—Nos. 148 to 160, 163 to 168, 172, 302, 383, 391 to 410, 433 to 444, 496 to 516. I regret I can give no information about No. 275.—REYMOND.

[62727.]—**Moulding Machine.**—The simplest practical way of giving the right profile to the moulding irons is:—1st, when they are to be used in the slot of a vertical spindle, saw a sample of the moulding across at 90°, and file out to the section obtained; 2nd, when they are to be used on a four-sided cutter block, saw the sample moulding at an angle of 45° and file to the section obtained. Your inquirer can puzzle the reason for this out for himself, bearing in mind that it is the distance of each point of the cutting edge from the centre of rotation that imports, not the distance from the back of the iron.—J. O. W.

[62731.] — **The English Language.**—"A Foreign Student" may well be astonished at this terrible language when he finds that a native (as I presume "E. S. H." to be) makes such absurd blunders about his mother tongue. There is no need for "E. S. H." to admit his ignorance of German, since he tells us that "the guttural *ch* is still in use, therefore it has not been dropped (!)—character, choir, chaos, chasm, &c., are cases in point." I daresay "A Foreign Student" could tell his instructor that the *ch* in these works is not guttural at all, but has simply the sound of *k*. This comes of your abominable system (or rather no system) of orthography, in which *c* has two sounds, like *k* before *a*, *o*, or *u*, or a consonant, and like *s* before *e* or *i*, and sometimes *h*. The letters *ch* have both the sound of *k* (in "character"), and of *sh* (in "French"). The letter *c* has no right to exist in the alphabet at all, being replaceable by *k* or *s* in all cases. Also *q* and *x* should be removed, *qu* having the sound of *kw* ("queen," "kween") and *x* that of *ks*. "E. S. H." has missed the point with regard to the French "*u*" and German "*ü*," these sounds being entirely wanting in English. He considers that it is not necessary to indicate the various pronunciation of the *u* in English, because it is "sufficiently well known." How does that square with the statement of "Nephesh" (same page)—"at present it is risky to try to pronounce a word you have only seen in print"?—REYMOND.

[62731.]—**English Language.**—(1) Whatever the Quaker sect and some rustics may keep up, the second person singular is more completely dropped from English now than from probably any other tongue except Spanish. It is an archaism kept to hallow the Bible and Liturgy (as is also the syllable *ed* after verbs), but in these is compulsory. We cannot say *you* to the Deity, as in French, and I suppose all the Latin nations. On the other hand, neither can we, as in French and German, use the singular to wife, husband, or even the youngest child. (2) The French *u* or German *ü* is absent, and disliked in other noble tongues, as Italian and Spanish, as well as ours. But our Devon dialect, and also Lowland Scotch, have it, as in the oft-quoted Scotticism, "unco' *guid*." (3) Old English had doubtless a guttural, but not written *ch* nor by any combination. It had, as every simple sound ought to have, its proper single letter; but when we began printing, no type was cast for either this, the W, our △ or our θ, simply because none of the four was Latin. Presently the printers, disliking *vv*, made a W, the only one of the four never really needed, for it had no distinct sound from U; but printed English continued to lack three, and still lacks two, of the letters necessary to the written language. The abbreviations, however printed, for *the* and *that*, are necessarily wrong, as *y* was never in them, but our θ, which slightly resembled it. As for the guttural letter, now silent, we express it by *gh*, except in the very few words that began with it. From those we either omit it (as from *if*) or make it *y*, as in *you* and *yet*, which, accordingly, in printing Wiclif and Chaucer, we make *ghou* and *ghit*. We have dropped the H of the pronoun *hit*, both in sound and spelling. (4) The △ and θ, both expressed now by *th*, are by no means uncommon sounds in the world at large, though happening to be absent (both at once) from Italian, French, German, and the modern Scandinavian family. Among the many grievous corruptions in our rapidly-rotting language, one of the noblest once, but now most decayed in the world, none is more idiotic than that change complained of by Franklin in his letter to Webster (Sparkes X. 412), the spelling our substantives without a capital. This way of distinguishing them was always (as he said) more needed in ours than in German or any other of the family, because we had more words used as nouns or verbs alike. But the proportion of these has multiplied the whole century since he wrote, and now grows faster than ever! It is perfectly idiotic that none of us can see, even in America, the direct breeches-pocket interest that a nation has, as he said, in making the acquisition of our own language as easy to foreigners as we can. Another grossly suicidal insult, equal to any that Chinese ever indulged in towards "outer barbarians," is our avoidance of accents, one of which on each word (but only one) is absolutely needed for two reasons: Foreigners have right to it, first, to mark which vowel is the emphatic one; and, secondly, to show what sound that has, for our "paradoxes" are all confined to one vowel of each word, the emphatic vowel. The others may all, safely enough, keep their Continental sounds. In French, accents are needed only for the latter purpose, there being practically no syllabic emphasis compared to ours. If some Americans had but had the wit, in Franklin's time, to combine and act on his few hints, the prediction of De Candolle, that English may become quite as proportionally spread as Latin ever was, would ere this have been realised. But it is not the spelling of to-day, nor of any time alone—even Queen Anne's—that must be taken, but a union of what was most rational in each earlier period. Why must there be a second *s* to the termination *ness*? Why an *e* to such innumerable words as the adjective *animate*, confusing it with the differently sounded verb? Our ancestors avoided such barbarous carelessness. Nor would their ear tolerate *fifth*, *sixth*, *twelfth*, but only "fift, sixt, twelft." Such verbs as *wander*, *temper*, made "wandred, tempred," not our barbarous *wandered*, &c. The very latest improvement, I believe, was distinguishing *than* from *then*. But the commoner words *that* and *thet*, from distinct roots *thatta* and *thæt*, are still spelt (though never pronounced) alike. There are surely serious errors in the reply of "E. S. H.," p. 481. English can by no means be classed in the Celtic family, however many names of English places may be Celtic. It has hardly a trace of a Celtic element, but differs far more from its British neighbours—Gaelic or Welsh—than from either French or German. Celtic and Gothic must not be confounded, being quite as radically different as either from Latin. Even in place names the Celtic habit of putting the substantive before the qualifying word is rare. Thus, Castle Cary and Market Rasen are named Celticly, and strike as Welsh compared with Corfe Castle or Downham Market, though both the words castle (castra) and market (mercate) are Latin. Again, "E. S. H." is very unjust to Luther's High Dutch (now rather affectedly called "German"), a quite equally old and noble cousin of English—not sister; the nearest sisters in the Gothic family are the Platt-Dutch and Icelandic. Then he is quite wrong as to the *ch* of such words as "character, choir, chaos, chasm" (all Greek-English), or of any other English words, having ever been guttural. When we had a guttural sound, it was written by its own separate letter, not *ch*. It is even very doubtful to me whether the Greeks ever made the original *x* of the above words different from the initial we give them, our *k* or the Italian *ch*. I shall be asked, What, then, was Kappa? Well, I hear that in some of the Greek islands that letter is called Chappa, and has the power of our or the Spanish *ch*. Now, if those islanders could be held to have kept the classic sound, observe what would follow. First, there would be no puzzle about pronouncing such names as Cnidus or Ctesias. Next, remember that in these and most words that now have C, inscriptions show that the Romans, nearly to the latest times of the empire, used K like Greeks. Then their grammarians never hint that either this letter or G had any variety of sound. Each sounded alike in all positions. But how? That is really the sole puzzle about old Latin pronunciation. Nobody doubts how the vowels sounded, or V or J; but all the doubt is of these two letters, C and G. The latter, observe, corresponded both in figure and alphabetic place to ς, never to γ, and ς was a double or compound sound, as well as ξ or ψ. I venture the theory that the classic sounds of *c* (also written *k*) and *g* were what they have in such an Italian word as *giace*; and that the only way the Romans could represent our *k* was by either *q* or *ch*, and their only equivalent for our hard *g* was *gh*. Now, in the 4th century (the same, by the way, in which they began to use the second person plural occasionally to a single person) their cockneys were satirised on the stage for degrading words like Commodus into "chommodus." Could that mean making a simple sound into a compound, a thing that phonetic decay never does? I conceive their error was simplifying what had resembled our *ch* into the present Italian *ch*. We afterwards did the same with every *c* that we still write only *c*, as in castle, and many names as Lancaster. But in lots of names originally having a mere *c* or *k*, as Karolus, Ricardus, Cippenham, Cicestre, St. Chad, the Franks (Franci), and all places that once ended in *cestre*; but now in chester, we have had to introduce an *h* to preserve (as I hold) the old sound. So we have in countless common words, as chalk, church, chapel, chandler, champion, chapman (from cheap, formerly ceap, a market) and our Frank neighbours in almost as many, *chose*, *champ*, *chandelle*, *chaud*, *chien*; but in vain, for their *ch* has decayed into another simple sound, losing the *t*, element, while, in the Northern departments we may hear *kand* and *kien* (but on the contrary St. Riquier is as if spelt Ritchier). The position of *c* wherein the Romans first hardened it was doubtless before *l* and *r*, making it indifferent whether works like Clodius, pulchra were spelt with or without *h*. Afterward, syllables beginning with *ca*, *co*, *cu* were hardened over the whole empire; but *ce* and *ci* in only one Romanised tongue, the Welsh. Elsewhere they were variously simplified, as were *ge*, *gi*, but everywhere into simple sounds, except in Italy. There alone (as seems natural) did the compound *c* and *g* survive until to-day (except the *g* partly here, in some English words and its name). Surely it is absurd to fancy Cæsar's name has been more altered in sound by Italians than by Germans. I hold it has not, for though Germans alone keep the *x* right, Italians alone keep the initial consonant, which is more important. Again, should a dative, as *cui*, be simpler in sound than its nominative, *qui?* I hold it was more complex, as the present Italian *ci* is more complex than *chi*. So the ladies' school where, we lately heard, *vicissim* was pronounced "we kiss 'im," I hold to be wrong, but only in the *k*.—E. L. G.

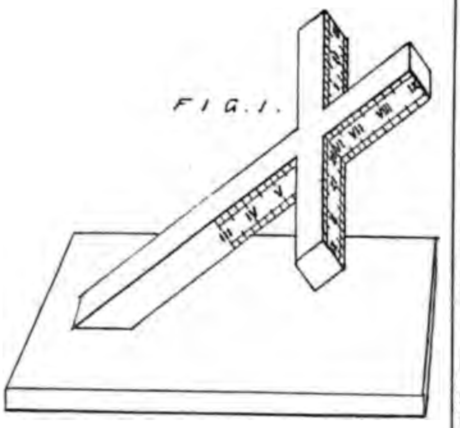
[62763.]—**Dynamos.**—TO MR. BOTTONE.—Annexed is sketch of carcase of dynamo capable of giving sufficient current to light up to 10 20c.p. lamps of about 48 ohms cold resistance. Use a laminated cog armature, and put about 5lb. No. 20 on the armature, with about 20lb. No. 22 on the fields in shunt with the armature. If you use a cable of seven strands of No. 16 wire, the dynamo will do the work at 100 yards' distance. You can charge accumulators with it.—S. BOTTONE.



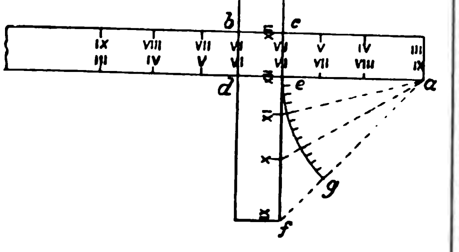
[62766.]—**Miners' Tools and Smiths' Work.**—I read with interest "A., Liverpool's," experiences under above head, but must object to his condemnation of my "hammer." I have five smiths' hand hammers. Four of these are the "proper" shop hammers of different forms, but I find none so useful "all round" as the ugly tool of which I gave sketch. Having no "striker" at command, I am restricted, like many other amateurs, to the use of hand hammers; and I find the thick pane supplies the place of a fuller in rounding hollows, and draws down and spreads in any direction more evenly and effectively than the narrow pane. Of course, a flat face is required for the finishing. On old files, which require a low heat and are rather tough customers to draw down, this hammer is especially effective. For working steel it is a mistake to hammer at a very low heat, as generally recommended. I have never yet spoilt a piece of steel by working at a full red. At any rate, the material should not feel stubborn under the hammer except at the last finishing touches. This latter applies also to iron—the nearer to welding heat it is worked at the sounder will the job be. At red most irons become internally disintegrated by continued hammering, and white is the correct heat to work at. But the job must be done without hesitation, which means without repeated white heats, otherwise it will in the end be below dimensions. On the other hand, I quite agree with "A. L." that only "about one in 500 smiths is fit to be trusted to manufacture any tool from cast-steel without overheating same." The overheating of steel can never be remedied, let quacks say what they will. It is the common defect in steelwork coming from a smith whose regular work is in iron. The other defects are cracks. These may arise from original invisible flaws in the steel spread in working, or from visible cracks left instead of being carefully filed out before hammering, or from sudden cooling in one spot in dipping, where the cooling should have been spread gradually by moving steel up and down in the water, or from suddenly dipping a piece of steel with parts bright, others black, where the bright steel, immediately cooled, splits or warps by contraction from those parts still hot under the non-conducting black places. This latter was exemplified to me in a knife I made. I roughly filed up the blade after forging, and hardened in water, and found then it was twisted and cracked in several places, the twists starting each from a place untouched by the file, the cracks being continuations of small ones left on the edge before hardening. I find the beak is the chief cause of the ring of an anvil, and fail to see how the "ring" is stopped by "A. L.'s" method, seeing that a smith's anvil is usually bedded, as described, and yet is known by its ring. My lump of lead changes the ring to a dull thud, and is slipped off easily enough. I quite agree that "the putting of salt or anything in the water for tempering is bosh." If anything could be added to raise the boiling point to that of grease, say, there would be some sense in the adding of it, for then hardening and tempering might be effected at one operation of dipping. I should say the imbedding of bright articles in carbon would at least be useful in protecting the surfaces of them; but beyond that there can be no use in the plan, excepting where *mild* steel is put in with a view to *case-hardening*.—SILKE.

[62773.]—**Sundial.**—Old schoolmasters were fond of teaching puzzling rules for the determination of the "hour arc" for a sundial: each half hour involving a separate calculation, and each latitude ditto. Then the arcs thus determined had to be set off on the face of the dial, and the dial itself should be a true plane made perfectly horizontal; any inaccuracy in these several operations resulted, of course, in corresponding erroneous indications by the dial. Now, to avoid all this bother, follow this simple rule—it will suit for every latitude, from the poles to the equator, and for every hour of the day, and for every dial, no matter how uneven its face, or how oblique its inclination. Set your watch to true solar time, and mark the points which the shadow of the style strikes at every half hour or quarter hour; the intervening spaces you can then divide into minutes or five-minute spaces. But, mind, the edge of your style must be "truly parallel to the earth's axis." If you want further help, I shall be happy to give it. By the way, what has become of the promise "E. L. G." gave some time ago to furnish a plan of sundial indicating "mean time" for the greater part of the year?—D. DOYLE.

[62778.]—**Sundial.**—The cruciform sundial belongs to the class of dials called equinoctial, it being placed neither horizontal nor vertical, as in the more familiar kinds, but in a plane parallel to the earth's equator. When so placed, it is evident (see sketch, Fig. 1) that the edges of the arms of the cross are parallel to the earth's axis, and will, therefore, take the place of the style of an ordinary dial. In constructing the cross dial, the length of the arms should first be decided upon, and the thickness will then follow, for the latter must be such that the shadow of the edges used will fall upon some part of one of the arms, whatever may be the north or south declination of the sun. It will be found that if the thickness be made rather more than half the length of the arm, it will do. Thus, for a dial measuring 4in. from *a* to *e* (Fig. 2), a thickness of about 2⅛in. will be about sufficient. The three arms should be made equal in length, and the whole very carefully squared. The setting out of the hour lines is remarkably easy in this form of dial. Make a diagram (Fig. 2) of the cross on paper, of course the exact size of your solid work. From point *a* with radius *a e* describe the arc *e g*. Join *a f*, which will cut off 45° of the arc described. Divide this into three equal positions of 15° each; and, further, sub-divide each into four. Draw radii through the point in the arc thus found, prolonging them until they mark off tangents on the line *e f*. You will then have every quarter of an hour shown for three hours. But this is all that is wanted, for if the same distance be set off on each of the six working faces, starting from the points *b*, *c*, *d*, *e*, the whole of the hours and quarters from 3 a.m. to 9 p.m. will be shown. In erecting the dial care must be taken to get the centre limb of the cross in the meridian, the east and west arms horizontal, and the inclination equal to the co-latitude of the place. The base plate shown in the sketch plays no part in the work of the dial, and might theoretically be dispensed with, but it is useful to have a level surface to start from, and renders the rectification of the dial much easier.—W. J. R.



F I G. 1.



F I G. 2.

[62775.]—**Deafness.**—TO MR. J. COATES.—I have been from home for a few weeks, and have only just got an opportunity of reading "Our" paper. Some few years ago I was quite astonished on finding myself getting very deaf. I went to a friend of mine, who is a doctor of very great experience. The first thing he did was to syringe my ears, and gave me some glycerine to drop into them; but I still got worse. When I saw him next he concluded that the cause of deafness was a cold. The syringing was discontinued, and gargles used, and in less than a month I could hear as well as ever I did. Red sage (about a handful), simmered in half a pint of vinegar, makes a first-class gargle. I have been deaf four times since, but have always found the above a good remedy.—JOHNNY NASH.

[62782.]—**Locks.**—For special purposes an expensive lock may be cheapest. However, both Messrs. Hobbs and Chatwood make four lever locks of thoroughly good workmanship and finish, and the gatings true, which are secure against the ordinary depredators. Chatwood's box-locks are from 3s. 3d. each; for cash boxes, 6d. extra. Hobbs's are, I believe, somewhat less; but Chatwood's lever springs are made out of the levers themselves.—J. M.

[62792.]—**Photography.**—Your Lancaster ¼-plate will suit perfectly for Ilford, Britannia, or, indeed, any other make of plates. The chemicals required for development are pyrogallic, liquor ammoniæ, and a bromide, such as potash or ammonia and hyposulphite of soda. If "Beginner" invests 1s. in a box of Ilford ¼-plates he will get full formulæ for making up the developer on the lid of box. The best negative papers are either Morgan and Kidd, or that of the Eastman Co. But it will be better to have some experience with plates first.—ROSARIO.

[62794.]—**Distilling Whiskey.**—Strong acids, such as sulphuric and hydrochloric (or muriatic), are used in grain distilleries in the treatment of maize and, occasionally, rice, in order to bring about saccharification of these grains without the use of malt, or to reduce the proportion of it. It is also used with the great heat of steam-pressure, or prolonged boiling in open vessels, to effect a better result in the preliminary process of rendering the starch (or such matter as may be converted later to fermentable sugar) more soluble, thus improving extracts, and giving an increased return of spirit. Acids are never hardly used in the making of good whiskey, which demands a high percentage of malt, and is not manufactured on a large scale in England, nearly all "whiskey" coming from Scotland or Ireland. The best whiskeys are made from malt alone, with no raw grain, such as maize or rice, though barley and oats are generally employed in large whiskey distilleries in both Ireland and Scotland. In these places no acids are used, English and Scotch distillers that make Coffey's rectified spirit being almost the sole users of acids.—CYGNET.

[62794.]—**Distilling Whiskey.**—I am obliged to "W. H." and "Nun. Dor." for their information on page 494. The reason that I ask the question is, that I have been struck by the fact that in this part of the world it is most unusual to come across any young person, and more especially women, who have not lost their front teeth before the age of 20 years; whereas in Ireland (when I hailed from "that ilk") such an eyesore was uncommon to meet with. However that may be to-day I do not know, and in cogitating the cause of this bony blight, leading to such a demand for dentists as we are painfully made aware of in our peregrinations, by the brassive doorplates, and the ghastly gum-plates backed with velvet and glass plates, at such a number of doors. Thus I am beginning to conclude "that the aforesaid sulphuric acid is a principal one of the bad spirits busily engaged in turning the little totties into toothless tabbies." Thus I find that it enters into the manufacture of the sweeties so largely swallowed by them; it is also an ingredient in the manufacture of the legion of gassy gulps to be found in every place of refreshment; now it challenges fusel oil in our whiskey. Liking a glass of good ale, I fear that it may bring me to my bier; my very boots would cease to shine without its brimstone bite. In short, I am met by a host of reminders neither to eat nor to drink if I value my grinders.—A., Liverpool.

[62799.]—**Potash Oxalate.**—To form neutral oxalate of potash, take 126 parts of oxalic acid and 138 parts of carbonate of potash; but equal parts, say 1lb. each, will come near enough for practical purposes. But if great exactness is wanted, the solutions after mixing are tested with litmus paper, and a little more potash or oxalic acid added till thoroughly neutral. Dissolve 1lb. carbonate in 25oz. of warm water. Treat the oxalic acid in the same way. Pour the one solution into the other in an open jar, as it effervesces very violently. They must be slowly mixed. This will give over 50oz. of saturated solution of oxalate of potash. There is, however, very little need now to make it, as good oxalate of potash can be bought at a price little more than the combined price of the oxalic acid and carbonate of potash.—ROSARIO.

[62799.]—**Potassic Oxalate.**— To make pot. oxal. from pot. carb. and oxalic acid is certainly an expensive process, since pure pot. carb. is 4s. a pound. The impure article (salts of tartar) may be purchased for 6d. per pound. The best way to prepare the salt, if for photographic purposes, is from pot. hydrate (1s. per pound), and it is not at all necessary to calculate the quantity required. Take some oxalic acid (say 1lb.), dissolve in water, and add pot. hydrate until the solution is neutral to test paper; filter, and evaporate, if necessary, till, on cooling, it begins to deposit crystals. This will give a saturated solution. To use oxalic acid at 8d. per pound, and pot. hyd. at 1s., is cheaper than buying pot. oxal. at 1s. 3d. My prices are from Burgoyne's list. All but one of the answers to this question in last week's issue are incorrect as regards numerical quantities. Some correspondents omitted entirely the water of crystallisation in their formulæ, and another put in too much. Oxalic acid crystallises with two molecules. Pot. oxal., with one molecule of water.—SM.

[62800.]—**Neutral Solution**—Zinc sulphate is normally acid to litmus paper, and you cannot make it neutral. Why do you wish to do so?—SM.

[62800.]—**Neutral Solution.**—Perhaps "Weald" does not know that zinc sulphate is naturally an acid salt—that is, it is acid in constitution. The reason is that zinc oxide ZnO, is too weak a base to render neutral that quantity of H_2SO_4 that is required to form $ZnSO_4$, although it is normal salt.—W. T.

[62800.]—**Neutral Solution.**—Is there not some mistake about this query? An acid solution of zinc chloride or sulphate will certainly be neutralised if well mixed with ammonium hydrate, magnesium carbonate (magnesia), or potassium carbonate. Add the neutralising agent, with constant stirring or shaking, until it begins to precipitate the zinc salt, and filter; the resulting solution will be quite neutral to test paper.—PRINCIPIA.

[62801.]—**Dynamo.**—TO MR. BOTTONE OR MR. EAVES.—If well made, a dynamo with a 5in. armature will light at least six 20c.p. lamps of 48 to 50 ohms resistance—in other words, will give 6 or 7 ampères at 50 volts. Dress the armature with tape before winding on the wire, and then give the tape covering a layer of shellac varnish. After having wound the wire, soak the wound armature in thin shellac varnish (in methylated spirit), and bake in an oven, at a temperature not exceeding 212° Fahr. You will be able to get about 4lb. of No. 18 on the armature. You must also cover the portion of the F.M.s which have to be covered with a layer of thin silk (sarsenet), and then varnish it. You will require about 20lb. No. 20 d.c.c. in one length on the F.M.s to balance the armature if your machine is intended to be shunt wound. See my book, "The Dynamo," for further instructions.—S. BOTTONE.

[62803.] — **Yellow Lacquer.** — Cannot you colour your lacquer with gamboge or turmeric? I have seen good results obtained with the former.—SM.

[62803.]—**Yellow Lacquer for Gunmetal.**—Any well-made shellac and spirit varnish, coloured with gamboge or annatto, will give the desired yellow tint. Try the following:—Best shellac, 3oz.; methylated spirit, 1 pint; camphor, 1 drachm; aloes, 1 drachm; annatto, 1 drachm; gamboge, 1 drachm. Break the shellac up fine, mix it with its own bulk of broken glass; add the camphor and other gums. Place in a stoppered bottle capable of holding a quart. Add the spirit. Shake frequently until the shellac is all dissolved (perhaps a week), then decant off the clear portion. Apply with a large, soft camel-hair brush to the work, which must be as hot as the hand can bear.—S. BOTTONE.

[62805.]—**Screw Thread.**—You will probably require ten cuts to finish on such a light bar. Use a square nose tool raking at same angle as pitch of screw so as to clear. If you have to screw the boss more than 2in. it would be better done with boring bar and saddle, otherwise with inside tool as usual. What particulars do you want? You seem to know the way: why not set to and do the job?—T. C., Bristol.

[62805.]—**Screw-Thread Cutting.**—If really "A Beginner" and you have not witnessed the chasing of a square-threaded screw upon a slide-lathe, you will, I opine, spoil a few bars if the screw is to be some feet long. (How can any person form an idea of the number of cuts when no length is given?) I got a dose once upon a time, to cut a square thread perfectly accurate for a ruling machine; this was 6ft. long and only 1in. diameter when finished, so I will give "Ours" a wrinkle or two at the risk of being thought to have a "screw loose" somewhere. I tackled the first bar in the rough as it came from the forge smith, having a collar near one end, and measuring, say, $1\frac{1}{3}$in. diameter. I straightened this by using a swage, so as not to strike the bar with a hammer; but when this was turned up ready to commence screw-cutting, it was "full" of dog's-legs. However, I straightened this by means of a block tin hammer, and commenced with a tool in the slide-rest of the actual size of the screw when finished. Of course, a backstay was used; this came to grief, it became so crooked. I then pondered upon the problem, got another bar, and when it left the smith's hands I made it red-hot in the boiler furnace and shoved it into the flue to cool slowly. (Memo.—Any bar struck by hammer when cold has its grain compressed, and when this is removed by turning, planing, &c., most of the original bend will appear again; hence the use of a tin hammer.) This resulted in a shaft almost true, which I applied a wooden lever upon between the lathe centres, so as to run practically true. I also found that the tool required to be made exactly like one tooth of a chaser—that is, "flat" upon the top side, and a little more than half the width of the finished screw, thus working down alternately one side and one-half of the bottom, bringing the tool up to a drilled hole where it ended by hand, which is a ticklish operation as regards the point of the tool. I then found the necessity for a more certain means of replacing the tool for the next cut than the usual chalk mark, and fitted an index plate and pointer on handle of slide-rest. The backstay I used was of lignum vitæ, and when it was done I got a brass nut cast upon it and touched it up nicely with a fine file where it bound as it approached the mandrel end. (Note.—If any emery be allowed to grind iron or brass, no matter how fine it may be, it will imbed itself in the same, and I know of no way to get rid of it.) I could not make a good fit of the nut by cutting in the lathe with a similar tool, so I had eventually to make a tap for the same job; but for most purposes it answers well to get the nut cast on in a good brass foundry. (Memo.—Oh horrors! to contemplate a Homo who asks for instructions "How to surface by hand," going a-nutting amongst square-threaded screws! I would use, say, a hook tool, a graver, and a flat tool, accompanied by a calipers.)—A., Liverpool.

[62806.]—**N. E. Compound Engine.**—"East Coast" will find a sketch in the "E. M." for May 13th (No. 1155, p. 243). As full particulars have not appeared, I send the following, taken from *Engineering* for June 17th:—"H.p. cylinder, 18in. dia.; stroke, 24in.; length of ports, $11\frac{3}{4}$in.; width of steam ports, $1\frac{3}{4}$in.; width of exhaust ports, $3\frac{1}{2}$in.; lap of valve, $1\frac{1}{8}$in.; lead, $\frac{3}{16}$in.; maximum travel, $5\frac{1}{4}$in.; low-pressure cylinder, 26in. dia., 24in. stroke; length of ports, 1ft. 5in.; width of steam port, 2in.; width of exhaust port, $3\frac{1}{2}$in.; lap of valve, $\frac{15}{16}$in.; lead of valve, $\frac{3}{8}$in.; inside clearance of valve, $\frac{1}{8}$in.; maximum travel of valve, $5\frac{1}{4}$in.; diameter of piston rods, 3in.; length of slide blocks, 15in.; length of connecting rods between centres, 6ft. 1in.; wheels, cast steel—leading dia., 4ft. $7\frac{1}{4}$in.; coupled dia., 6ft. $8\frac{1}{4}$in.; thickness of tires, 3in.; width, $5\frac{1}{2}$in.; throw of crank-pins for coupling rods, 11in.; dia. do., $3\frac{3}{4}$in.; length do., $4\frac{11}{16}$in.; crank axle, steel; dia. wheel seats, 9in.; bearings, 8in.; centre, $7\frac{3}{4}$in. centre's cranks, 2ft. apart; length of bearings, 9in. Frames, steel, length, 25ft. 11in.; thickness, 1in.; distance apart, 4ft. Boiler, steel; height of centre from rail, 7ft. 8in.; length of barrel, 10ft. 7in.; dia. outside, 4ft. 6in.; thickness of plates, $\frac{1}{2}$in. Firebox shell, steel; length outside, 6ft.; width at bottom, 3ft. 11in.; inside firebox, copper, length at bottom, inside, 5ft. $3\frac{9}{16}$in.; width, 3ft. $2\frac{1}{8}$in. Tubes, 242; length, 10ft. $11\frac{1}{2}$in.; dia. outside, $1\frac{3}{4}$in.; working pressure, 170lb. Heating surface—tubes, 1,211·3sq.ft.; firebox, 112sq.ft. = 1,323·3sq.ft.; grate area, 17·33. Weight—leading wheels, 12 tons 18cwt.; driving do., 17 tons, 6cwt.; trailing do., 12 tons 9cwt. 3qr.—total, 43 tons 6cwt. 3qr. The tender weighs 17 tons 6qr. empty, has wheels 3ft. $9\frac{1}{4}$in. in dia., a wheel-base of 12ft. 8in., and carries four tons of coal and 2,650 gallons of water. This engine (No. 1324) was worked with excellent results before being taken to the Exhibition. On one occasion it brought 20 carriages (including an 8-wheeled sleeper) from Edinburgh to Newcastle, only being helped up the incline at Grant's House (4 miles of 1 in 96). On the outward journey to Edinburgh, it took the newspaper express of 12 coaches, and on the round trip only consumed $22\frac{1}{2}$lb. of coal per mile, carefully weighed, the average consumption of these trains with ordinary engines being 30lb. per mile." Should "East Coast" wish it, I will send a sketch of the patent starting valve used in these engines.—A. W. B.

[62808.] — **Cleaning Stone Floor.** — Apply caustic soda. If you do not know how to make it, procure a few knobs of fresh quicklime—it must be fresh—put in a pail together with some water. When it begins to bubble up, put in about three or four times the quantity of soda crystals. As soon as these are dissolved spread the mass on your floor, and in ten minutes scrape all off. Be careful not to get your fingers into it or splash it on to anything painted. After washing down your floor with water you can if you wish neutralise the caustic remaining in cracks with weak oil of vitriol or even common vinegar. The success of the operation depends on getting the caustic mass on whilst hot.—SILKE.

[62809.]—**Partial Paralysis, &c.**—The only "cure" for this delightfully vague complaint is to get the best possible medical advice at once of the hospitals of London or other large towns, and let the quacks and battery-mongers look out for other victims.—REYMOND.

[62811.]—**Water Supply.**—An air-vessel on suction-pipe close to pump will be much better than a foot-valve, although you had better add the latter as well. Yes; the pump will do if it will deliver sufficient for you. You do not say quantity required.—T. C., Bristol.

[62811.]—**Water Supply.**—I should say that your pump will be choked by such a disproportionate supply-pipe; it ought to measure $2\frac{1}{2}$in. at least for a 3in. bore barrel. Theoretically, there ought to be no need for the back-pressure valve, but practically it would be wise to put it on, as there is certain to be a slight leakage of air somewhere in such a length of piping. Take care that the pipe is laid so that there shall be no bends where any air will lodge in it, or you will have trouble. Of course, your force-pump has an air-vessel upon the rising main, as this is a small pump and will tempt the operator to "go ahead."—A., Liverpool.

[62813.]—**Engine Queries.**—1. Total heat of steam at 142° F. = 1082 + (142 × ·305) = 1125·3° F., and as it is condensed to 120° it must give up 1125·3 − 120 = 1005·3°. The water enters at 60 and leaves at 100; therefore it carries away 40° of heat, and the quantity required is therefore 1005·3 ÷ 40 = 25·13lb. of water for each lb. of steam condensed. 2. The relative volumes of the water and steam being ·016 and 3·6—that is, 1 : 225—their velocities will be proportional to the velocity of a body falling a height equal to a column of either fluid sufficient to give the pressure indicated on gauge, and which will be as the square root of the height $\times \sqrt{29}$, or : $8\sqrt{1} : 8\sqrt{225}$, or 1 : 15. The energy of water would be $1^2 \times w$, and of the steam $15^2 \times w$—w being the weight of each fluid passing through the orifices in the same time, and which will be 1 in the case of the water and $\frac{15}{225}$ in case of steam, so that final result stands as 1 is to 15. 4. I do not think you will be able to get on without Euclid, which is usually included in mathematics. For my own part, I am not a grand one at either, but I mastered sufficient to read good mechanical works with understanding; in fact, I should scarcely be able to follow some writers without the smattering I have. Get some honours questions and examine well; you will then know if you can manage without—it is possible.—T. C., Bristol.

[62814.]—**Thermopiles.**—TO MR. BOTTONE.—You would require about 150 elements in series for your purpose, and would use about 6 cubic feet of gas per hour; each circle must be separated from its neighbour by a layer of cement the thickness of sheet iron, about $\frac{1}{24}$in.; they will hold sufficiently without any holes. Each casting will cost about 4d. The flame should not touch the casting; the top ring should not be made solid. Antimony costs about 10d. per pound; zinc about 4d.—S. BOTTONE.

[62816.]—**Electric Bell.**—Pure water is a very bad conductor of electricity, being very many million times less than the metals. Three Leclanchés could not possibly ring the bell through even a couple of inches of water.—REYMOND.

[62816.]—**Electric Bell.**—The earth was formerly supposed to close the circuit and conduct the return current back to the battery, thus supplying the place of a return wire. The theory now is that the earth receives and dissipates the current as fast as it arrives, and thus prevents the tension at the terminal wires, which would otherwise stop the electric flow. The earth being a good conductor (when wet) acts as above; while water, being a bad conductor, will not carry the current across even 2in.—PRINCIPIA.

[62816.]—**Electric Bell—Water Resistance.**—To any electrical mind it is evident the resistance between the two wires when placed in the bucket of water was too great for the battery used. The resistance of water without the addition of acid is exceedingly high. On p. 42 of Vol. XXXV., "E.M.," in reply to a query as to what liquids give the highest resistance to a current, Mr. J. Tolman, of Wolverhampton, replied: "Water offers the highest resistance as far as I am aware. I believe a glass tube 12in. long (filled with water only) offers as much resistance as the Atlantic cable." The querist has learned a little by experimenting, but had he used the bucket of water by pouring it on his earth places, probably the bell would have rung. Anyway, to prevent a recurrence of the failure, I should advise him to join his earth wire to a water-pipe each end, or, better still, to run a return bare wire. Culley says it is quite a mistake to use earth for return under half a mile; and this from experience I have found quite correct. True, signals will go through, and bells will ring with an earth under this distance, but not nearly so well as when a wire is used.—AN A. S. T. E.

[62817.]—**Book Rest.**—TO "SILKE."—I am afraid the affair would become too complicated to be efficient on a bed. But does querist want it for a bed or for a table? If he will say I will try to suggest something to suit. Will he also give weight and size of *Ency. Brit.*?—SILKE.

[62820.]—**Trawl Net.**—I am a fisherman, and have invented and obtained the Royal Letters Patent for an improvement on the Otter trawl, or boards on edge, as shown in your sketch, which is quite inaccurate as regards detail. I will make or send detail of my improvements, which you can use free, for cost of material only, time the patent is in force. For name and address refer to Address Column.—PATENTEE.

[62823.]—**Fret-Cutting Machine.**—I have had two treadle machines of different English makers, and one small American, all three very poor things. I believe I once saw a substantial affair at Melhuish's, Fetter-lane, Holborn-circus, where you might get the information wanted.—SILKE.

[62824.]—**Pinhole.**—Like "J. P., Hull," I tried a pinhole made through a piece of black cardboard, and the resulting photograph had the same fault—viz., want of definition. I then got a piece of thin brass, hammered it out very thin in the centre, and bored a hole with a needle; the result was a great improvement, but a long way behind a photo taken with a good lens. Pinhole photography is a curiosity; but the long exposure needed, coupled with the want of sharp lines in architectural subjects, will hinder it from becoming a rival to the photography of the present day practiced with good lenses.—B.SC., Plymouth.

[62824.]—**Pinhole.**—The pictures produced through a pinhole can never be in focus as a photographer understands the term, viz., "sharp." The rays from an object passing through a pinhole diverge unbroken, so that the farther from the hole the more diffused or indistinct will the image be: similarly, the larger the pinhole the more room will the rays have to diverge between the object and the ground glass. By means of a lens, on the other hand, these diverging rays falling on the lens are bent back, viz., made to converge to points at a certain distance behind the lens, forming thus a distinct image of the object at this distance. Before and behind the point of distance the image, formed of scattered rays, is similar to the pinhole image. When it is said the image from a pinhole is "always in focus," it means in focus as far as possible. At about 1in. distance from pinhole I have had pictures outdoors (whole plates) somewhat indistinct, but which I like better than lens pictures. I gave, I believe, about three minutes' exposure in winter on rapid dry plates. The pinhole was as fine as I could manage to make in a piece of tinplate. I drilled nearly through with a fine drill, then pricked the remaining film with a fine needle. If you use card, see that it lets no light through, and be careful to have no chinks. —SILKE.

[62827]—**Violin Soundpost.**—The soundpost should stand upright at about ¼in. or less behind the right foot of the bridge (E string side). It should only just hold when the strings are off, should, of course, be solid (pine); but not glued in. If you have a soundpost to fit, you can put it in place through the *f*-hole with a bit of wire flattened and stuck into it. The ends of the post should be cut to match the slope of belly and back. —SILKE.

[62827.]—**Violin Soundpost.**—The best place for the soundpost "must" always be ascertained by shifting it forwards and backwards until the proper place is hit upon, but they are usually stuck up a little behind (that is, nearer to the chin) than the nicks in the *f* holes. It must not be glued, and ought to be erected so as to stand exactly behind the treble foot of the bridge, with all the strings slacked up, and only just tight enough to keep its position whilst being strung up again.—A., Liverpool.

[62827.]—**Violin Soundpost.**—The best position for the soundpost of any violin must be found by experiment; but as a general rule it should be just behind (one-eighth of an inch say) that foot of the bridge which is under the E string. It should be a solid post, and it need not be glued in—though a touch of glue might be applied to keep it in position when the strings are slackened, provided the best place has been found. It is not usual, however. I daresay some of our friends who are violinists will give you their views, and then you can form your own opinion.—N. E. CHILD.

[62828.]—**Camera without Lens.**—"Poor Lad" will observe from my reply to No. 62824 that I do not think pinhole photography will ever rank with lens photography, but no doubt it can be commenced on a much cheaper scale. For the camera itself an ordinary cigar box, about 6in. deep and 5in. broad, will suit nicely for 5 by 4 plates. First take out the one end and make it so that the dark slide will slide in and out easily. A focussing glass—that is, a piece of ground glass—should be cut to slip into the same groove, not for focussing but to put the camera in position, as it would be awkward after photographing a church to find that the principal object in the negative was the chimney of an adjacent mill. Glue or cement the lid on to the box, and see that not a particle of light can get in at any of the joints. Bore a ¼in. hole in the centre of the front, on which fasten a piece of thin sheet brass (such as is used for cartridges). In this bore a hole with a fine needle. Brush all over, especially inside, with common ink, and the camera and lens are ready for work. The dark slide is more difficult to make. The cheapest plan for "Poor Lad" is to get the loan of one, and copy it by cutting out millboard, and build it up, as it were, with glue or shellac cement. If he can afford it, a 5 by 4 metal double dark slide could be got from Tylar, 31, Yates-street, Aston Cross, Birmingham, for about 4s.; or, if he can do joiner work, he had better make it with mahogany fretwork wood. Afterwards he can make some sort of tripod stand or legs to fix it on. He will see amateurs taking photographs now and then, and can pick up ideas as to the best form of legs; then, as to the photography, get any of the shilling manuals, and follow its instructions. The exposure required is somewhere about 1,500 times longer than with a rapid lens. For a small needle hole, I find that about a minute in bright mid-day sunshine for light architectural subjects is little enough. For portraits, groups, or landscape with figures, pinholes are of no use.—B.SC., Plymouth.

[62830.]—**Legal.—Income Tax.**—The landlord is quite right; he is clearly only bound to allow property tax upon the rent he receives, although this fact seems generally unknown to tenants. But then, although in this case the rent is only £50, the assessment at £60 may be right; for this is based upon gross rental value, and the rent paid may be lower, because of a lease or for other reasons. The tenant can, however, appeal from the assessment, and he should ask his collector for the necessary papers.—FRED. WETHERFIELD, Solicitor.

[62830.]—**Legal.**—"Householder" is assessed at £60, and his rent is only £50. There are cases in which this is quite right—for instance, a long lease where the property has increased in value. But, supposing the value is only £50, then, when "Householder" receives his first notice of assessment for the year, he should call immediately on the surveyor of taxes, produce his rent receipt, and he will, no doubt, get the assessment corrected. If not, lodge an appeal with the surveyor in writing.—B.SC., Plymouth.

[62830.]—**Legal.**—The landlord allows the property-tax only on what he actually receives, and if your premises are assessed at more than the rent, you can appeal and get the assessment revised. But did you pay a premium, or make any other arrangement to keep the rent low? The Queen's taxes would be based on the Poor-Law assessment, and are supposed to be on the full rental value of the premises. Thus, if they are worth £60 a year, they would be assessed to the Poor-rate at five-sixths, or £50; but I doubt whether you can get the Queen's tax-collector to accept the same. If you have not made any arrangement or paid any premium, and £50 is all the rent you pay, then the charge on £60 is clearly illegal, and you can get it back by applying to the Commissioners at Somerset House. If the place is really worth £60, you will have some difficulty in convincing them that you get it for £50. There are plenty of houses in London held on a merely nominal rent—say, £20 a year for a house worth £150, in consideration of a heavy premium having been paid; but the tenants do not expect their landlords to allow them the property-tax on £150. The whole arrangement is a jumble and, I fancy, a juggle; for, although there must always be a difficulty in assessing the value of property, it is singular that while small houses are assessed at their full value, mansions inhabited by dukes and similar people get off at a remarkably low figure.—NUN. DOR.

[62832.]—**Bending Zinc Tubes.**—I am not sure that I know what "handles on French zinc jugs" are like; but this I know, that zinc bends readily enough when made hot. If I wanted to bend zinc tubing, I should fill it with sand, plug the ends, make it rather hotter than I should care to hold, and bend it to the shape desired. What a pity "A Tinman" did not say what "ways" he has tried. Perhaps he has been all the time dodging success by not doing some simple thing, in ignorance of the first principles;—that is, for the want of technical education.—NUN. DOR.

[62832.]—**Bending Zinc Tubes.**—I have bent zinc tubes successfully as follows:—Solder the joint evenly, and with as little solder as possible; put a cork in one end, fill with slightly damp sand, and ram in tight, closing with another cork; heat the tube until just uncomfortably hot to the hand, and then bend round a bit of board sawn to the curve required.—SILKE.

[62834.]—**Light and Heat.**—If a body is capable of reflecting heat in the light, it will certainly continue to do so in the dark. There is no such thing as a "white" body in the dark, as colour presupposes the presence of light. I would advise you to read Tyndall's "Heat," or some other book on the wave-theory of light and heat.—REYMOND.

[62836.]—**Repairing Sofa Springs.**—"Young Joiner" must not take bottom out, as I suppose him to intend. He must, first of all, take the back off the sofa, which he will find fixed by two screws or, rather, bolts. He must then take off the covering of the sofa; then the canvas. He can then restitch the springs, or, if the canvas be nailed on the under-side of sofa, so that he can get at it, let him leave the top canvas on, but take the cover off the sofa, so that he can stitch the springs to the canvas by the aid of a long needle—an upholsterer's needle, to be had at the ironmongers' shops. He will need to take the stuffing out, and replace it when his springs have been fixed.—KENDAL.

[62837.]—**Current Breaker.**—Probably your contact breaker has no back nut to it, so that after a few vibrations the screw works loose and slips away from the spring.—S. BOTTONE.

[62838.]—**Siemens Armature.**—Fill one side of the armature—say, to the left of the spindle, first; then, continuing to wind in the same direction, pass over to the other side of the spindle (the left) until that is also filled.—S. BOTTONE.

[62839.]—**Legal.**—The local board could stop building operations on ground within their jurisdiction if the plans are not according to their regulations. "Alexander" should call on the surveyor or the party who does that duty for the board, and on getting his consent verbally, he may safely proceed with the work without waiting for the formal consent of the board.—B.SC., Plymouth.

[62840.]—**Softening Leather.**—Would not glycerine do for this?—PRINCIPIA.

[62840.]—**Softening Leather.**—Soak the leather in lukewarm soapsuds. I am not aware that anything is applied to make them harder than they will be after the compression in the cup.—A., Liverpool.

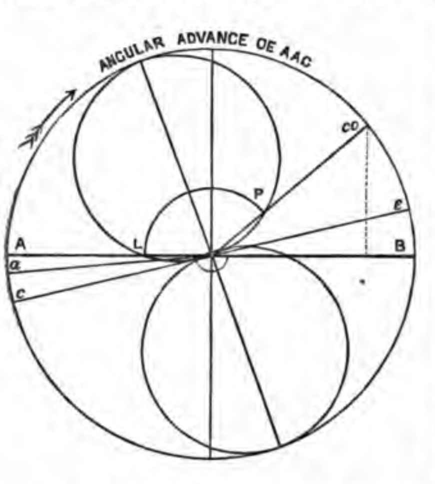
[62841.]—**Parrots.**—My experience of teaching parrots to talk properly is steady, quiet perseverance, saying the words, &c., quite distinct and fairly loud; but distinctness is the main thing. My own bird (a grey), which I have had some years now, was at first very wild, and with all my talking to her, was over eighteen months before she said a single word. Very soon after she could say many words and sentences, and turned out a good, plain talker, and is so yet; of course, she forgets some words, but picks up others instead. I could give you a lot of amusing words and sentences that she repeats, some of them long. Her tone of voice, my friends say, is like mine. I account for that by her picking up very few words from other members of my family. I have no doubt your bird will do the same if you persevere. Always speak to her every time you pass her cage; feed her as often as you can yourself. She will get to know and speak to you, even when you are taking no notice of her. But, after all, there are parrots and parrots.—J.P., Aigburth.

[62843.]—**Petrolatum.**—By way of a guess, I should think that "petrolatum" is a fancy name for benzoline or benzine.—THEO.

[62844.]—**Charging Secondaries.**—TO MR. BOTTONE.—Yes; from 20 to 25. If well made, the said dynamo will not heat injuriously for six or eight hours; but if the armature, instead of being mounted on spiders, were on a wooden sleeve it would get hot in half the time.—S. BOTTONE.

[62846.]—**Zeuner's Slide-valve Diagram.**—I do not understand your query—viz., "explaining their practical use." Slide-valves are used to equalise the distribution of steam into the steam-engine cylinder. "Machine Design," by Unwin, will give you a good description. If you obtain the *Practical Engineer* (a weekly journal) for June 17th, 1887, you will find an example worked out.—PATIENCE, Bristol.

[62846.]—**Zeuner's Slide-Valve Diagram.**—In Vols. XXXIX. and XL., our old friend "Glatton" treated the subject of the slide-valve very fully. Quite lately "Elag" also sent a diagram of the above. Last year I gave a large diagram as applied to the consideration of the cut-off slide on back of main. I now give the ordinary diagram, neglecting length of connecting rod. The motion of piston is from A to B in diagram. A B represents travel of valve. Set-off angular advance of eccentric towards A (not towards B as it really is), and on it describe a circle. Let C O be desired cut-off, join this to centre, and scribe an arc L.P. cutting small circle where the line intersects at P. The radius of this arc is amount of steam lap. If you do the same opposite, and draw the small arc equal to lap on exhaust side, and draw lines to large circle through points of intersection with small circle, you find *e* and *c*, which are the points of exhaust and cushion—C O being point of cut-off, and *a* admission or lead of slide. "Burgh's Slide-valve" gives the diagram with others.—T. C., Bristol.



[62849.]—**Tests for Arsenic.**—Dissolve out arsenic from wall paper with pure dilute hydrochloric acid, insert strips of clean copper turnings in the solution and apply gentle heat; if As is present a grey deposit is found of As_2Cu_5. This is called Reinsch's test, and gives reaction from very dilute solutions. Another delicate test is Marsh's, but requires some little skill and knowledge in the use of chemical apparatus; a proper stink cupboard is necessary, as poisonous and objectionable fumes are given off. Fleitman's test is the decomposition of silver nitrate by the action of arseniuretted hydrogen (AsH_3). Place pure granulated zinc, free from arsenic and lead, with KHO and a little water in a test tube, cover the top with piece of blotting or filter paper moistened with siver nitrate, and on the application of gentle heat the paper is blackened if arsenic is present.—WALTER POTTER.

[62850.]—**Tar Pavement.**—Heat the tar in an old boiler, such as is used to prepare food for cattle. When melted, throw in your gravel, stir, and then ladle out with a drainer, leaving all the tar in the boiler but that adhering to the gravel; repeat the operation until all the gravel required is coated with tar. Lay the tarred gravel in place, roll with heavy iron roller previously coated with grease, and then sprinkle over thickly with sand or dry cement.—B.SC., Plymouth.

[62851.]—**Polishing Pebbles.**—First process: To grind the pebble flat rub it on a coarse stone. Second process: Rub it on a piece of wood sprinkled with silver sand. Third process: Rub on a piece of leather dressed with powdered pumice-stone and water. Fourth process: Rub on a piece of leather dressed with putty-powder and water.—HENRY E. S. HARVEY, Kingston-on-Thames.

[62854.]—**Dynamo.**—TO MR. BOTTONE.—To soften your castings, pack them in a large crucible or square iron case with powdered quicklime. Raise them nearly to a white heat in a furnace or forge, and keep them there for a week or more, the longer the better. Let them cool down very gradually. For a machine as small as that described in my book no great advantage will accrue from using wrought-iron fields, since the discontinuity of the pole-pieces counterbalances the superiority of the wrought iron.—S. BOTTONE.

[62855.]—**Electric Bell.**—TO MR. BOTTONE.—1st. Let the mat rest on a flat board, touching the contact. Let the contact have a spring sufficiently powerful not to depress with less than 1cwt. 2nd. Your contact must be dirty, or there is leakage somewhere on the line.—S. BOTTONE.

[62856.]—**Boiler.**—If you want a vertical boiler, have a simple conical flue, and make shell 18in. by 15in. of $\frac{3}{16}$in. plate, and $\frac{3}{8}$ rivets pitched $1\frac{1}{4}$ apart. Size of safety-valve, $\frac{1}{2}$in. diameter, and $\frac{1}{2}$in. gauge-glass and cocks, and steam pipe and feed-valve.—T. C., Bristol.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "A., Liverpool," has replied to 62560.

62413. Brasses, p. 281.
62432. SS. *Glen Rosa* of London, 281.
62449. Flour Machinery, p. 281.
62454. Correction of Telescopes, 281.

62593. Daguerreotype, p. 376.
62594. Engines for Screw Steamers, 376.
62601. Movement Wanted, 377.
62623. Clock and Sundial, 377.
62632. A Platyscopic Pocket Lens, 377.

QUERIES.

[62857.]—**Solution for Batteries.**—I have made a 15-cell square battery of the Bunsen type, with carbon and zinc plates for the poles, and have used chromic and sulphuric acids for the exciting elements; but want to find, if possible, a cleaner and cheaper solution and yet be as constant and strong (about 35 to 40 volts). I use it for driving an electro-motor, and sometimes want it running for nine or ten hours at a stretch. Any information regarding the above will be thankfully received.—G. BEAVEN.

[62858.] — **Indiarubber Moulds.** — Can any reader give me instructions for moulding small flat objects in indiarubber or vulcanite? What should moulds be made with? Also how to enamel castings with colours to stand out-door exposure, particularly white enamel.—NOMEN.

[62859.]—**Heating Water.**—Water at 212°, circulates though a coil in a tank of cold water. How do you obtain the length of pipe required to raise the water in the tank to any given temperature?—J. B. B.

[62860.]—**Yeast.**—Can any of "ours" describe the manufacture of the above? Also the cost of plant, medium size factory?—ZEMA.

[62861.]—**Chloride of Calcium Crystals.**—Will some of your chemical readers have the kindness to inform me how to prepare crystals of the above at a cheap rate? When I dissolve marble or chalk in muriatic acid, a liquid is the result which I have failed to crystallise out. Can I also be informed the formula (with examples of working) showing how to arrive at the quantities of salts in solutions of different densities?—W. R.

[62862.]—**Windmills.**—Will some of our numerous readers kindly help me with the following? I want to erect a vertical windmill, large enough to drive a small force pump of 5in. stroke, and to pump about half a pint of water per stroke, into a cistern raised about 10ft. Now I am at a loss about size of wheel, inclination of fans and shape of same. Therefore before starting should feel obliged if some one would help me.—INCOG.

[62863.]—**Hammock.**—Can any of "ours" give the querist directions in netting a hammock? The mesh which I had made is $1\frac{1}{2}$in. The cord which was made for it is about 3-32in. thick.—J. E. B., Leeds.

[62864.]—**Faceplate.**—Can any of "ours" tell me how to turn up a faceplate under the following circumstances? Faceplate 8in., lathe $5\frac{1}{2}$in. centre, backgeared. My slide rest is pinned to bed, which is double flat, by a bolt like an ordinary T rest. The surfacing slide, which is the lower one, swivels right round, but has no mark or gauge on it to tell when it is at right angles. By what means can I best set it true. The surfacing slide is 9in. long. The feed about $4\frac{1}{2}$in.—J. E. B., Leeds.

[62865.]—**Analysis of Phosphate of Lime, &c.** Will Mr. John Grey or other of our analyst friends kindly give a simple way of analysing a commercial sample of precipitate bone-phosphate of lime, including the percentage of tri-basic phosphate soluble in citrate of ammonia?—QUÆSITOR.

[62866.]—**Hydrochloric Acid.** — Is there any known way of making this acid commercially without its being a by-product? How would the electrical current do in a saturated solution of chlorine gas in water?—QUÆSITOR.

[62867.]—**Troublesome Zinc Rod.**—In a cell of nitrate of soda class I have a Leclanché rod in small porous pot containing zinc chloride solution. After some hours of action I find zinc nearly covered with white pasty substance, especially thick at water-line, which does not easily wash off in water. What is the paste and how avoided? It obstructs action. Zinc solution had been treated with magnesia (carb.) to neutralise.—WEALD.

[62868.]—**Emulsions for Opals.**—Could any correspondent oblige me with instructions and formulæ for the preparation of gelatino-bromide, chloride, or citro-chloride emulsions for coating opal glass? To be used either by means of development or simply toning and fixing. Or direct me as to which of Abney's formulæ for emulsions is best suited to this particular purpose?—M.R.C.S.

[62869.]—**Venezuela.**—Will any English Mechanic who has been out there give his experience and opinion of the climate, advantages, and disadvantages of Venezuela for the benefit of one who thinks of going out there if at all favourable?—GUILLAUME BOIS.

[62870.]—**Dredging.**—How is mud or anything else measured in a barge or boat or vessel? A contractor is paid for dredging measured in barges. How is it best and fairest done?—GUILLAUME BOIS.

[62871.]—**Concrete Floor.**—What would be the best way to erect profiles for, or otherwise accomplishing, the laying of a fine cement concrete floor curved upward to a radius of 500ft.; length 300ft.; width 50ft.?—GUILLAUME BOIS.

[62872.]—**Oil Gas.**—I should be obliged for advice as to the advantages, if existing, of oil gas for town lighting over coal gas. I am purposing the erection of a works, capable of yielding about 500 lights for four hours each day, and am given to understand that I should require a coal-gas apparatus consisting of two furnaces with three retorts, each making 7,060 cubic feet of gas for 12 hours, or an oil-gas apparatus with one spherical retort making 217 cubic feet of gas per hour. The illuminating power of oil-gas is said to be four times that of coal-gas, so that 1,765 cubic feet of oil-gas would be equal in lighting effect to the 7,060 cubic feet of coal-gas. As 217 cubic feet is made per hour only, $\frac{1,765}{217} = 8{\cdot}1$ hours would be required—instead of twelve—to provide this quantity, and thus nearly four hours of labour would be saved. The illuminating power of oil-gas is said to be equal to 10 standard candles per cubic foot, whilst about 4 cubic feet of coal-gas only corresponds to this. Is this correct? Coal yielding about 9,200 cubic feet of gas per ton (and 1,430lb. of coke) can be supplied to the works at about 14s. per ton. Paraffin oil yielding about 21,000 cubic feet of gas per ton would cost 109s. per ton and require about one ton, 16 cwt. of coal per ton of oil, to heat the retort. As only one-fifth by weight of material has to be handled in the case of oil-gas it would necessarily be economising labour, and in the matter of first cost of plant, the proportion of 5 for oil to 16 for coal-gas, it would seem altogether in favour of the former. As oil-gas is also of much greater density than coal gas, in the proportion I think of 2 : 1, it follows, I presume, that much smaller mains will suffice, and so economise again in this direction. There remains, however, the question of illuminating power, stability of flame, &c., which I am less assured about, and relative to which I should be very glad to receive information through these columns. As to the cost of oil-gas I am given to understand that it is about 8s. per 1,000 cubic feet at the prices before mentioned, whilst that of coal-gas is probably 2s. 10d., with coal at 14s. per ton. If this is correct, an oil-gas burner, consuming 1 cubic foot per hour, would cost 96-1,000ths of a penny per hour, whilst a coal-gas burner consuming 4 cubic feet per hour, would cost 134-1,000ths of a penny in the same time. This upon 500 lights burning four hours per diem would represent a saving of 40 × 500 × 4 = 880-10ths or 6s. 8d. per day. It is probable, however, that the loss of gas from leakages is greater with oil than with coal-gas (the latter averaging in small works about 10 per cent.) owing to its greater density, unless, on the other hand, owing to its greater permanency, a less condensation takes place. For gas-engine driving, I am given to understand that oil-gas does not go as far in the way of illuminating when compared with coal-gas, being only in the proportion of $2\frac{1}{2}$ to 1. In this respect, therefore, it is not so economical as coal-gas. I believe there is very little danger connected with the manufacture of oil-gas, and a minimum degree of labour and attention required, but it would be very agreeable to learn the opinion of those who have had to do with the manufacture on this head. For very large works it is probable that coal-gas would, in the end, be cheaper (although I have heard of a works for supplying 12,000 lights with oil-gas having been carried out with advantage), and I should be glad to learn at about what capacity with coals at 14s. and oil at 109s. per ton, this might be the case. The oil I have referred to is a residue from the manufacture of paraffin. Assuming the spec. grav. of oil-gas at 0·8, what is the rate for calculating diameter of mains?—MARIENBERG.

[62873.]—**Leyden Jar and Fulminating Pane.**—Will some contributor to the "E. M." kindly help a fellow-subscriber with a little information respecting the above instruments? I have tried making Leyden jars of all sizes, but never with success. Made as follows: Glass jar coated half its height with tinfoil inside and out, knob on wooden lid with wire to connect with inside foil. To charge I use $\frac{1}{2}$in. spark coil, put one electrode in contact with outer foil, and the other $\frac{1}{4}$in. distant from knob. Result: When coil is in action sparks pass between electrode and knob of jar; but after working, say, ten minutes, not a trace of electricity can I find in the jar. Where is the fault? Also what length of spark should I get from a jar charged with coil of the power named above? In other words, is the length of spark from jar limited to that of charging apparatus? The fulminating pane: Made of window glass 12in. square. Tinfoil to within 1in. of edge cemented on to both sides with paraffin and mounted on varnished wood. To charge I connect one electrode to foil and bring other electrode to within $\frac{1}{4}$in. of other foil. Result: After charging 10 or 15 minutes gives no discharge over edges of plate as I expected. On stopping coil no electricity can be found in the plate. Charging spark $\frac{1}{2}$in.—MAORI, N. Z.

[62874.]—**Medical Electricity.**—TO MR. BOTTONE OR "EOS."—I am recommended to provide myself with a continuous current battery, and am at the same time informed that the best results are obtained from large low-tension batteries? Which is the best? 1. Is there such a thing as a medical Daniell? 2. Would the Leclanché be suitable, and give a constant current, say, for half an hour at a time? 3. Or would the binoxide of manganese and chloride of lime of Gaiffe of Paris be the best?—NEURALGIC.

[62875.]—**Painting Furniture.**—Will some one who has done—or seen it done—say how the finely lined decorative patterns are drawn upon painted furniture? How are the long straight lines ruled so as to have no uneven edges, and the geometrical work so accurately drawn? Much of it appears too finely lined to be stencilled. And yet, from the cost of the furniture it is evident that such work is very quickly done to make it pay. If stencilled, what medium is used with the colour, and how are the stencil plates held so closely against the wood that not a single raw edge appears?—O. J. L.

[62876.]—**Induction Coil.**—Would some one kindly tell me what advantage is gained by dividing the secondary coil into several sections by means of ebonite partitions? About what length spark could be got from a coil containing two layers of No. 16 c.c. wire as the primary coil, and about 6oz. of No. 32 s.c. wire constituting the secondary coil. The quantities are those mentioned in a little book by Dyer, entitled "Induction Coils, and How to make them."—W. T.

[62877.]—**Faulty Electric Bell.**—I would thank some kind reader of the "E. M." for information. I have a line wire about 400 yards long with bell and battery each end; the battery seems to work very well one end, but the other end there is a sort of blue metallic salt forms on the binding screws, which stops the ringing of one of the bells while the other will ring. Will someone kindly tell me the cause, and how to prevent the same?—GARRET.

[62878.]—**Dynamo.**—To MR. BOTTONE.—Will you please tell me the best manner to wind machine of the following dimensions? Armature, cog ring, 12 cogs, 6in. dia. outside, $3\frac{1}{2}$in. long, F.M.'s cores $7\frac{5}{8}$in. long by 3in. diam. Pole pieces of massive malleable iron. You will see it is Mather and Platt type. Should prefer it shunt wound, and for a single arc light requiring 50 volts and about 10 ampères. Please say what size the pulley should be, and about the speed to give the above E.M.F. and current.—CARNWORTH.

[62879.]—**Tug and Launch Blades.**—Required handy rules for working out diam. and pitch, also surface, of blades for tugs and high-speed launches, given the size of engine cylinder and approximate revolutions per minute?—E. S. H.

[62880.]—**Wood for Marine Boilers.**—In the case of a marine boiler burning woods must the boiler be larger in all its parts than if used for coal? What amount of grate surface per N.H.P. is necessary for burning wood?—E. S. H.

[62881.]—**Marine Engines.**—Can any correspondent recommend a handbook on small high-pressure and condensing marine engines, where proportions of same may be readily found without much calculation?—E. S. H.

[62882.]—**Niaudet's Battery.**—Professor Silvanus Thompson mentions this cell in his "Electricity" saying it has a higher electro-motive force than the Leclanché. It is zinc in salt, and carbon in crushed carbon and chloride of lime in the porous cell. Can any one say how long it goes without recharging? At the same time kindly point out its weak parts, as I know from experience chloride of lime is a most corrosive powder.—M.M.I.SC.S.

[62883.]—**Water Motor.**—What power should I require to churn three mugs of milk at once in one churn?—the old-fashioned one up and down called a plunge churn about here. I am informed by our township's surveyor that the water is at a pressure of 25lb. to the inch.—B. E.

[62884.]—**Musty Butter.**—How can I cure the above, which has gone so through not having had enough of salt put in it when first churned? Good colour and pure.—B. E.

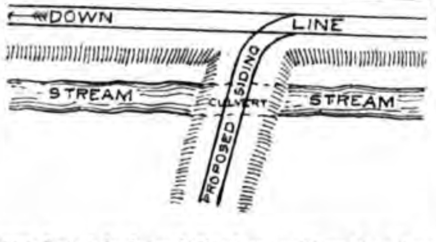
[62885.]—**Grand Trunk Railway of Canada.**—Can anyone say what brake is used on this line?—REYMOND.

[62886.]—**Flux.**—I want a flux that will make melted wrought-iron more liquid so as to run into moulds (this is possible). Can any reader tell me of such a one?—TROUGHENER.

[62887.]—**Triple Expansion.**—What are the advantages, and disadvantages of high grades of expansion of steam? In what way does the triple expansion engine tend to obviate the latter, and how to calculate the horse-power from the indicator cards where the clearance is assumed?—W. W.

[62888.]—**Power Tests.**—Will some reader give me a sketch of apparatus to test accurately the power required by different machines? It should be capable of being attached to a pulley on the machine and show exactly what resistance is offered by the machine.—MOSLEYITE.

[62889.]—**Siding.**—I shall have to set out a siding road on an embankment, as sketched. What is the smallest curve I can take for main line locos, and how shall I proceed to set it out under the circumstances?—GUILLAUME BOIS.



[62890.]—**Victoria Organette.** — Will some of "Ours" kindly tell me how to make the bottom bellows work—the top bellows works correctly? No fault is visible, but the instrument will not play.—B. S.

[62891.]—**Shellac.**—Can "Eos" or others give an account of the shellac factories of Calcutta or refer to a book on the subject, if one is published? I think there is, as I distinctly remember seeing a reference to it in "E. M." some years ago and to making a note of it at the time. I have mislaid the book in which note was made.—T.

[62892.]—**Milk in Hot Weather.**—What is the best way to keep milk? There seems to be an objection to borax and carbonate of soda. I find saltpetre keeps it as well as anything I have tried, but am told that a continued use of it is injurious. Is it? How do the milk purveyors manage in America, say Washington (where it is so very hot), or India?—B. E.

[62893.]—**Photographic.**—Many of your readers seem interested in the cameras without lens. Would someone kindly give a description of their performance and capacities? Will Mr. "Somebody" also be so good as to describe the preparation of the more modern form of dry plates?—C. HARLEY.

[62894.]—**Diamonds.**—To "Eos."—I remember reading some years ago a fascinating article on "Diamonds and their Formation." Has he not during his recent travels found sufficient material for "just one more," and oblige, besides others—C. HARLEY.

[62895.]—**Electrical Employment**—I have a son, age 17, who is at present a telegraphist in the Telegraph service; but he finds the confinement does not suit his health, and has a great wish to leave and get a situation, if possible, with an electric-light company, or makers of electrical apparatus. He attended classes and sat for the Elementary Examination in electricity and also telegraphy last winter, but the result is not announced yet; but, no doubt, he has passed, for he has a great liking for the study of electricity and will keep it up. He is also a fair draughtsman. Will you kindly tell me if there is any chance of his getting employment in almost any capacity with the above, if so how shall he proceed?—M. M.

[62896.]—**More Wind wanted for Harmonium.**—Would Mr. Fryer or other able correspondent kindly advise? I have a portable harmonium $3\frac{1}{2}$ octaves with two sets of reeds, three stops, which appears to me to be decidedly short of wind. It is, I am told, the latest French pattern, with the bellows under feet, the wind, of course, going up legs at each side. There is no leak that I can see; but I am obliged to work the pedals so rapidly that it is quite tiring, and that with only one set of reeds. If the stop is drawn I cannot get anything like enough wind. Is there any remedy short of putting in larger bellows, as that would mean almost reconstructing; but I am willing to sacrifice some portability to obtain efficiency?—SHORT WIND.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, July 27, and unacknowledged elsewhere:—

E. ECCLES.—Medical Battery Co.—H. Milnes.—Handy.—Boniface.—Ironworker.—A. E. I.—J. H. T.—W. G.—J. T. B.—L. S. M. Pyke and H. T. Barnett (corrections noted).—Edmund Roberts.—W. J. P.—Copper.—Fal.—Prismatique.

H. (The "death watch" is the common name of a little beetle about a $\frac{1}{4}$in. in length, known as Anobium tesselatum. In its larval state it bores those round tunnels frequently seen in old furniture, and in its adult state makes the tapping noise which has given rise to the superstitious name of "death watch." No known cure except clearing out the old wood. There is a species of cockroach which acts in a similar manner, but it is rarely found except on board ship. It is known to sailors as the Drummer.)—A. O. (Why not look in some textbook of physics if you have not back volumes? All three cases are instances of friction.)—DUSTY MILLION. (For a good deal of information about amber see p. 319, present volume; but you must explain what you mean by "cleaning amber." Is it polishing, or what?)—MR. SMITH. (Condenser for coil described and illustrated in No. 1155, p. 254, of this volume. See also the indices of back volumes.)—ARBE. (If you cannot refer to back volumes you should procure a little book entitled "Photo-Engraving and Photo-Lithography," by W. T. Wilkinson, North Parade, Otley, Yorkshire.)—A SUBSCRIBER, Bracknell. (For perspiring hands, see pp. 369, 415, 440, 462, 510, 557, Vol. XXXVII., especially p. 462, No. 956, or p. 404, No. 928, p. 519, No. 958. A simple remedy is to bathe the hands in a solution of alum.)—CYCLONES. (You will find out all about it in any of the textbooks on navigation.)—CHARLEROI. (Scarcely suitable. You will find it described in handbooks of games.)—GEO. JOHNSON. (We do not know of any special work of the kind, but the subject is treated in several large works. Crane's "Smithy and Forge," published by Lockwood and Co., Stationers' Hall-court, E.C., price 2s. 6d., may give you as much information as you need; but you should look up back volumes for special articles. 2. We do not understand what you mean by deciphering Latin sentences. To do that you must have a knowledge of the language. If you mean a work giving translations of Latin sentences you will find one at any large booksellers. Stamps were not sent with the advertisement.)—SAPO. (Many recipes for soaps in back volumes. See, for instance, pp. 326, 391, 414, Vol. XXXVI.)—J. S. L. (Scarcely likely that such a book would be published; but there are many recipes in back numbers, even in this volume.)—A. FISH. (A good cement for aquariums is made of two parts common pitch and one part guttapercha melted together and well mixed. Another is made by mixing intimately three parts each of litharge, fine white sand, and plaster of Paris with one part of rosin, all in very fine powder. Make into a paste with boiled linseed oil and driers; beat the "putty" well, and let it stand for five hours before applying it. About 24oz. or 32oz. glass.)—BUTTONS. (Why did you not give more particulars at first? Try David Evans and Co., 24, Watling-street, E.C., or send us a sample and we may be able to tell you what the adhesive composition is.)—OURS. (If there is anything new in it, probably we may have something about it; but we have already in back volumes almost exhausted the subject, for there is nothing novel in the industry.)—LEICESTER. (Recipes have been recently given, and can also be found in many back volumes. See, however, pp. 255, 278, 300, 325, this volume. The simplest preparation is lamp-black ground up in turpentine, with just a few drops of gold size as a binder.)—WESTCOMBE PARK. (If they are grease spots, they can be removed with benzine, or by means of fuller's earth. Dust the earth on, put a piece of paper over that, and then a warm iron. 2. There are several works of the kind. See publishers' lists. 3. There is prepared carboard, or fancy coloured papers. 4. For the coil, see indices of back volumes. You will find all sorts of sizes described.)—HYDROPATHIST. (The query is too indefinite. Is the room 3ft. 6in. square, or what? If you want to construct a Turkish bath for home use, see Nos. 900, 901, 902, 910, wherein will be found fully illustrated directions for making such appliances; but there is also much information on the subject in back volumes.)—E. C. M. (It would if a sufficient quantity were used, but coke or charcoal would be cheaper unless the lime could be used afterwards.)—S. B. R. (How to make a Phonograph was fully described with illustrations in No. 683.)—INCUBUS. (Several incubators have been illustrated and described in recent volumes. See Nos. 1075, 1009, 1007, 935.)—COUNTRY MILLWRIGHT. (There are special papers prepared for the purpose. They are absorbent paper steeped in a solution of arsenic and dried.)—J. L. (Certainly it would do, if there is enough of it; but heating greenhouses by means of oil-stoves is rather expensive work. There is nothing to be said in the matter. A certain quantity of heat is required to maintain the temperature at a given minimum, and it is entirely a matter of taste how that heat is obtained. The old-fashioned furnace and flue is probably cheaper than anything else.)—M. (The wood can be obtained from any of the timber dealers planed to the proper thickness; it is not sold in "blocks," but each "zincotyper" cuts up his own to the sizes required.)—W. DAVIDSON. (Impossible to answer such a question without an inspection of the apparatus.)—A. W. G. E. (Does not the fact you mention about the observations of other members of your family prove that the effect is due to something personal to yourself? At any rate, it is not easy to understand how any one can explain why you see two objects when you look through your marine glasses. 2. Use pomatum. 3. See indices. There are several works on the subject now.)—H. WALKER. (The copper bath is generally made by dissolving sulphate of copper and adding a little sulphuric acid. Watt, in his "Electro-metallurgy," says two ounces of concentrated sulphuric acid to each gallon of a nearly saturated solution of sulphate of copper. 2. The limelight apparatus has been frequently described in back volumes; but why is it wanted for a small studio? Will not a magnesium light answer your purpose?)—W. H. G. (Proctor's "Small Star Atlas," Longmans, 5s. 2. Whitaker's Almanac. 3. Why not inquire of the editor of the paper in which the description appeared? If you want to make a 2in. achromatic telescope cheaply, see Nos. 881, 884. Prices of lenses can be obtained from any of our advertisers who sell them.)—W. HOWARD. (Gunter's "Modern Confectioner and Biscuit Baker," Dean, 6s. Any bookseller.)—W. G. P. (Apply a piece of sheet rubber by means of rubber solution.)—YOUNG DYER. (Any of the patent agents who advertise in our columns will give you the number and date of the patent for a small fee.)—IMPECUNIOUS PUP. (Practically only one route, and all particulars can be obtained from the Emigration Office, 31, Broadway, Westminster, S.W. Send for the Canada Handbook, price one penny.)—LEATHER. (It depends on what you want—morocco or roan. A dyed skiver is as good as anything for practical work.)—DEVON. (Of stout, unbleached calico or linen, damped thoroughly, and while still moist dipped into or dressed with raw linseed oil. Hang up to dry, and give another dip or dressing.)—J. M. (Full particulars of the Whitworth Scholarships in the "Whitworth Prospectus," price 6d., from Chapman and Hall, Henrietta-street, Covent-garden, and all booksellers.)—ELECTRICIAN. (We certainly do not think the letter worth the space it would occupy.)—JOHN ADAMSON. (If there is really anything in him he should try to get on the staff of some local journal and work his way on; but a man of 23 ought by that time to have something more than "inclinations" to literature or anything else.)

HARNESS' ELECTROPATHIC BELT should be worn by all WEAK MEN AND WOMEN. It restores health, strength, and energy to the whole body, and promptly relieves and cures all Nervous and Rheumatic Affections, Liver and Kidney Diseases, Sleeplessness, &c. Thousands of testimonials received. Pamphlet and advice free of charge. Harness' World-famed Electropathic Belt may be obtained (post free) by remitting Cheque or P.O. for 21s., to Mr. C. B. HARNESS, Consulting Electrician, THE MEDICAL BATTERY COMPANY (LIMITED), 52, OXFORD STREET, LONDON, W. (corner of Rathbone-place).

Gelatinised Benzine.—A gelatinised benzine, which is being applied for the purpose of removing stains from tissues, &c., fully preserving the most tender colours, is obtained in the following manner: — Dissolve 120 parts of white soap (medicinal) in 180 parts of hot water contained in a 2-pint bottle of strong glass. Then add 30 parts of strong liquor ammoniæ. The whole mixture is afterwards diluted with water till the whole quantity is about 26 fluid ounces, and the bottle is afterwards filled with benzine, and thoroughly agitated. A teaspoonful of this mixture is mixed with a small quantity of benzine in a pint bottle, and the bottle is then gradually filled with benzine by shaking it continually. This gelatinised benzine does not easily evaporate.

colour that he meets with in the orchestra; which, in its general appointment, shall so group these tone-colours that he shall experience no difficulty in painting his musical picture; and which shall be so flexible and replete with powers of expression that it will respond to every thought of his mind, readily producing every delicate gradation of light and shade, every subtle *nuance* his conception may demand, and he will acknowledge its supremacy over all the inventions of man in connection with his art. Such an Organ as I have thus shadowed forth does not at the present hour exist; but that it will some day take its proud position amongst the masterpieces of human ingenuity and skill, I have no doubt. If I shall have done anything, by pen and pencil, towards hastening its appearance, my labours will indeed be fully repaid.

I have, in my remarks on the four representative Concert-room Organs, shown how timidly the swell-box has been used for Organs in this country. Let me now mention one instance of the rapidly-growing appreciation of this important adjunct in America.

At the present time there is in course of construction, in the Roosevelt factory, at New York, an Organ which will mark a new point of departure in practical organ building. This instrument is destined for a church, and this fact makes its specification all the more remarkable and interesting. The Organ is to contain 62 speaking stops distributed over a pedal and four manual departments. Of the 62 stops no fewer than 47 are inclosed in three independent swell-boxes. The disposition is as follows:—The Great organ, of 16 stops, has 12 inclosed in a swell-box; the Choir organ has all its 11 stops inclosed in the Great swell-box; the Swell organ has all its 18 stops inclosed in an independent swell-box; and the Solo organ has all its 6 stops inclosed in another independent swell-box. The only manual stops which are uninclosed and, accordingly, expressionless, are two stops of 16ft., and two DIAPASONS of 8ft. Let any skilful organist, with an unbiased mind, play this organ in imagination, and he will realise a whole world of new effects and complex refinements, absolutely impossible on the best of our English church instruments with their *single swells*. The reader will remember how strongly I have advocated, in my previous "Notes on the Chamber Organ" and "Notes on the Church Organ," the multiplication of expressive departments, even extending to the Pedal organ, by the introduction of additional swell-boxes: and as my arguments and opinions were published before this interesting American instrument was schemed, it is a matter of great gratification to me to have so great a proof of the value of my arguments and the soundness of my opinions. About fifteen years ago I practically tested my views on this subject, in connection with my own chamber Organ, with a success that from that time to this has never once been questioned. As I have already written a letter to the Editor of this journal (No. 27639, July 22, 1887) on the American Organ here alluded to, I need not now occupy valuable space with further remarks.

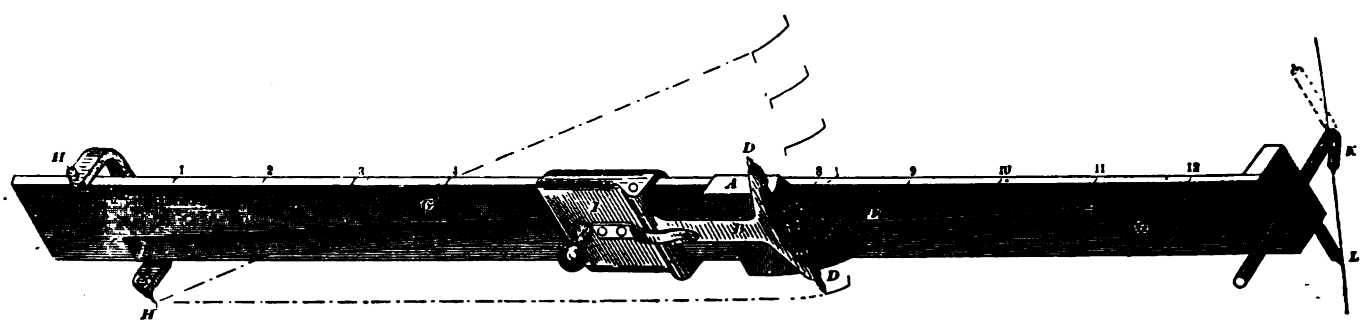
In speaking of Mr. Willis's large Organs, I remarked that their tonal structures and stop appointments and dispositions call for no special comment; but, before closing this introductory article, I may say a few words on them in connection with the tonal structures, &c., of the other two Concert-room Organs mentioned.

On a general survey of the specifications of the four instruments, beyond the simple element of size, one fails to see any feature, either in tonal structure or in the disposition of the stops in the several departments, which marks the peculiar province of the instruments, or which separates them from ordinary first-class church instruments. They might have been schemed for cathedrals or very large churches without any special criticism being passed upon them. I am at present speaking of the lists of stops as they appear on paper allotted to the different departments. I certainly hold very decided views anent the subject of organ building, and one of them is that an Organ ought to be specially schemed for the place it has to occupy and the work it has to do, and this leads me to the conviction that an Organ schemed for a church, however large, should be as inappropriate in a concert-room as an instrument schemed for the concert-room would be out of place in a church. I may be wrong, but I have much to unlearn if I am. Now, if these Willis, Lewis, and Cavaillé-Coll Organs are admissible as large church instruments they are not what they ought to be as Concert-room Organs. Perhaps my meaning will be rendered clearer to the reader before I bring my present series of Notes to a close. Let me be understood once for all. I am in no way attempting to disparage the works of these great builders. I am approaching my subject from a true art standpoint, and am using, and shall use, existing landmarks in the art of organ building in their dual capacity of negative and positive teachers. I have absolutely no trade prejudices and interests to serve, and, accordingly, can preach my crusade against inartistic organ building without fear of being misconstrued.

(*To be continued.*)

THE INSTITUTION OF NAVAL ARCHITECTS.

THE summer meeting of the Institution of Naval Architects was held last week at Newcastle-on-Tyne and Sunderland on the invitation of the North-East Coast Institution of Engineers and Shipbuilders and the mayors and sheriffs of the two towns—the existence of the Newcastle Exhibition being also a reason for the visit. Lord Ravensworth, as president, in his address, said that he appeared in the double capacity of host and guest, and as host he particularly desired to direct the attention of the members to the Exhibition on the Town Moor, while as guest he would refer to the fact that they stood to the North-East Coast Institution in the relationship of parent and child—though the "child," Minerva-like, had sprung into full maturity. Lord Ravensworth then referred to the great works on the Tyne and Wear, and briefly summarised the course of the proceedings, which included the reading of several interesting papers and visits to many of the establishments which have made Newcastle the "arsenal of the North." Lord Armstrong read the first paper, written jointly by himself and Mr. Josiah Vavasseur on the "Application of Hydraulic Power to Gunnery." The authors commenced by describing the form of naval gun carriage which was in common use down to so late a period as 1860. It was made of wood, the recoil being controlled more or less by the friction produced by making the axles of the wheels abnormally large or by substituting a chock of wood for rear wheels, and finally checking by a rope breeching. About the year 1864 iron was substituted for wood in the construction of the carriages, and slides and traversing platforms were introduced. As the weight of the guns increased, however, it became necessary to provide some power greatly superior to hand labour for working them, and the hydraulic devices were invented, with the advantage that the number of men required for working the guns was greatly reduced. Hydraulic machinery possesses simplicity and compactness, while it is admirably adapted to the transmission of power through long distances and by intricate ways. Further, it is essentially safe and free from any explosive or reactionary force. Lord Armstrong proceeded to describe the application of hydraulic power to gunnery, by dividing it into two classes—the first comprising those guns which, being, comparatively speaking, of moderate weight, are loaded, trained, and elevated by manual labour, the hydraulic power being used only for absorbing the force of recoil, and for controlling the running in and out of the gun. In the second class, not only is the force of recoil absorbed, but all the other operations of gunnery are carried out by hydraulic means, the 9·2in. or 23-ton gun being the largest that can be manœuvred by hand with reasonable facility. The paper then described the Vavasseur mounting, in which the recoil of the carriage itself closes the valves in the piston head, and the effect of any greater energy in the recoil results only in the production of higher pressures in the cylinders and not in any difference in the length of the recoil. In the case of a 9·2in. gun, the hydraulic method involves the use of a greater weight of machinery than by the hand method; but there is greater speed of working, and the number of men required is reduced from sixteen to five. The paper contained much information of interest to gunners and naval men, as details are given of the application of the hydraulic system on vessels in our own and foreign navies. In the course of the discussion which followed, Mr. W. H. White said that although the conditions had from time been made more severe, he did not believe there had been a single case in which the hydraulic mountings had failed. Mr. F. C. Marshall then read his paper on "Recent Developments in Marine Engineering," in which, after reviewing the improvements introduced from 1872 to 1881, he spoke of the recent developments as "really remarkable." As we have recently described the advantages obtained by the employment of triple expansion engines, we need only mention that Mr. Marshall's paper gave an interesting account of their development, the use of one, two, and three screws, and of the employment of forced draught. The paper led to a long discussion, which had to be postponed, but several important points for further investigation were elicited. In the course of his remarks, Mr. Parker, of Lloyd's, mentioned the case of a vessel which, by the use of triple expansion engines and improved boilers, had its carrying capacity increased by 740 tons, and its coal consumption reduced from 46 tons per day to 27, without impairing the speed. The business of the first day ended in a visit to the famous Elswick works, which now employ between twelve and thirteen thousand men. On the second day the members journeyed to Sunderland, where two papers were read—one by Mr. W. H. White on "Some Recent Experiments with Basic Steel," the other by Mr. B. Martell, "On the Present Position Occupied by Basic Steel as a Material for Shipbuilding." As is well known, steel made by the Siemens-Martin or acid process has altogether replaced iron in the construction of marine boilers, and is rapidly driving iron out of the market in connection with ship plates. The experiments referred to by Mr. White were carried out by two experienced overseers of steel in the service of the Admiralty, and the result of many hundreds of separate tests may be stated generally as very satisfactory, "affording good evidence of the trustworthiness of basic steel." Mr. White says, however, that tests of riveted work must be made before basic steel can be accepted with the confidence justly enjoyed by Siemens steel made by the acid process. Summing up the results of the investigations, Mr. White expressed the opinion that there is now no reason for doubting the possibility of producing, with proper care, basic steel suitable for ship work without departing from the limits of tensile strength and ductility which have been maintained in Admiralty practice. Mr. Martell, in the course of his paper, referred to the fact that so far as Lloyd's is concerned—and practically that governs the trade—steel made by the basic process has generally failed to commend itself to those engaged in ship-building. In fact, it was in consequence of sundry failures and generally unsatisfactory results that the Committee of Lloyd's Register declined to accept basic steel at the end of 1885, and since then no vessel in which basic steel has been used is classed in the Register. Here it will be seen two authorities are distinctly at variance, for while the Admiralty have concluded that basic steel may be used with confidence for the less important parts of vessels, the Committee of Lloyd's Register will have none of it, although



be correspondingly dirty, and when extra sound and clean work is required, nothing but new metal should be used. Iron is much easier to manipulate than alloys of copper and gives less trouble, besides leaving but little dross in the crucible. You may calculate on a loss of 10 per cent. with zinc, 5 with gun-metal, and about 1 per cent. with iron.

Cores are best made with pieces of well-dried tile or brick rubbed down to the desired shape and inserted in their places in the sand. It is not desirable for amateurs to attempt to make them from loam, as it requires a drying oven and various other matters more or less out of place in the amateur workshop.

☞ Success in the art of founding is only to be attained by patience and thought. A good plan is to fee one of the "sand rats," who, for a small consideration, will gladly assist the tyro and initiate him into the mysteries of the foundry, which otherwise can only be learnt, as in my own case, after many startling failures. For myself, I am much indebted to the courtesy of Messrs. Barrett and Sons, Beech-street, E.C., who have practised their trade for more than a century, and were kind enough to take an interest in my feeble efforts in the same line. My first attempt was a latch-key, which, when finished, presented rather a pock-marked appearance, arising from the mould being imperfectly faced, and caused some amusement among the burly inmates of the foundry on being handed round. It opened the door, however, and was in every other respect satisfactory. Since then my ambition has risen to small parts of machines, chucks, and other articles easily moulded; but as regards complicated patterns with large cores and undercut angles, I should strongly advise the amateur to trust to the superior skill and life-long experience of the professional founder.

THE WESTINGHOUSE BRAKE—FURTHER IMPROVEMENTS.

THE *Railway Review* (U.S.) states that after the close of the Brake trials at Burlington, it was the intention of Mr. Westinghouse to endeavour to so improve his air brake as to greatly quicken its application on long trains, and thus avoid as far as possible the severe shocks in the rear part of the train. He did not believe that the use of electricity would be regarded favourably by railway managers, and did believe he could overcome the shock without it. He has accordingly been studying and experimenting to that end. The cars have been kept at Burlington and the apparatus having been changed and tested in the shops at Pittsburgh, was taken to Burlington and applied to the same cars, which were then run over the brake course. The tests made recently were very interesting as showing great progress. Our information regarding them comes from a thoroughly impartial and reliable source. The improved triple valve was used and a 1¼in. train pipe. It will be remembered that, before, only about 25 cars could be stopped without objectionable shock. This limit has now been extended to 45 cars. With a 45-car train in emergency stops made when going at 20 miles and 40 miles an hour, the slideometer was only moved from 5 to 6in. The shock was not of the abrupt, severe kind, such as were experienced before; but more in the nature of a slide, such as resulted to some extent with the electric brakes. It was considered by competent judges that such shocks were not seriously objectionable—especially as no shock is experienced in service stops. When, however, the train was increased to 50 cars, a decided shock of the "rale old sort" was experienced, which moved the slideometer 30in. This of course shows that the time must be still further shortened for 50-car trains, and Mr. Westinghouse believes he can still gain about one-half a second, and that will be sufficient to obviate the shock. He is accordingly making new apparatus and will soon have it on the cars and make further tests at Burlington. In view of the gain already made, it seems probable that he can do it.

The speed with which the brakes now go on the rear car is remarkable. When the signal was given by whistle from the engine, that the brakes were applied, those who were on the rear car could see the steam from the whistle, and the brakes would begin to apply before the sound of the whistle was heard. It thus appears that the brakes will now apply somewhat quicker than sound will travel. This of course is not as quick as electric application. The question is, "Is it not quick enough?" If Mr. Westinghouse succeeds in overcoming the shock, the advantages claimed for electric application will be reduced to superiority in graduation and quickness of release. These will have to be balanced against the disadvantages of introducing a new element in railway operation.

A SIMPLE PHOTOGRAPHIC SPECTROSCOPE.

A SIMPLE and useful appliance for work in connection with the photography of the spectrum has been described in the American *Journal of Science* by Mr. C. C. Hutchins, of the Jefferson Physical Laboratory, Harvard College, Cambridge, Mass. The writer says:—

The constant demands of spectrum analysis for ever-increasing accuracy can be satisfied only by instruments of the highest dispersion, and most perfect defining powers; and when applied to photography, the dispersion must be produced directly, and not by enlarging-lenses at the camera. The large apparatus of Rowland does this most beautifully, as the writer, who has used it for the past year, can testify; but the fact that a large room must be set aside for its accommodation, and moreover that the large concave gratings are very difficult to obtain, will forbid its use to most workers. I have therefore devised the following simple, and it would seem upon a short trial, effective arrangement for producing the desired results. A rather long slit is placed at the focus of a crown glass (or better, quartz) lens of 40ft. focus. The ray from the slit, after passing through the lens, falls upon a large flat grating mounted to turn about an axis passing through the middle line of the ruled surface. The spectrum is projected by the same lens upon a horizontal arc of 40ft. radius, and is observed a little to one side or above the slit. The spectrum will not be normal throughout its length unless the radius of projection be kept constant. I think this had better be provided for by employing two lenses of crown glass, the one nearer the grating fixed, the other movable, than by the use of a corrected lens, to avoid the absorption of flint glass in the achromatic combination.

More or less absorption when glass is used is unavoidable, and this, with the variation of the focal plane of the lens for light of different wave-lengths, constitutes the most serious defects of the apparatus—defects which are avoided in the Rowland instrument. However, compensating advantages are not wanting. The Rowland apparatus integrates all impressions received at the slit. The ordinary comparison prism cannot be used with it, and the lower orders of spectra are too narrow to admit of convenient division at the camera; in fact, the spectra begin at nothing at the slit, and spread in a widening band as we move toward the higher orders. The new instrument possesses the advantages of the analysing spectroscope. The spectrum can be made wide or narrow, or divided at the slit. A preliminary trial has given the following results:—A flat grating of 14,000 lines to the inch, and a ruled surface of 2in. by 1½in., was employed with a lens of 37ft. focus. The latter was placed close to the grating, and its spectrum observed near the slit. In the second spectrum b_1 and b_2 were fully 1in. apart as projected on a screen, and D_1 and D_2 had a separation of 13 to 14mm. The excellence of the definition is shown by the fact that with an ordinary reading-glass of 6in. focus, E was seen double, and 14 lines connected between D_1 and D_2. With this form of apparatus the amount of dispersion can be varied at pleasure by simply altering the relative distances of slit and camera from the grating, but in such a way that slit and camera shall occupy conjugate foci of the lens.

A NEW ODONTOGRAPH.

THE following description of a new odontograph is contributed by Mr. H. Fladvad to the *American Machinist*:

The illustration represents an odontograph which I believe to contain some new features and may be of practical value to draughtsmen and pattern-makers. It is not patented, nor do I intend to apply for one, leaving any one of your readers at liberty to make one and use it. I have made a rough wooden model that I find—in spite of its poor workmanship—to work pretty well for constructing the form of teeth, whose sides correspond to the involute curve. I in the illustration represents a slide moving easily on the straight edge G G, and carrying the hinged cross-shaped lever B with the pencil D D, and the guide point C, which is—by means of a spring—pressed against the block A. The outer surface of the block A is a curved surface, similar to a conical surface, but correctly shaped, so that when the guide point C slides along this surface, the pencil point D will describe the correct form of tooth. The block A is made to move along the diagonal rail F, the former being dovetailed with a sufficiently tight fit not to shift out of position by the friction between the guide point C and the outer surface of the block A during the time the former is moved along the latter to describe the side of the tooth. H is the centre of the wheel to be constructed. It will be seen that in setting the block A to any given distance from the centre H, the diagonal rail F will adjust the block A vertically, that is, it will give the block A such a relative position to the guide point C which will cause the pencil D to describe the right curvature of tooth corresponding to the radius H D. The formation of the tooth is therefore entirely automatic. For drawing the other side of the tooth the instrument is reversed. On the outer end of the instrument there are two needle points L and K. The point K is adjustable and is set to suit the pitch. If instead of making the block a solid, we build it up by a number of thin steel plates, we obtain by separating them a number of templets for different radii, that might be handy in the drawing room or pattern shop.

A WOOD-TURNING JOB: SETTING THE REST—NEW LATHE RESTS—INSIDE TURNING—SAND-PAPERING—CHISEL FINISH—SHAVING, POLISHING AND SHELLACKING.*

(*Continued from p. 482.*)

IN all turning operations where the chisel must be traversed from place to place along the work, the rest whereon the chisel bears must be smooth, straight, and set parallel with the axis of the work to be turned. Turning-rests are very apt to be sent out just as they come from the blacksmith's hands, or finished only by the painter by means of a coat of tar paint. The rest must be straight and smooth, as above stated, and it should be put on a planer or a milling machine and three sides dressed at least. In case the rest is sent out rough, do not attempt to use it in that shape, but take out the work, slide back the tail stock so there is plenty of room, and "go for" that rest with a 12in. or 14in. bastard file. With one corner of the file take off the paint, then file the top of the rest, taking care to make it straight, and to avoid all holes and high places. Next, file off the inside of the rest, or that part which would strike the work were the rest advanced far enough for that purpose. If there is a vice in the shop (and every shop should have at least two) this part of the rest may be best filed by making it fast in such a manner that shank and the rest both lie horizontally, and then filing while it is in this position. At any rate, make this side of the rest straight and smooth also, then take off the sharp corner, leaving a facet of about $\frac{1}{10}$th of an inch. When the finishing touches are put on, this corner may be nicely rounded. Be sure to file up the outside face of the lute safety can only be obtained by the use of thoroughly reliable oils of a higher standard than that required by law. Fifteen years ago, long before the introduction of these modern burners of high heating power, Dr. Chandler urged the adoption of a much higher legal standard than the present one, and stated that the requirement of a flashing point not lower than 120° would add but a few cents per gallon to the cost of the oil. Now that the necessity of better oils has become urgent, and in view of the great progress that has been made in the process of petroleum refining, the adoption of a more strict legal requirement would certainly cause no hardship to manufacturers.

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* By JAMES F. HOBART, in the *Manufacturers' Gazette*.

The results of the tests given above are by no means a reproach to the new forms of burners which have been lately introduced, for the excellence of the light which they give will always greatly outweigh the trifling increased cost of better oil. Dealers who supply these lamps should, however, take especial pains to furnish oil of suitable kind, and should insist that no inferior article be used. Certain well-known brands of oil show a flashing point far above the legal requirement, and are thoroughly safe to use in any modern lamp. The manufacturers of these oils should welcome a standard which would shut out all inferior products from the market. We are at present engaged in an extensive series of tests of various commercial oils of different flashing points, with the object of determining the comparative illuminating power of each when used in the best modern lamps. We have little doubt these experiments, when completed, will show that the use of oils of higher grade is in the interest of economy as well as safety.

METHOD OF STAINING AND FIXING THE ELEMENTS OF BLOOD.

RECENT discoveries of morphological elements in the blood hitherto unknown, as well as the newly-published facts concerning its coagulation, have aroused an interest in the subject which calls for an acquaintance with the methods with which it is possible to follow those results. Accordingly, I would like to describe the method employed in this laboratory [Physiological Laboratory, Zurich]; for, although it has been mentioned by Professor Gaule in his lectures for several years, it has not as yet been published. The methods formerly used were that of examining fresh blood, and that, perfected by Ehrlich, which consisted in staining dried blood. Our method consists in a series of manipulations requiring only thirty-five minutes for their completion. The following is a list of the reagents, together with the length of time and the order in which each is to be used:—

	Min.
1. Corrosive sublimate (concentrated solution)	6
2. Distilled water	1
3. Absolute alcohol	5
4. Distilled water	1
5 Hæmatoxylin (½ per cent. alum solution to which, for every 100 c.cm. employed, 20 drops 5 per cent. alcoholic solution have been added)	6
6. Distilled water	1
7. Nigrosin (½ per cent. water solution)	1
8. Distilled water	½
9. Eosin (1 gr. eosin dissolved in 60 c.cm. alcohol; 140 c.cm. distilled water)	2
10. Alcohol	5
11. Oil of cloves	1—2
12. Xylol.	
13. Canada balsam (diluted with xylol until it readily flows).	

As receptacles for these fluids, each person has upon his table three shallow glass dishes with flat bottoms, so large that a slide may be easily put in and taken out of them. Into the first of these we pour corrosive sublimate, into the second distilled water, and into the third absolute alcohol. It is necessary either to label the dishes or to place the two not at the moment in use at one side. For the colouring fluids we use bottles whose stoppers serve at the same time as droppers or pipettes. The most convenient form has a glass stopper, which is hollow and drawn out into a fine point below, while above it broadens into a funnel with a lip whose opening is closed by a rubber membrane. A slight pressure upon the membrane causes, upon the removal of the finger, a rise of fluid in the funnel, which, upon the removal of the stopper from the bottle, can be at pleasure dropped upon the slide. For oil of cloves, xylol, and Canada balsam wide-mouthed bottles are used. In the first two bottles are brushes; in the last, the ordinary glass rod. Other necessary utensils are a glass rod, sharp-pointed scissors, clean slides and cover-slips, filter-paper, twine or coarse thread, a small bottle of absolute alcohol, a sharp, clean needle, a fine clean rag, and a hand-towel.

Aside from these, a board, 15 by 5in., with two pair of holes, large enough for a piece of tape to pass through double, is an essential help. The first pair of holes should be 4in. distant from the second, and the two holes of each pair 1½in. apart. The tape should be so passed through the holes that there will remain upon one side of the board loops, on the other long ends, by which, upon passing the extremities of the frog through the loops, one may easily and firmly tie the frog upon the board. Such preparation is necessary, otherwise the manipulations cannot follow one another quickly enough. After these preliminaries have been completed, the labelled bottles being placed within reaching distance, the distilled water and alcohol in front of these, and the corrosive sublimate nearest of all, we are ready to bind our frog upon the above-mentioned board and begin our preparation. We make use of the frog for this purpose at first, since its blood coagulates less quickly than that of mammals. The vena femoralis, which may be seen as a dark blue line below the knee-joint on the inner side of the leg, having been snipped, we quickly bring with a glass rod a drop of the blood which comes from the wound upon a slide previously moistened by the breath, and throw the whole into the dish of sublimate for six minutes. If a little care is taken to spread out the drop of blood in putting it on the slide, the result is more satisfactory. Brought from the sublimate into the dish of water, we find that the greater part of the blood adheres to the slide. The superfluous sublimate being washed from the preparation during the moment that it remains in the water, we next partially dry the slide by resting it upon filter-paper before dropping it into the alcohol bath. The slide, which has remained in alcohol six minutes, is brought again into distilled water six minutes, is brought again into distilled water for half a minute, since our colouring fluids are water solutions. The hæmatoxylin is then dropped upon the slide, and removed again at the end of six minutes by resting the edge of the slide upon filter-paper, and afterwards washing with distilled water for one minute. The same process follows with the nigrosin and eosin, the first remaining upon the slide for one minute, the second two minutes. From the eosin we bring the preparation directly into alcohol, since the eosin is partially an alcohol solution. At the end of five minutes the slide is taken out of the alcohol, and, in order to be quite sure that there is no water still clinging to the preparation, we incline the slide at a slight angle to the rag with which we are holding it, and pour a few drops of alcohol from the small bottle over it. If upon dropping oil of cloves on the preparation it should be dark upon a dark sleeve or other dark background, we may remove the oil of cloves with a few drops of xylol. Having quickly cleaned the slide close up to the preparation, we place a drop of Canada balsam upon it, which must be allowed to spread out before the cover-slip is lowered upon it.

Human blood is prepared in the same way, except that here the finger-tip undergoes the surgical operation. If a finger of the left hand be lightly bound with a string and a sharp needle be held in the right a ¼in. from the end, one quick, energetic stroke suffices to bring a drop of blood to the surface, which should be transferred to the slide by drawing it, previously moistened, across the drop of blood.

A look at our preparations with the microscope shows us that the colouring substances we have used have attached themselves to certain parts and certain forms of corpuscles. In the preparation of the frog's blood we find that the large oval red corpuscles have been coloured red with eosin. The nuclei are for the most part blue from hæmatoxylin, the well-known colouring substance for nuclei. The protoplasma, provided no coagulation has occurred, is homogeneous. The usually oval nuclei are also generally homogeneous, though occasionally granulated like the nuclei of other cells.

The white blood-corpuscles differ among themselves in form, colour, and the number and size of their nuclei. (1) Those coarsely granulated which are deeply coloured with eosin, hence their name "eosinophilous cells" (Ehrlich), are perhaps the most striking. Their form is usually round, and they contain from one to four nuclei. (2) A second kind is perhaps best characterised by its large nucleus sparely surrounded with protoplasma, coloured blue with nigrosin. The form of the cell, according to the position in which we see it, is spindle-shaped, with an oval nucleus in which the granules are distinct, and seemed to be arranged in lines parallel to the long axis of the nucleus, or it is quite round with a round nucleus. The name "hæmatoblasts" was given them by Hayem. (3) Another variety has, like the "eosinophilous cells," several nuclei. Its protoplasma is, however, blue like that of the "hæmatoblasts," its form irregular, recalling the forms that the amœba is wont to assume; accordingly, such cells have been called "amœbocytes." (4) Occasionally one sees still another cell, whose single large necleus is oval or irregular in outline, and lies in protoplasma like that of the "amœbocyte." These cells are larger than the other white blood-corpuscles, and contain here and there foreign bodies, such as pigment-granules and drops of fat in their protoplasma. They are called on account of their form "endotheloid cells." With further study of the preparation other forms are found, which may be looked upon as intermediate between "hæmatoblasts" and "amœbocytes," for in some cases the corpuscles have nuclei like "hæmatoblasts," whereas the protoplasm has increased in amount and sent out projections like the pseudopodia of an amœba; in others the nucleus is round instead of oval; in others still the nucleus seems to be in the act of falling into two parts.

These latter forms suggest the idea that a relation may exist between "amœbocytes" and "hæmatoblasts," but what the relation may be, whether the change is from "amœbocyte" to "hæmatoblast" or the opposite, whether the "eosinophilous cells" and "endotheloid cells" are in any way related to them and to one another, cannot be determined by the method just described. Two courses lie open to us in our attempt to answer these questions: 1, to examine the same blood at intervals after it has been taken from the frog; or, 2, to watch changes in fresh blood which has been protected from evaporation. To do the first, we have simply to place a slide with a drop of blood upon it in a moist chamber (the moist chamber is easily constructed by covering the bottom of a flat-bottomed dish with wet filter-paper and placing a ground-edged cover upon the dish, whose edges should also be gound), and after certain intervals (five minutes, fifteen minutes, half an hour, two hours) to fix and colour the blood as above. If we examine a preparation fixed at the end of two hours, the whole aspect is changed. We find representatives of the different forms, but not in the same proportion. The "endotheloid cells" have become more numerous and the other forms less so. The former have also become much larger, with broad hyaline borders. The granules of the protoplasma are coarser about the nucleus, but constantly smaller and less distinct towards the hyaline border. Between the protoplasma-granules are frequently pigment-crystals and bodies coloured with eosin. These foreign bodies lie often in clear oval spaces next to the nucleus; otherwise these spaces are empty, or contain a small nucleus, a clump of yellow pigment, or a body closely resembling a small red blood-corpuscle. To control this experiment we may make use of another one—that is, we may cover a fresh drop of blood with a cover-slip and seal it from the air. (The edges of the cover-slip must be thoroughly free from moisture, a bit of melted wax dropped upon every corner, and the wax then drawn along the edges of the cover-slip with a heated iron wire.) Thus the blood coagulates slowly, and we may study directly the changes the forms undergo during coagulation. The granules of the "eosinophilous cells" may be seen to become larger, less distinct, and disappear. The "eosinophilous cell" has developed into the "amœbocyte." The "hæmatoblasts" assume the forms mentioned above, the nucleus and cell as a whole become round, and at length send out pseudopodia in every direction, so that it is impossible to distinguish them from "amœbocytes." The "amœbocytes," in their turn, at first stretch out their pseudopodia in a lively manner, then gradually attach themselves to the cover-slip, where they spread themselves over a large surface, and resemble the "endotheloid cells" with their broad borders of hyaline substance and the granulated protoplasma about the nucleus. If we now bring together the facts we have observed —1, in instantly fixed blood; 2, in blood fixed after intervals; 3, in fresh blood—we find that the first three kinds of white blood-corpuscles may at length become "endotheloid cells."

What is, then, the fate of the "endotheloid cells"? Are the bodies we have described as lying in their protoplasma and resembling incomplete blood-corpuscles to be considered as such? The endothelial cells which they resemble are, as is known, broad, flat cells that lie spread out on the inner surface of the blood-vessels similarly as the "endotheloid cells" flatten themselves out on the cover-slips. Their protoplasma is coloured with nigrosin, and in the small capillaries, where one or two cells suffice to form the circumference of the capillary, has been observed to contain pigment and more or less developed red blood-corpuscles. Especially is this the case in the liver and spleen of the frog. If the spleen be teased out, and its cells fixed and coloured in the manner mentioned above, not only do we find that the number of white blood-corpuscles, especially of the "endotheloid cells," is much larger in proportion to the red blood-corpuscles than it is in circulating blood; but other cells are present which possess the general characteristics of "endotheloid cells" and endothelial cells. They are richer in pigment, contain often several undeveloped red corpuscles, and cling together in groups. Gaule, in his Strassburg lecture, called these cells "ammenzellen," because he observed the development of the [illegible] corpuscles. In the course of his observations of a series of frogs he noticed that the "ammenzellen" which lie in groups similar to the follicles of the animal spleen, between the arteries entering and the veins leaving the spleen on the periphery, undergo significant changes, normally, in the course of the winter, under the influence of pilocarpine, in a few hours. The result in both cases was the same. The "ammenzellen," at first rich in pigment, lose their pigment as the number of undeveloped corpuscles increases. At the same time the number of corpuscles in the circulating blood was counted, the result showing that as the pigment of the "ammenzellen" decreased the number of the circulating red corpuscles became greater, the quantity of undeveloped corpuscles increased, and that many of the circulating corpuscles were still bordered with granules of pigment. Another indication that blood-building elements are present in the "ammenzellen" was the iron reaction which the protoplasma gave with potassium ferrocyanide. From these observations it seems hardly to be doubted that red blood-corpuscles are developed in the "ammenzellen," and partially at least in the endothelial cells, and in the "endotheloid cells." The relation in which these three cells stand to the blood-vessels remains to be considered. The blood-vessels of the embryo have their origin, as the embryologists have taught us, in the mesoderm in chains of endothelial cells which contain clear spaces in their protoplasma that later communicate with one another to form a fine capillary, in whose walls the first red blood-corpuscles are formed. Returning to the spleen, we recall the fact that the "ammenzellen" groups lie between the capillaries of the arteries, with their endothelial cells on the one hand, and the capillaries of the veins on the other hand, and that between the in-flowing and out-flowing vessels the regular blood-vessels with their lining cells fail. It is, then, not difficult to suppose that the "ammenzellen" and the "endotheloid cells," which are so numerous in the spleen, might be the stage upon which, as in the mesoderm of the embryo, a constant building of new blood-vessels and blood-corpuscles is taking place. The white blood-corpuscles of the frog may perhaps be looked upon as undeveloped "ammenzellen," though their origin and the functions peculiar to each form are not yet clear. It is significant that a seeming relation exists between the coagulation of the blood and the formation of white blood-corpuscles, for as the blood of the frog begins to coagulate the "hæmatoblasts" become especially numerous, and group themselves characteristically; but to this point we shall refer again in connection with human blood, which is in many points similar to the blood of the frog.

The red blood-corpuscles of human blood contain, as is known, no nuclei. In our preparation they retain the disc form and colour, like the protoplasma of the red corpuscles of the frog with eosin. The white blood-corpuscles are represented by the two forms "eosinophilous cells" and "amœbocytes." The "hæmatoblasts," as such, are wanting in human blood; but since we have had our attention directed by Hayem to the fact that the "hæmatoblasts" play an important part in the coagulation of the frog's blood, it is possible to think that some element is present in mammalian blood which also acts as a factor in coagulation. The coagulation of the frog's blood begins with the grouping of the "hæmatoblasts" into a rosette form. The red corpuscles then arrange themselves radially about this point as a centre. Do we find an analogous process at the commencement of the coagulation of mammalian blood? The blood of mammals coagulates very rapidly, whereas that of the frog changes very slowly; hence, if we would study the blood of mammals before coagulation, we must prevent this process by means of some reagent. Such an experiment cannot be tried with a human being, but is easily made with a dog. The reagent usually employed is peptone, which is injected in solution into the jugular vein of the dog, the amount injected being 0·3 grain peptone for every kilogramme weight of the dog. The microscopical examination of blood in which coagulation has thus been prevented shows that there exist in the blood, aside from the other elements, tiny tablet-like granules which tend to cling together in clumps. These elements were described by Bizozerro, and called by him "blutplättchen." It thus seems probable that the "blutplättchen" have something to do with the coagulation of the blood. That they also exist in human blood is evident from their presence in our preparation as small, faintly-tinged bodies, which lie in groups of twos and threes together. They did not disappear from the blood we employed, because we did not give it time to coagulate before fixing it. Therein lies the advantage of this method in the examination of human blood. It gives us not only the possibility to distinguish the different elements of the blood, but through it it has been possible to discover elements which, like the "hæmatoblasts," accompany the phenomenon of coagulation, and also to determine in part the relation that exists between the elements. It would not agree with the general plan of nature if every form did not play a different role in the organism, and after all that has been discovered, it is not improbable that we shall one day be able, through watching the changes which the different elements undergo in the blood, to discover the disturbances caused by different ferments and organisms in the blood. Thus we think that the hope of clever physicians may one day be verified—that the analysis of a drop of blood may give a clue to the pathological changes in the body.—ALICE LEONARD GAULE, in the *American Naturalist*.

SOME OF THE CAUSES OF YEAST DETERIORATION.

THE following extracts from a paper read at a recent meeting of the Laboratory Club, by Mr. C. G. Matthews, of Burton-on-Trent, are useful contributions to a study of the yeast fungi.

In the first place it would appear desirable to consider the *Saccharomyces* family in relation to their natural surroundings, putting aside for the moment the artificial adaptation of one or other variety to the production of alcoholic liquids. We have to deal with a class of very lowly organisms, each individual a simple cell, multiplying, as a rule, by two distinct methods—gemmation and sporulation—living for the most part in free contact with air, and utilising any opportunity of securing certain forms of nourishment from fruits, &c., on to which they are carried fortuitously by air-currents; a somewhat irregular and precarious mode of life, and one denoting a considerable degree of hardihood, more especially as it has been demonstrated by Hanssen that *Saccharomyces* cells may spend months in a state of quiescence in the earth, and then sustain a free exposure to air and moisture previous to their appearance as active ferments on fruit trees in the autumn. From what we know of yeast in its natural condition, the main deductions to be drawn from its mode of life are the following:—That a supply of oxygen is associated with its well-being. That its aliment consists of the saccharine juices of vegetable products, which contain nitrogenous and mineral matters; in fact, all the substances, except free oxygen, necessary for the cell envelope and the protoplasmic contents; as also, speaking very generally, does the saccharine extract of malted cereals. It hardly concerns us here to inquire as to the evolution of the *Saccharomycetes*. That they bear a close relationship to the moulds is almost beyond question, and it is more than likely that, as we know them, they are retrograde forms from higher fungi.

Were there only one *Saccharomyces*, and that capable of fermenting the more commonly occurring sugars, there would doubtless be little difficulty in keeping the ferment pure; but there exist so many species of *Saccharomyces* in nature, and they hold their own, in some cases, so strongly against each other, that it is not surprising that a variety of ferments are present in most samples of yeast, and frequently constitute a very considerable proportion of what is, perhaps, regarded by the brewer as a pure "store." Then, again, we find that variations in the character of a fermentable liquid tending to the nourishment of certain ferments as apart from others may determine the growth of a majority of one species, especially in the case of spontaneous fermentations; for instance, *Saccharomyces apiculatus* grows readily in grape must, but only with difficulty in beer wort, even when freely sown therein. A natural selection has doubtless taken place in the case of brewers' yeast, which last may be regarded as an educated and modified form from spontaneous or air-sown fermentation, and all ordinary yeasts contain a preponderating quantity of this selected form. Nevertheless, yeasts that appear pure and homogeneous may, and generally do, contain four or five different species of *Saccharomyces* of different degrees of persistency according to the nature of the process, and these species are often almost identical in appearance, and in one or two cases not very dissimilar in their fermentative action, and it is not until an abnormal percentage of one or other kind appear that the presence of these foreign ferments is easily demonstrable, though some time before this the yeast may exhibit peculiarities and irregularities in its mode of action.

English brewers, perhaps more than their *confrères* in other countries, pursue methods which tend to encourage the development of more than one kind of *Saccharomyces*, and granting that a selection could be made of a typical cell suited to each mode of fermentation carried out in this country, the present conditions of the process would necessitate a frequent production *de novo* of the typical yeast to replace the degenerated ferment. Still experiments in connection with this matter are being carried on in England, and the results cannot fail to be of the highest interest practically and scientifically. On the Continent the production of pure yeast is a thoroughly established fact, and a well-known Continental brewer, whom I had the good fortune to meet some days ago, informed me that it was becoming a widely extended branch of the brewing industry, and that the supply even now was not equal to the demand. The low temperature method of fermentation undoubtedly renders the accession of foreign ferments less likely, but even low yeast may contain, besides some positively injurious species, more than one kind of *Saccharomyces cerevisiæ*, each kind when cultivated alone giving a beer of specific character. I am alluding more especially to Hanssen's recent researches, which have led to such important results. The differentiation of yeast is an exceedingly interesting field for experiment, and some of the ferments obtainable can be very easily cultivated in large quantities.

Passing on now to fermentation, it may be taken as an established fact that the oxygenation of yeast, and of the liquid into which it is introduced, are a practical necessity; the amount of sugar broken up by yeast being, within certain limits, a measure of the oxygen originally absorbed by the ferment whilst in a resting state, though the respiration of oxygen and the decomposition of sugar are assuredly distinct functions. I cannot allow the theory that it is on account of the intense avidity for oxygen that yeast breaks up sugar, for were it so, surely the yeast would assimilate more oxygen than it does, and not yield up nearly the whole of it in the form of excreta—that is, as alcohol and carbonic acid gas, unless these are not the immediate products of the decomposition. I think it is more likely that the *Saccharomyces* family have adapted themselves to the decomposition of sugars on account of the readiness with which such substances can be absorbed through the cell membrane, and that the alcohol formed acts as a stimulus to the activity of the cell, causing a modification of substances existing in the protoplasm, and at the same time enabling it to break up and assimilate other matters in its vicinity. The latter view would be in accordance with Nägeli's theory of molecular action extending to a slight distance from the cell; whilst fermentable sugars would, I believe, undergo decomposition in the cell interior. The alcohol formed being taken up very quickly by the surrounding liquid would prevent an undue excitation of the cell until a certain percentage was arrived at, and in the cases of the lighter gravity ales this would only be coincident with the disappearance of the greater part of the fermentable matter. Assuming such a stimulating effect of the alcohol to be a possibility, it would help to explain the rise of temperature as fermentation progresses, for though a portion of this heat results probably from the mere breaking down of sugar, &c., there must be a corresponding loss of energy by the yeast, which would weaken its action unless reinforced by the alcohol stimulus, the rise of temperature being very likely a consequent.

Speaking, again, of aëration or oxygenation, I should say that yeast from quick fermentations will bear with advantage a very thorough exposure to air before being set in succeeding fermentations, and the worts also benefit by a short but complete exposure to air during cooling. These conditions are certainly found in the Burton system. With medium and slow fermentations, caused by their corresponding ferments, initial aëration does not seem to be quite so important; the fermenting liquids, especially in the case of the Scotch and Yorkshire systems, receiving supplies of oxygen in detail by rousing and pumping, whilst a low pitching heat and consequent attemperation combine to so modify the activity of the ferment that to attempt to carry out a fast fermentation with, for instance, a stone square yeast, would be about the same thing as to expect the performance of a race-horse from the animal drawing a brewer's dray, and the converse applies equally.

A good deal of light has been thrown by Hayduck on some of the conditions determining the welfare of yeast, by tracing the connection between the amount of nitrogen it contains and the fermentative capacity, the conclusions, broadly stated, being these: An increased nitrogen percentage is accompanied, as a rule, by increased fermentative power; but that after a certain limit it diminishes. Again, yeast takes up nitrogen in proportion to the amount of this constituent existing in the wort, and will take up more at a higher than at a lower temperature. Now, an agreement can be arrived at, I think, between these premises and the vigorous action of a quick fermentative yeast in worts produced by water of great permanent hardness. Reverting to the fact that a gypsum water is capable of dissolving, or causing to be dissolved, a much larger quantity of coagulable albumenoids that an ordinary soft water will do, and assuming, what is very probably the case, that such bodies or their derivatives are well adapted for yeast nourishment (the more stable forms of nitrogenous matter existing in less proportion than in soft-water worts), there is more assimilable matter for the yeast, and this is more than a set-off against such retarding influences as may be exerted by some of the mineral matters present, such as gypsum and magnesic sulphate. The accelerating effect of other salts may, however, be an adequate compensation in itself. Now, if quick yeast be carried through consecutive worts of high gravity, a marked deterioration ensues—owing, doubtless, to a repleted state of the ferment. It has become so rich in protoplasmic constituents that saccharine solutions no longer exert their normal stimulating effect, and it is quite possible that in addition the cells are alcoholised or partially asphyxiated. Such deteriorated yeast may be restored to activity by fermentation in a comparatively weak wort, and it is a fair reasoning that the surplus cell constituents are passed into new cells without drawing entirely on the cell-forming constituents of the wort. It would, of course, require very careful and exact investigation to discover the best working percentage of nitrogen for each type of yeast used in this kingdom, and keep it up to the standard so established. But it would be only controlling one influence of many.

The visible deterioration of yeast by the accession of bacteria is a matter of high importance. All through the process air-borne germs are being conveyed into the products, and when the opportunity arrives they take effect, and this opportunity occurs when the vitality of the yeast has been lowered; for a healthy fermentation precludes their development. Bacteria then may be both cause and effect in yeast degeneration. Where the materials and process are good, and the yeast clean, air-borne germs are of little consequence; a malt that shows mould carries in itself the cause of more trouble than would be given by spores or bacteria surviving the boiling in copper, and in the same way a contaminated yeast carries its character stamped on it, and will, apart from the organisms, prove an inferior ferment. Bacteria associated with unclean vessels, such as *Sarcina* and *Bacillus ulna*, denote, of course, a reprehensible state of things. Other organisms are also associated with the same thing; but the connection of those given with uncleanliness is, I think, fairly clear.

There are some abnormal fermentations, which are the more interesting on account of the causes being by no means plain. One of these is the boiling or bladdery fermentation, which is usually ascribed to slack or inferior malt, and some other causes which do not always agree with this phenomenon, which I have seen occur in worts of good quality set with an average yeast. I am inclined to think that it is due mainly to want of oxygenation of yeast and wort causing a sluggishness of the ferment, which, instead of being in suspension in the wort, thereby increasing its viscosity, is giving off gas at the bottom of the square, the bubbles coalescing, and forming large bladders at the surface. The yeast may partially recover during the fermentation, and the beer, as it approaches completion, assume a normal character.

Another very curious phenomenon is the so-called "stinking" fermentation, deriving its name from the unpleasant associations connected with a more or less pronounced evolution of sulphuretted hydrogen generally in the fermenting vessel, but sometimes during cleansing. I have met with some marked instances of this somewhat uncommon occurrence, and could have no apparent defect in material, method, or pitching yeast, and yet I think it is to the yeast that one should look for an explanation, making only an exception as regards sulphured hops or bisulphite containing hyposulphites, both of which might cause it. As regards the case of stench I have mentioned, I can only offer a theory based on a few observations. My partner, who has met with the same thing, agrees with me that these fermentations generally occur in the autumn, a time of the year when the material is old, the atmospheric temperature high, and when organisms abound in the air—all these tending to modify the ferment in respect of nutrition and aëration. The activity is maintained by the external heat; but the want of oxygen causes the yeast to break up bodies containing oxygen, and possibly amongst these are sulphates which become reduced, giving off sulphuretted hydrogen. I must admit that there are other plausible theories, but I will not enter into them. The stinking fret of ales in cask is usually accompanied by the growth of a specific ferment, *Saccharomyces ellipsoideus*, though what determines the appearance of this organism is not clear.

A few remarks on the storage of pitching yeast. Very cool vessels in a clean cool place are desirable at all times, but more especially so in summer and autumn when the air is teeming with organisms. It is astonishing how contaminated the air of racking rooms, tun-houses, &c., may become by neglect of thorough cleanliness. One case I have encountered will illustrate this. My attention was called to the state of a water tank used for general purposes in a tun-house. The water in it smelt badly, although it had been recently renewed. On examination, a black sludge was found in the bottom consisting of bacteria and yeast cells, stained black by contact with iron, the whole mass was developing sulphuretted hydrogen freely. The yeast and bacteria had mainly come, I should say, from the air of the place, and had fallen into the tank, which had a cover consisting of a few loose boards. In conclusion, I fancy that some of the chief developments in the future of the industry with which we are connected will be the production of a standard ferment and the manufacture of an ale which, whilst retaining the general character of English beer, shall compete on the same terms with Lager beer, and be suited to the digestion of all classes.

USEFUL AND SCIENTIFIC NOTES.

MR. A. L. ROTCH has published the results of the observations made at the Blue Hill Meteorological Observatory, Norfolk County, Massachusetts, U.S., in the year 1886. The mean temperature for the year was 45·6°. The absolute maximum in the shade was 91·0° in July, and the minimum—15·0° in January, giving a yearly range of 106°. The greatest daily range was 38·2° on December 25th, and the least 1·7° in February. The total rainfall and melted snow was 46·99in., measured on 132 days; the greatest monthly fall being 8·29in. in February, and the least 1·52in. in June.

MR. C. S. WILKINSON, the New South Wales Government Geologist, reporting upon the seams of coal pierced in the diamond-drill bore at Holt-Sutherland, near Sydney, says that in this bore a depth of 2,307ft. from the surface, or 2,175ft. below sea-level, has been attained. This is the deepest diamond-drill bore in Australia. The diameter of the bore to a depth of 500ft. is 3½in., and below that depth it is 3in. The strata passed through consist of Hawkesbury sandstone, 653ft. 6in.; shales, sandstone, and conglomerates—the upper 314ft. consisting chiefly of chocolate-coloured shales—1,573ft. 3in.; upper seam of coal 4ft. 2in.; shales, sandstone, and conglomerate, 65ft.; lower seam of coal, 5ft. 3in.; black shaly sandstone, 5ft. 11in.

Black Dyeing of Ivory.—To dye ivory black it must be immersed for six hours in nitrate of iron of 13° Twaddle. In taking it out again the excess liquid should be allowed to drop off, the articles washed, and afterwards placed into a warm logwood bath of 145° F. The specific gravity of the latter may be about 4½° Twaddle. Before the ivory is placed into the logwood bath 1½oz. of ordinary washing soap is added to every 20lb. of ivory. The ivory must remain in the warm logwood solution until the colour has obtained the desired intensity. If the black is not deep enough, the ivory must be taken from the bath, rinsed, and afterwards placed in a solution of acetate of iron 3° Twaddle. After three hours' immersion in the latter it is taken out and brought into cold water in which a sufficient quantity of chalk has been added to form a milky consistency by continued stirring. After the ivory has been immersed about half an hour to deaden the free acetic acid, it is rinsed and subsequently treated in a freshly-prepared logwood bath with an addition of soap as above mentioned, and submitted to further treatment.—*The Dyer*.

An Indian Remedy for Tapeworm.—Dr. G. H. Harris writing to *The Lancet*, from Simla, says:—In reply to a correspondent's letter asking for a remedy for the cure of tænia solium in a case in which male fern, kousso, and pelletein had each and all been tried unsuccessfully, may I suggest to him to try the powdered seeds of *Embelia ribes*, called by the natives "bao-birang"? If your correspondent is unable to procure these seeds from any druggist in London, and will place himself in communication with me, I will very gladly put him in the way of getting any quantity of them. I have used this drug for the past four or five years in cases of tapeworm amongst Europeans and natives with good results, and it is a favourite Indian remedy in this disease. I have usually given from one to four drachms(or even more) of the powered seeds with milk or with curds early in the morning, fasting, following it up some hours later with a purgative dose of castor oil. This latter I have found nearly invariably necessary, as the seeds themselves are not purgative. The seeds are about the size and shape of pimento seeds, and are not unpleasant to take, being slightly aromatic in taste. The dose which is efficacious is, I admit, unpleasantly large, and possibly if the active principle could be isolated it could be given in a much smaller dose, and more palatably. I have asked Dr. Warden, the Chemical Examiner in Calcutta, to try to isolate this active principle. Dimmock, in his recent work on the Materia Medica of Western India, mentions that the seeds of the *Embelia ribes* are largely imported into Germany, and form the chief ingredient in several patent medicines for tapeworm. I can vouch for the efficacy of this when given in full doses, repeated every morning if necessary, and I have never seen the slightest ill effects follow its use. The general price of the seeds is about sixpence for 2lb.

SCIENTIFIC NEWS.

THE eclipse of the sun on August 19 will have its greatest duration a little to the south-east of Lake Baikal in Siberia, where it will last for nearly four minutes; but the majority of the observers will be located in the vicinity of Moscow. Father Perry, it will be remembered, is one of the English observers, and as he is a Jesuit as well as an astronomer, special leave had to be obtained for his entry into Russia, through the good offices of Sir R. Morier. The American astronomers have all passed through this country *en route* to Russia, and the majority will, on their return, stay for the forthcoming meeting of the British Association, at Manchester, which commences on the 31st inst.

The Astronomische Gesellschaft holds its twelfth meeting at Kiel on August 29th and 31st. It meets in alternate years, the last occasion being at Geneva in 1885.

Mr. W. H. Pickering, of Boston, Mass., who observed the total solar eclipse last year at Grenada, West Indies, has communicated some notes to *Science* in order that they may be of use to observers of the approaching eclipse. It was found that by using rapid gelatine plates an exposure of one or two seconds was sufficient to show the details of the inner corona satisfactorily with an ordinary telescope lens. With a portrait lens, the ratio of whose aperture to its focus was as one to five, the same exposure showed the outer corona satisfactorily as far as a distance of 15′ to 30′ from the limb of the moon. Beyond that the light was very decidedly fainter, and was shown best by exposures of from eight to forty seconds. The corona showed the usual short rays proceeding from the sun's poles, and from the south-western quadrant a very conspicuous ray, appearing like a hollow cone, projected to a distance of about 20′. A number of prominences were seen near the equator on both sides of the moon; but the most conspicuous one was situated in the north-western quadrant. It extended to the height of about 100,000 miles, and had apparently a somewhat spiral structure. The spectra of the various prominences were shown very clearly by the prismatic camera. In the equatorial ones the hydrogen and H and K lines were prominent, superposed on a background of continuous spectrum; but in the large prominence the hydrogen lines were absent, although the H and K lines were strongly marked. The position of the maximum density in the continuous spectrum of the prominences was found to be quite different from that of the corona; in the former it is not far from G, whilst in the latter it lies between G and F. A large number of persons observed the shadow bands, which appeared before and after totality. The general result of their observations indicated that the bands were about 5in. wide and 8in. apart, that they were coloured like the spectrum, and that they moved with a velocity comparable with that of an express train—at all events, much faster than a man could run. Before totality the bands lay N. 12° W. and S. 12° E., and travelled west; after totality they lay N. 60° E. and S. 60° W., and travelled north-west.

The programme of the long excursion of the Geologists' Association from August 8 to 13 has been issued in pamphlet form with geological illustrations of the principal spots to be visited, and three papers recently read before the Association—viz., "On the Geology of Cornwall, with special reference to the Long Excursion," by J. H. Collins; "The Basic Igneous Rocks of Cornwall," by J. J. Harris Teall; and "Note on the Pliocene Bed of St. Erth," by Robert G. Bell. To those interested in geology the excursion will be something more than a pleasant week's outing.

Mr. J. T. Cunningham, M.A., F.R.S.E., Fellow of University College, Oxford, who has been for some time engaged in the work of the Scottish Marine Station, has been appointed to the post of naturalist to the Marine Biological Association, whose laboratory at Plymouth is being rapidly completed.

The report of the Edinburgh Committee on the Etiology of Scarlet Fever made to the Medico-Chirurgical Society of that city on the 20th ult., is only a preliminary expression of

Take one or more transits of Stars given in the *Nautical Almanac*. [FORM TRANSIT 1.]

Then RA of Star − observed time of transit corrected for errors = the clock error.

Correct the observed times for all errors [see Note Book for errors, Table I., and Form Transit 9.]

Subtract each corrected time from the RA of each Star.

The mean of the remainder is the Clock error, + if slow, − if fast.

II.—*To find the right ascension of a Star or other object.*

By its transit. [FORMS TRANSIT 1 AND 9.]

Observe its transit. [FORM TRANSIT 1.]

Then RA of Star = observed time of transit corrected for errors + clock error.

Correct the observed time for all errors [see Note Book for errors, Table I., and Form Transit 9.]

Add the clock error.

Sum = RA of star.

FOR DETERMINING LONGITUDE.

.... 188

Name of Star
h. m. s. h. m. s.
RA of Star =
(*N.A.* pp. 367—396)
Transit =
Clock error =
Mean =
h. m. s.
Observed transit of Moon's limb =
Clock error =
Apparent RA, Local =
Apparent RA, Greenwich =
N.A. pp. 367—396)
Moon's Variation in RA =
Seconds in 1h. = 3600

Variation of Moon's RA in 1h. =
N.A. pp. 367—396) =
= Long. in seconds
Computer.

III.—*To find the Longitude.*

By transits of the moon, and stars of known position.

[FORMS TRANSIT 1 and 10.]

Observe the transit of the moon's bright limb.

[FORM TRANSIT 1.]

Observe the transit of one or more stars culminating about the same time as the moon.

The object of taking the transits of stars is to eliminate the effect of instrumental errors, and error in rate of clock, which affect the transits of moon and stars almost exactly alike.

[N.A. pages 367—396.]

Then the time of transit of moon's limb corrected for clock error as shown by star's transit (= apparent RA at local transit)—apparent RA at Greenwich transit = variation of moon's RA in the interval between the two transits; and the variation in 1 hour : 1 hour : : observed variation : longitude.

Subtract the observed time of transit of each star from its RA, and find the mean, giving the clock error.

Apply the clock error to the observed line of transit of moon's limb, giving its apparent RA.

Subtract the apparent RA at Greenwich transit, giving the variation in the interval due to difference in longitude.

Multiply by the number of seconds in 1 hour = 3,600.

Divide by variation of moon's RA in 1 hour of longitude, giving the longitude in seconds of time.

or, using logarithms for the latter part.

Add arith. comp. log. motion in 1h.
log. observed difference.
log. 1h. = 3,600s.
Sum = log. longitude in seconds of time.

THE TRANSIT CIRCLE: ITS ERRORS AND ADJUSTMENTS.

This instrument consists of a transit instrument with an accurately divided circle attached to its axis in order to read off the zenith distance of the observed object. The circle should be exactly centred on the axis and move in the plane of the meridian, and should read zero when the telescope is pointing to the zenith. These requirements can never be exactly fulfilled, so the errors must be found and allowed for, or otherwise eliminated.

I.—*Error of Centring.*

Due to the circle not being truly centred on the axis. This error is usually small and is eliminated by reading the circle by means of two or more verniers or microscopes at the opposite ends of a diameter.

II.—*Index Error.*

Due to the circle not reading zero when the telescope points to the zenith. To determine this error. 1. By reflection from mercury. Observe the reflection of the wires from mercury, and bring the principal wire and its image to coincidence. The circle reading is the error in question. 2. By transits by reflection. Observe the transit of a star by reflection from mercury, and again the next night directly, or observe the star when on one side of the central wire, read the circle, and then rapidly observe it on the other side directly, intersecting it each time by the principal horizontal wire. The 90°—half the sum of the two observed zenith distances is the error in question. It is applied to readings of zenith distance according to its sign.

TO DETERMINE LATITUDE.

(*By Transits above and below Pole*)

........................188

Name of Star
° ′ ″ ° ′ ″
Observed zenith distance above = do. below =
(mean of both verniers)
Refraction = ′ ″ do. = ′ ″
Index error = do. =
Total correction = do. =
True zenith distance = do. =
Ditto below pole =
2
Zenith distance of pole =
90
Latitude =
Computer.

TO DETERMINE LATITUDE.

(*By Transits of Known Stars.*)

........................188

Name of Star
Observed zenith distance = =
(mean of both verniers)
Refraction = ′ ″ =
Index error = =
Total correction = =
True zenith distance = =
Declination = =
Latitude = =
Do. from other star =
2
Mean =
Computer.

PROBLEMS IN THE USE OF THE TRANSIT CIRCLE.

I.—*To find the Latitude.*

1. By transit of a Circumpolar Star.

[FORM TRANSIT 11.]

Observe the transit of a Circumpolar Star when above the pole, and again when below it, and note the Zenith distances.

Then ½ sum of observed distances corrected for errors and refraction = co-latitude.

Correct the two readings for Index error and any other special errors, and for refraction.

Divide by 2 given Zenith distance of pole = co-latitude.

Subtract from 90°.

Remainder = Latitude.

2. By transits of Known Stars.

[FORM TRANSIT 12.]

Observe the transits of one or more *Nautical Almanac* Stars, and note the Zenith distance.

Then observed Zenith distance corrected for errors and refraction + Declination = Latitude.

Correct for Index error and any other special errors, and for refraction.

Add the declination North of Star to the corrected Zenith distance, giving the latitude. If Dec. is South, subtract.

II.—*To determine the Declination of an Object.*

By its transit. [FORM TRANSIT 12.]

Take one or more transits of the object, and note the Zenith distance.

Then Latitude − observed Zenith distance corrected for errors and refraction = Declination.

Correct for Index error and any other special errors, and for refraction.

Subtract the mean of the observed Zenith distances South from the latitude. If the ZD be North, add.

Remainder is the Declination of the object.

Sm.

PHOTOGRAVURE IN COLOURS.

[27679.]—ON reading a paragraph on thi[illegible]ject in the ENGLISH MECHANIC, an id[illegible] to me whereby I think a coloured pi[illegible] might be obtained by a method simpler and more of a mere mechanical process. I would illumine the picture to be reproduced successively with lights consisting respectively of the three primary colours, regulating the exposure according to their actinic power, and thus obtaining three negatives in which the portions of the picture where the tints were that contained most of the particular primary would appear respectively darkest in each. The illumination had best, I should think, be obtained from a spectrum partly cut off by means of a screen. Coloured glasses, giving suitable absorptions, might possibly be used instead, and this would enable a natural landscape to be photographed. Now, if from each of these three negatives positives were prepared, and those positives were used as slides for three magic-lanterns illuminating with a light passed through those same three absorption glasses, it is evident that the picture in its exact natural colours could be produced on the screen.

On the other hand, the three plates could afford three zincs suitable to print with proper pigments the necessary tint, and by successive printing with the three the picture would be approximately reproduced in its colours. I say approximately, for I have been ignoring the fact that a mixture of pigments does not give the same tint as a mixture of lights; and, secondly, that a mixture of the three primary colours gives in pigments a black, and not a white.

The first and most serious objection might to some extent be modified by an experimental selection of pigments, and also by using a plate for each spectrum colour—though that seems hardly practicable. The second objection can readily be obviated by treatment of the zinc-graved plates.

Very probably these suggestions have before been tried without success; but if not, they are certainly worth trying, and I should be glad to hear how far anyone is successful who makes the attempt.

Huyton, July 28. **P. J. Beveridge, B.Sc.**

"TECHNICAL EDUCATION" AND "FOREIGN COMPETITION."

[27680.]—THE temptation to retort the opening sentences of "Shaper's" letter would be overwhelming if it were not that his conclusion is substantially and in part verbally mine. Perhaps our points of view would approximate more nearly if he (and Mr. Gobert, too) could clear his mind of the notion that the one end of English statesmanship is to injure the foreigner; but of that more anon. Neither does any question of copying foreign practice come within the scope of my argument, though I take it that an occasional glance at what goes on outside our island need not be incompatible with our self-respect as Englishmen. Nor am I fairly chargeable with the swamp of labour, incompetent or otherwise; the children are here, and the schoolmaster has but to make the best of them; the doctrine of Malthus is not for him. Again, while I cannot defend the unpublished scheme of the School Board, as I share the general ignorance as to its nature, what "Shaper" regards as an *admission* on my part—namely, that a trade must be learnt in a shop—is my central contention and starting point, rather than an incidental admission; since I am pleading for a change in, and enlargement of, our system of elementary *education*, which is quite another thing than specialised trade instruction, for education must be regarded in various aspects, physical, mental, and moral. Now, till the last few years the English ideal of elementary education has been that whose oldest monuments may be sought in such statutes and buildings as those of the old college at Winchester, founded nearly five centuries ago by William of Wykeham. Regarded as a preparation for the Church or Bar, little can be said against them; but it does not follow that the attempt to stretch their methods into a rational system of education, enforced alike on boys and girls, should result happily. As a piece of educational theory, it is a mistake to set up scholastic eminence as the one ideal of life (cf. "F.R.A.S.," p. 509), when intelligent bodily labour is the means of livelihood, meaning thereby not earning of wages, but actual production of commodities, "in the sweat of thy face shalt thou eat bread," and therefore, as well as on other grounds, I plead for the recognition of handicraft at school. Platitude and generality, if you like, but so far resembling the early stages of many an idea which has gone forth and conquered.

"Shaper's" [illegible] paragraph [illegible] valid [illegible] selves on common ground again, and the only question is, *how* the three R's and the mere elements of various sciences are to be taught. Is it not the fact that to the great majority of mankind science is unintelligible, or is not grasped to any purpose unless associated with an art?—that is, they learn by doing. In the infant schools this is recognised, and the first ideas of number are obtained by counting beads on a wire, and from this the elementary science of arithmetic is generalised. Just so; I would have the science of mensuration generalised from the practice of cutting out a dress or the sides of a box, and combined with these would come such geometrical drawing as corresponds to written arithmetic. Then surely elementary mechanics and elementary carpentry would illustrate each other, and the foundations of chemistry might be laid in cookery or mixing of paint, and glue, and paste. That it is possible to introduce such teaching at one stroke, without experiment and without trained teachers, is not pretended; but that this is the direction in which we should move I cannot doubt. You may call what I say generalities; but science consists in generalisation, so that is no reproach. With a clear grasp of the principles, the practical result is just a matter of tact, and it is the fault of the teacher if the children are trained into conceited amateurs.

If the education that is to fit a man for his place in the nation does not end at school, none the less it ought to begin there; and that training which turns out the largest proportion of quickened intelligences is the best, wholly irrespective of its effect on competitive commerce.

As to this last, how anyone who professes to have studied the question can speak of the effects of Free Trade as a simple matter, which Mr. Gobert does at the bottom of page 487, passes my comprehension. Why, he himself immediately contradicts his assertion by suggesting the teaching of foreign languages as a factor in the question. Is it our blind Free Trade that gives a London workman some 40s. for 54 hours' work, while his fellow at Berlin gets but 23s. for 72 hours a week? And if Free Trade causes the competition complained of here, what causes the competition that is complained of in France and in Germany? It were even easy to maintain that competition was a good in itself; but in any view the subject is excessively complex, and it is a pity to introduce it into the already sufficiently difficult question of education. The fact is, that so far as Englishmen have failed in competition, it is less for lack of specialised training than because of a certain unreadiness to take general views, a certain want of flexibility—perhaps, the "practical" quality pushed into a defect. But, on the whole, there is little evidence to show that we have been beaten, and not even does the extreme cheapness of the Victoria reading lamp, sometimes as low as 1s. 6d., incline me to throw up the sponge.

We can't monopolise the work of the world, and if we export we must import something; if we loan out capital we expect good interest thereon; and if we fetch and carry for the world we are paid for it. However the account stands with foreign nations, and whether we live by trade or by home produce, it is the duty of the teachers of the nation to do all they can to make our labour efficient, and the first step thereto is to take all possible care that our children have grown up with trained intelligences and serviceable bodies, together with habits of discipline and right senses. Platitudes and generalities, no doubt; but if you don't know what your aim is, how will you avoid muddling the details?

W. A. S. B.

[27681.]—In response to the request of "Shaper" (27661), I beg to offer my small mite of information concerning technical education abroad, limited to my own experience in my native town, Copenhagen. In many handicrafts high standards of perfection are obtained, and the results are in a very great measure due to the excellence of the technical school. It is nearly twenty years since I was a pupil myself, and although much has been altered since then, the changes are improvements and extensions of the original plan which in all its main features remains the same as it was then. The Technical Institute is a preparatory school to the Royal Academy of Fine Arts as well as a technical school. Those who wish to perfect themselves to become artists, scene-painters, sculptors, architects, &c., have here classes where drawing in all its branches—freehand, geometrical, perspective, from the plaster casts, &c.—is taught to a perfection as high as can be attained; modelling in clay and wax is also taught to intending sculptors. These classes are day classes, as the inten[illegible] all their time on abo[illegible] those, there are [illegible] subjects are [illegible] tech- [illegible] who [illegible] and amateurs—bring them within the reach of even very slender purses. Tuition is given in turning (wood and metal), modelling in wax and clay, engraving on wood and metal, embossing in sheet metal, chasing of cast metal, &c The teachers are well-known craftsmen, highly skilled in their own trade, every one of them being a tradesman turning out the best articles in his own particular trade. An apprentice in any trade which can benefit by development in any one of the above-named arts has an excellent chance. Under the most proper guidance can he here tackle such jobs as would not easily come within his reach in his workshop. As an apt illustration I shall quote, that it was, and is still no doubt, quite a common practice when a lad has got proficiency in turning to make a headstock and a tailstock. Patterns for castings and forgings could easily be got where everyone was desirous of helping the lad on, and the teacher's sound advice would enable him to make as good a choice as possible. It may easily be imagined that such a headstock would become the very pink of good workmanship—a real labour of love. A youth would throw in all his spare time for half a year or so, and with just and natural pride see his handiwork grow into perfection, and when finished he would not only have an excellent tool but a good experience much more valuable than the tool itself.

Besides these classes for handicrafts, there are others in which the commercial and artistic phases of different trades are attended to. Such are classes in book-keeping as accommodated to the factory and workshop, explaining builders' quantities, plane and solid geometry, as, for instance, applied to sheet-metal working or ironfounding, &c. The artistic classes teach the pupil how to get an eye for the beautiful and avoid the clumsy. A coppersmith might join a class for sheet metal-workers. Here he will learn to cut his material according to rational methods; he will become acquainted with a series of specimens where beauty is combined with durability and utility, and will learn that it is as easy and far more satisfactory to make a beautiful as an ugly thing. He will not learn the use of tools—that is the business of the workshop; but he will learn how to consolidate what the workshop taught; his mind will be trained to guide and control the work of his hand, raise him from mere rule of thumb to rational understanding.

I think that this is just the proper scope for a technical school. I have no faith in the belief that any and every lad and girl ought to go through a course of technical drill. To start with, it will be necessary to specialise at the very outset. It is handy and convenient to know the elements of wood-working: it is pleasant to be able to use a lathe. But of what use would be the elements of cabinet-making to a shoemaker, or the turning of a table-leg to a tinsmith, and it is obviously impossible to teach all sorts of trades to minds so young and in a time so short.

I would rather that the Government played second fiddle in the case of technical education. It is rather a question of co-operation amongst the members of the different trades themselves. If they want to raise the standard of workmanship in the pottery trade, the potters themselves are far better judges as to ways and means than any number of baronets, M.P.'s, reverend gentlemen, and the like, whose knowledge of trade and tradesfolk is too limited to command confidence. And it would be less likely that that pernicious system of jobbing which mars what else might be an all-powerful institution, would get hold of a private enterprise, as things would be governed by business men, and not left to the tender mercies of a Government office under no proper control.

Anglo-Dane.

[27682.]—Let me cordially endorse "F.R.A.S.'s" recommendation to "Shaper" to read Mr. Herbert Spencer's "The Man versus the State," to which also might profitably be added "The Study of Sociology" by the same learned writer.

A week or two ago a very influential deputation waited on Mr. Goschen to urge the claims of "higher education," which, being interpreted, means the claim to tax the whole nation to provide colleges for well-to-do people. Before Mr. Goschen has given his reply, we now get another demand on the public purse in the shape of "technical education."

It is useless to guess what the Government mean by "technical education," because they do not appear to know themselves. But it is quite evident that we are fairly on the road to a system which, logically developed, must end in complete State education of every kind.

I thoroughly agree with Mr. Spencer that slavery is none the less slavery because the victims vote their own liberty away. Justice requires that every man shall receive whatever he fairly earns; and it also requires that he shall not receive what he does not earn. Taxing the nation to technically educate a particular class violates an essential principle of justice; and to the extent it is taxed, the tax-paying class is enslaved: to that extent it works, and its earnings are given to others. If the State is to provide the mechanical classes with technical education, why should it not provide the medical classes with medical education, the legal with legal education, and the clerical with clerical education?

If it be the fact, as contended, that education is now a necessary of life, it is all the more reason why it should be supplied at the expense of the parents and not at the expense of the State. Taking upon itself what ought to be a parental burden, the State *pro tantô* encourages large families, and then it is surprised at over-population, and taxes the nation again to enable surplus population to emigrate!

And such is the superstitious faith put in Governments nowadays that the control of technical education is to be intrusted to the "Science and Art" department, it being tacitly understood, I suppose, that there is no science and art like Government science and art, which is, indeed, a fact, if we are to judge by the very defective execution of the Jubilee issue of coins.

July 31. **Kappa.**

HOT-AIR ENGINES:

[27683.]—I will give "B. R. W." what little information I possess if he likes to write to me at 25, Grange-road, Eastbourne. I began a little while ago to take an interest in the subject with a view to having one to drive my lathe, because the Robinson engine I saw running at the Metal Trades Exhibition had no disagreeable smell, and made no noise. But I then discovered that most small hot-air engines were rated too high, and, on testing one of German manufacture with the indicator and the dynamometer, I found that while the 9in. piston developed about 5-man power, the brake showed but about 2 man. This shows that a 2-man engine requires a 9in. or 10in. piston, and say, 6in. or 7in. stroke, and the engine becomes a far bigger thing than a gas-engine. Moreover, the engine on which I experimented requires at least 15 minutes to heat the large cast-iron pot in which the displacer works. I was attracted to Mr. Seal's design in the "E. M.," because there you have only a thin plate to heat, which should not require more than five minutes to grow red hot, and allow the engine to be started. At a small foundry in the country, with which I am acquainted, an engine has been made to his design; but the heater capacity proved insufficient, as, when heated up and the shaft turned by hand whilst the piston was left free, it only rose and fell about 1¼in. So far as I can see at present, the working capacity of the heater ought to be at least four times that of the cylinder. I have suggested certain improvements to this engine, and also designed a larger size, and I hope to be able to report favourably of them before long. The pressure in these engines cannot much exceed 8lb. They may, therefore, be made lightly, but they must be rather bulky and the working piston must be of large diameter, which leads to a loss of about half the power in piston friction. I should think an old piece of welded boiler flue would do for the body of such an engine. I think the flat top and bottom of the displacer should be strengthened with a few small open-ended pipes through which the air would pass as well as by the sides, and it should then take up a little heat as it went down through the displacer and part with a little as it returned. I thing it important to have the displacer of a good depth, say, 12 to 18in., though this again leads to more bulk, because otherwise the heat of the furnace will pass by conduction up the walls of the heater and so into the water and be lost without doing any work.

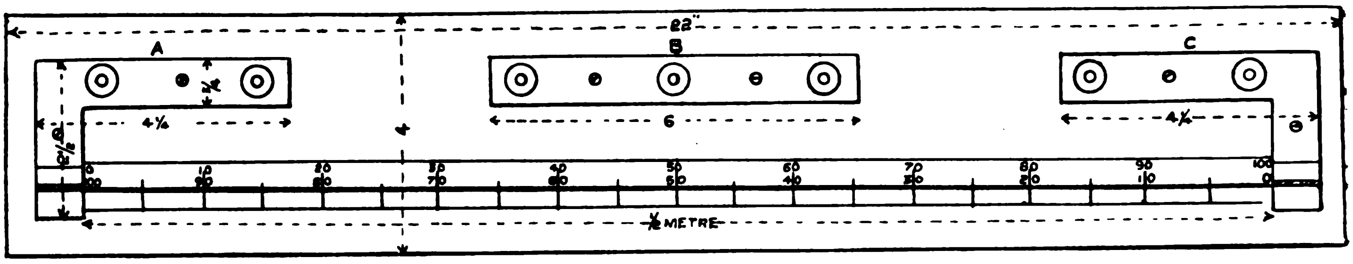
As to keeping the cylinder hot or not, it must surely be right to have it as hot as possible during the up stroke and cool during the down. Since we cannot accomplish this, it would seem to be of little importance whether it be kept hot or cool. If you keep it hot you assist the up-stroke at the expense of the down, which may be the best plan. The strength of the up and down stroke is often very unequal at first starting, but after a few revolutions they get equalised by leakage past the piston, the top stroke becoming actually the strongest in order to make up for the weight of the piston and its connections.

F. A. M.

ELECTRICAL MEASURING INSTRUMENTS.

(*Continued from page* 463.)

[27684.]—The next instrument is the slide Wheatstone's Bridge, and is much simpler in construction than the last. A plan of the completed arrangement is shown in Fig. 16, and is so simple as to render a long description unnecessary. The base board is made first out of 1in. wood planed and polished, the sizes being 22 by 4. Take a piece of sheet copper at least $\frac{1}{16}$ thick (the thicker the better) and cut out the two L pieces (A and C) to the sizes shown, and also the straight piece B. Drill the holes shown for both the screws and the



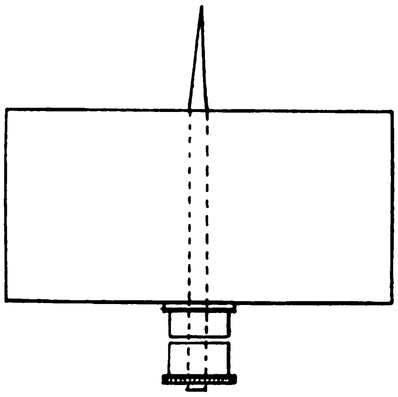


FIG. 17. PLAN

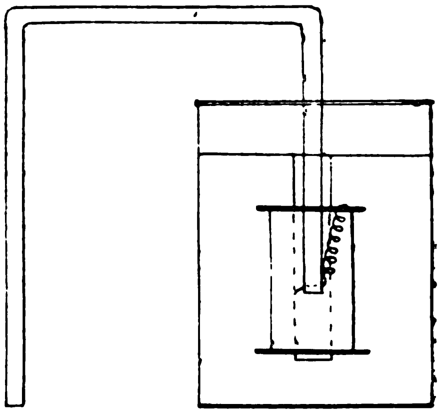
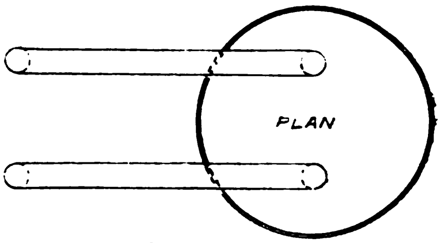


FIG. 19 PART SECTION



ONE OHM COIL

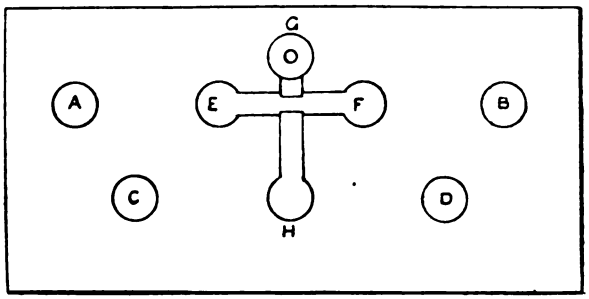


FIG. 18 PLAN

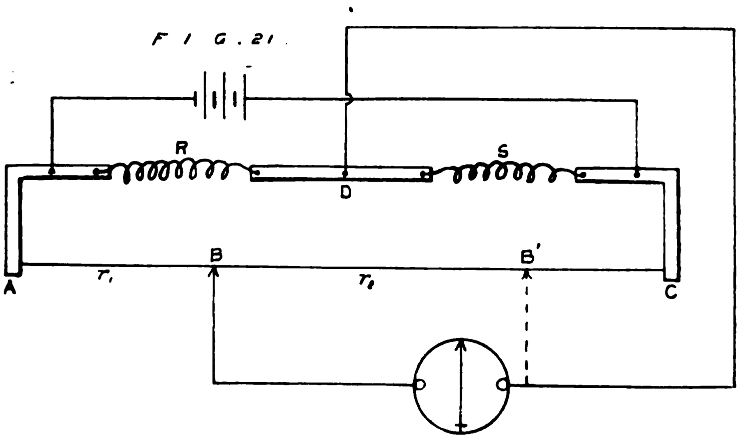


FIG. 21.

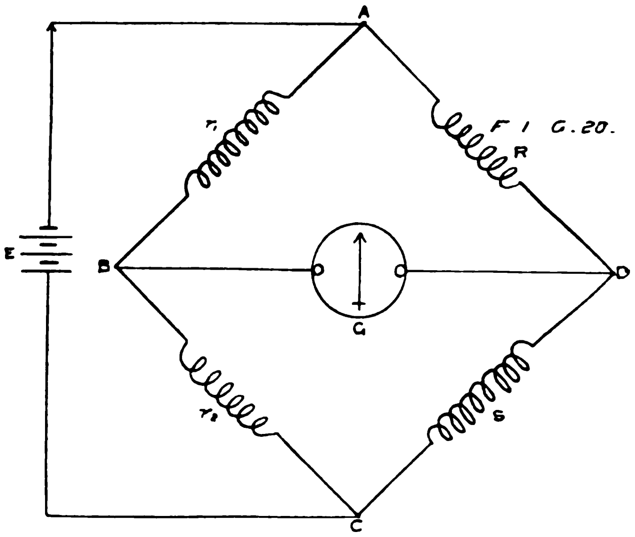


FIG. 20.

terminals, and solder the latter firmly to the plate (use the same terminals as in the galvanometer). Procure a ½ metre scale divided into ½ centimetres, about ⅞in. wide and ⅛in. thick; make a fine shallow groove in the face for the stretched wire to lie in, and also three holes (countersunk) to fasten the scale to the base; the numbering should begin at both ends. Screw the scale to the base 1in. from the edge, taking care that the heads are sunk below the surface of the scale. (If a metre scale cannot be obtained, one 20in. long divided into ⅕in. will do, or one 25in. divided into ¼in., in which case the bridge must be lengthened 5in. or so. All that is necessary is to have a scale about 2ft. long divided into 100 equal parts, or even that is not essential.)

Hard against the ends of the scale screw the two copper pieces so that the distance between the inside faces is exactly ½ metre; before doing so, however, solder two small squares of copper to the ends, of such a thickness as to make the top a little higher than the surface of the scale. In each of these make a fine saw cut in a straight line with the groove in the scale. Take about 2ft. of No. 24 German silver wire uncovered, and carefully straighten without straining in the least. (To remove the silk or cotton coveridg boil in a strong solution of caustic soda. On no account must the covering be removed by scraping.) Solder one end to one of the copper pieces (using resin only as flux), taking care that the solder completely fills the notch (as insuring good contact), but no further. Stretch the wire along the groove in the scale, and carefully solder the other end, keeping the wire tightly stretched all the time; but on no account putting on sufficient tension to strain the wire. Cut away the ends of the wire and file away surplus solder; screw in the middle copper piece B, and the bridge is completed.

Additional Apparatus before the bridge can be used to measure resistance. The following pieces of apparatus will be required in addition:—(1) Sliding contact; (2) Mercury cups; and (3) One ohm coil.

1. Cut a piece of wood 2 by 1 by ⅜, and through the middle, half-way down, make a 1/16 hole. To the stalk of a rather small terminal solder about 1in. of brass wire, file the end to a sharp edge, and screw into the hole so that the wire projects about ⅛in. and the flat edge is vertical (see Fig. 17).

2. Take a piece of 1in. wood and cut some 6 by 3, and make the seven holes shown ⅜in. diameter and about ¾in. deep (Fig. 18). Between E and F cut ¼in. groove the same depth. Join this groove with hole H by means of a copper strip let into the wood and amalgamated; also make contact with the terminal G in the same way. To amalgamate copper and brass plates and wires dissolve some mercury in nitric acid, taking care that there is always a little undissolved; keep in a stoppered bottle labelled "amalgamating solution." Dip the ends to be amalgamated into this solution and wipe with a rag, the ends will be found t-

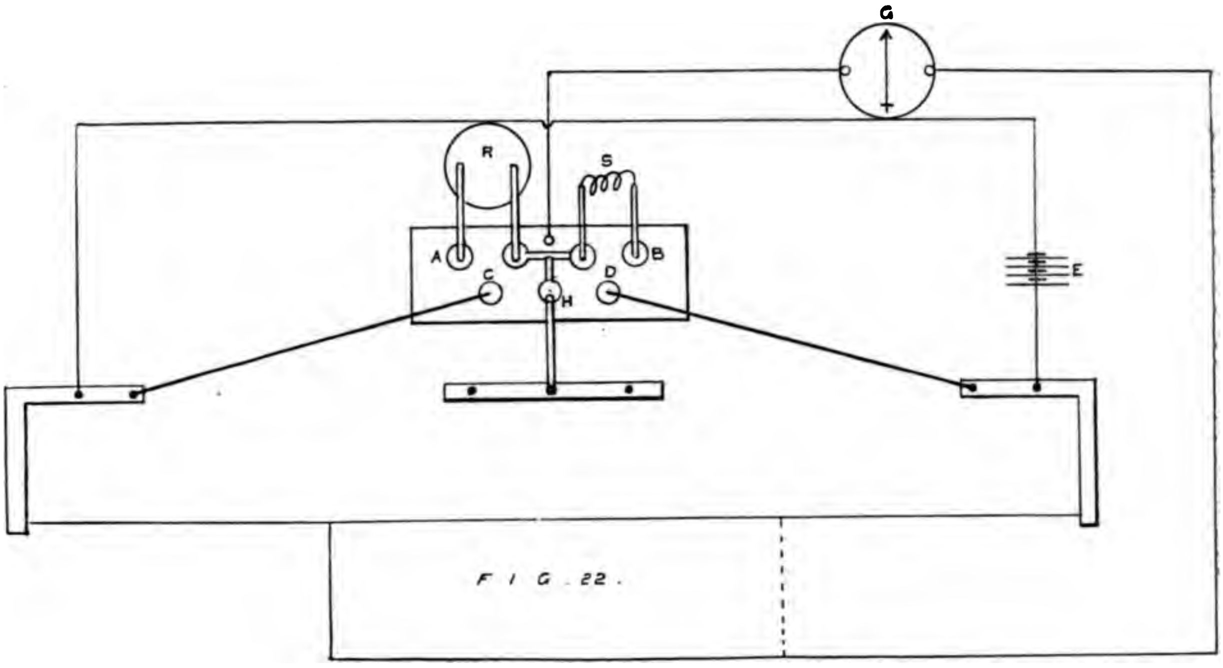


FIG. 22.

brilliantly amalgamated. Bend some stout copper wire (No. 12, or so), into this shape ┌──┐ making two or sufficient length to reach from A to C, and from B to D, also two from A to D and C to B, and amalgamate the short ends of each.

(3) Buy an unmounted bobbin of one ohm resistance, and in doing so choose one in which the wire is not very fine, and proceed to mount it as follows:—Take an ordinary tin canister 3in. diameter and 4in. high, and turn up a ¾in. cover out of boxwood or ebonite, make three or four holes in the side so as to fasten the cover on by screws. Fix a piece of wood to the bobbin and also to the cover, so that the bobbin is suspended in the middle of the canister. (See Fig. 19.) Out of some ¼in. brass, or, better still, copper, rod bend two pieces to the shape and sizes given, and near the bottom of the shorter arm drill a hole completely through the rod in both. Place the rods through the cover and pass the ends of the coil through the holes and solder carefully, so as to make a perfect connection; about 1in. of the other ends of the rods have to be amalgamated. Before going on to the method of measurement the reader should acquaint himself with the theory of Wheatstone's bridge. Suppose a circuit arranged as in Fig. 20. r_1 r_2 R and S being coils of a certain resistances, G a galvanometer, and E a battery. If contact is completed by pressing the key, a current will be sent round the circuit, and in all probability the galvanometer will be deflected, showing the points B and D to be at different potentials.

Supppose the resistances to be so altered that when the key is depressed no current passes through the galvanometer, then it can easily be proved that—

$$r_1 S = r_2 R_1, \text{ or } S = \frac{r_2}{r_1} R.$$

If R = 1 ohm, then $S = \frac{r_2}{r_1}$ ohms, and r_2 r_1 may be measured in any units whatever, so long as they are the same for both, since the ratio of their resistances is independent of the units employed.

In the actual slide bridge the connections are exactly the same as in the theoretical diagram. Fig. 21 shows the method of connecting, and is lettered in the same way as Fig. 20. The sliding contact B is moved along the wire until the galvonometer gives no deflection; suppose B is this position: interchange S and R, and again find the position of no deflection, it will be at the position B′ and if the bridge were perfect, C B would be exactly equal to A B′.

Method of Working.—To measure the resistance of 1 yard, No. 28 silk-covered G.S. wire. Measure out (accurately) 36½in. of wire, and to the ends solder ½in. of thick copper wire amalgamated; the length of wire clear of these ends must be 1 yard, the ½in. being allowed for connections. Connect up the circuit as shown in Fig. 22, R being the mounted 1 ohm coil, S the yard G.S. wire, G the galvanometer, and E testing battery. For galvanometer use the coils 3 and 4 of the tangent by leading in at screws 3 and 5; the battery may be 3 or 4 cells, Leclanché or Daniells.

The contacts between the cups C A D and the bridge are made with thick pieces of copper wire with the ends amalgamated.

Go carefully through all the connections, taking care that all wires dipping in the cups are well amalgamated, and those under the terminals are made bright and clean with emery paper.

Connect the cups A C and B D, place the slider at one end of the bridge, and make contact by pressing lightly on the German silver wire—a deflection of the needle should be the result. Now take the slider to the opposite end, and again make contact—a deflection in the opposite direction should take place. If not, some of the contacts are faulty, or the connections are not correctly made, and must be gone through again.

If the connections are correct, move the contact piece, and continue to make contact until a position is found which gives no deflection in the galvanometer; then take the reading from the right-hand end, reading to the $\frac{1}{10}$th of a division, if necessary by mental division of the ½ centimèter; let the reading be *a* divisions.

Now disconnect A C and B D, and connect across A D and C B; again find the reading on the scale when there is no deflection, reading this time from the other end of the scale. Let this reading be *a′*, which should be nearly the same as *a*.

Now, since the resistances of r_1 and r_2 are proportional to the length of wire, then as

$$S = \frac{r_2}{r_1} \text{ (since R = 1) we have } S = \frac{\frac{a + a'}{2}}{100 - \frac{a + a'}{2}}$$

$$= \frac{a + a'}{200 - a + a'}$$

Remarks.—In the preceding formula, assumption has been made that the resistance of the copper strips to which the G.S. wire is soldered is zero. The error due to this is a minimum when the slide is in the middle of the bridge, and increases with the distance from this point. It is evident then that the bridge is best adapted to measure resistances of about 1 ohm, for then the solder will have the middle position when the resistances balance.

In accurate work it is a good plan to find by the preceding method the approximate resistance of the coil being measured. Then remove the 1 ohm coil R, and in its place put one which is of nearly the the same resistahce as the one being measured. Example.—Suppose the resistance was found to be 2·8 ohms instead of the 1 ohm coil place in one of 3 ohms.

By this means the slider will be brought near the centre, and the above-mentioned error will have least effect on the results. Those who want to make a good bridge had better make the wire one meter long, the G.S. No. 22, and the copper ends at least ½in. thick. Such a bridge when well constructed will give the resistance accurate to ·0005 ohm.

J. S.

PROPULSION OF VESSELS—PADDLE BOATS.

[27685.]—HAVING read the letters which have been appearing recently in the columns of the ENGLISH MECHANIC relating to the above, perhaps the following may be of interest to those that are studying the propulsion of vessels. The model from which I gained my information is now being exhibited at the Newcastle-on-Tyne Exhibition. The inventor claims that a speed of 40 knots can be attained by a boat fitted with this motion. I will now attempt to describe with the aid of rough sketches the principle of this wonderful invention.

The four paddles are driven by a compound engine working at 100lb. pressure, and making 100 revolutions per minute. The high-pressure cylinder always works the paddles directly they strike the water, and continues to do so till they leave the water, when the low-pressure takes them. While this is going on the low-pressure cylinder is fetching the next two over, ready to be acted on in a similar manner by the high-pressure cylinder. Perhaps this will be better understood by referring to Fig. 1. No. 1 paddle is now being worked by the high-pressure cylinder, and No. 2 by the low-pressure cylinder. Fig. 2 is an end view of paddles for one side of boat. In this motion there is no slipping of the paddles, and with the paddle boxes being so low, they are not effected by a head wind. It will also decrease the cost of maintenance of the feathering paddles now in use. I will be glad to give our readers further information if they wish it.

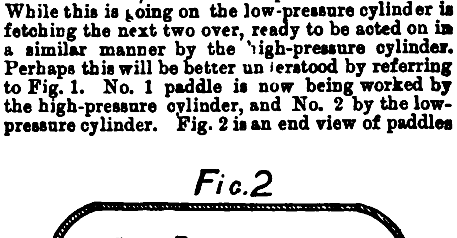
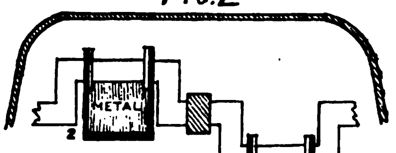


FIG. 1

FIG. 2



Edmund Roberts.

Mather-street, Newcastle-on-Tyne.

[27686.]—THE proposed arrangement of "Nomoplast," as described on p. 514, is a very objectionable modification of the many methods tried in order to make use of water by ejecting it, under the perfectly fallacious notion that any power whatever can be derived from the "push" of the issuing jet, against the "unconfined" water around the vessel. The fact is that if pressure is put upon any fluid or gaseous body in a confined space, and if then an orifice for the same be provided, whatever pressure be maintained in the receiver or cylinder, as the case may be, is removed off the area equal to aforesaid orifice, and this is the [illegible] power which is attainable by any such arrangement. Therefore it follows that, instead of proposing to place the nozzles deep in the water, there would be a freer exit, and consequently more power by discharging just above the water-line. Study will, or ought to convince, as practical experience has shown, that with the surrounding water unconfined, it gives way in every direction. "Nomoplast" does not state how, or where, he takes in the water, which is a very important factor. If he imagines that the water in the pipes acts as a piston, he seems to neglect the fact that the friction of the same against the walls which causes it to act as a piston is a fatal objection, as it is trying to pull the vessel backwards. If we assume a cylinder containing a piston area of 16ft., and ram plunger to force all this water through two orifices, with an area of only 1ft. each, we ought to know that it could only be accomplished at a slow speed, as a solid body such as water cannot be hurried along as if it were steam. Many years ago, I think it was an Edinburgh man, if my memory be correct, had a large vessel fitted with a sort of fan, laid horizontally in the centre and below the water-line; a large pipe from the stem allowed the water to flow freely in at the centre of the fan, which was set revolving at a slapping pace by engines of, say, about 100H.P., the water being shot out at its circumference with great force into a pipe leading aft in one experiment; but at first I think that it delivered into a curved pipe, which came out upon the port and starboard sides, and was provided with movable nozzles, so that these could be slewed fore or aft as required. Now, originally, these were placed as deep as possible; but it was proved, as I state, that the nozzles gave more speed when raised above water. It was also proved "that the friction of the water moving at high velocity in a pipe is a most serious objection to any plan which involves it."

A., Liverpool.

PROPULSION OF STEAMSHIPS.

[27687.]—I HAVE read with much interest (some with considerable relish) the numerous letters on this subject which have lately appeared in the "E. M." "Nomoplast" submits his notion, letter 27671, with the idea of discerning what practical value it possesses. I think I may venture to say it is similar enough to the plan of propulsion tried on the *Waterwitch* some twenty-two years ago, so that a statement of the results obtained on that vessel will give us an idea of the value of such methods of propulsion.

In the *Waterwitch*, a centrifugal pump, driven by powerful engines, was employed. First, to draw the water in through suitable openings, and then to eject it again through outlets or nozzles, the impact of the outflowing water (at a rate of 30ft. to 40ft. per second) on the external water forcing the vessel ahead or astern, the water being directed to the head or stern of the ship by reversible valves. On one of her trials the *Waterwitch*, with an expenditure of 750 indicated H.P., made barely 9 knots per hour. Her mean draught was 9ft. 9in.; displacement, 1,062 tons of water. On a later trial, with a deep draught, 11ft. 1in., displacement 1,219 tons, indicated H.P. 828, speed 9·255 knots.

There is one thing to be said—viz., the form of the *Waterwitch* was not of the best for speed; but taking into consideration the fact that vessels of greater displacement with much less engine power are driven at a higher speed, and looking at the wonders in speed that have lately been accomplished by screw propulsion, and the complete success of the screw over all other rival methods that have been hitherto tried, and although, as "Nomoplast" believes, the screw *may* waste too large a proportion of energy, yet I am strongly of opinion that it (the screw) will be "bad to beat."

I may safely say that of all the *new* modes of propelling ships submitted though these columns, that of "Nomoplast" is the most practicable, and I would suggest, if he has the time at his disposal, that he should go a little more into detail, and give us the necessary engine power to do what he proposes, sizes—weight of machinery, &c., and consequent size of ship, displacement, &c., so that we may compare with screw-propelled vessels of similar dimensions, power, &c. Such a statement, I am sure, would be read with deep interest by all concerned in this subject.

Engineer, St. Mary Church, Torquay.

ABOUT A HAT.

[27688.]—AS a general thing, when the animal man wishes to fabricate anything, he directs all his inventive faculties to the solution of the problem of so to construct the desired article, be it tool, bridge, ship, or what not, that it may be of the simplest design, and comprise the fewest number of parts consistent with the due performance of its intended work. Witness just now in the pages of the ENGLISH MECHANIC, the praiseworthy *efforts* of "F. A. M.," Dr. Edmunds, and others, to *give the amateur (and scientific)* mechanical world a better lathe than it has hitherto possessed. See how thoroughly all those interested in this speciality thrash out their subject, how searching are their mutual criticisms—not a point seems to escape them! The same may be said (to a lesser degree perhaps) of the thousand and one inventions and suggestions that from time to time bubble up to the surface of that never-failing spring of knowledge, the ENGLISH MECHANIC. In nothing does developed man show out more grandly than in the way he grapples thus with mechanical difficulties.

There is one lamentable exception, however, to the afore-mentioned method of investigation and invention. The moment that clothing his body comes in question, then man at once descends from the lofty pedestal on which reason has placed him, and gives strong presumptive evidence of his kinship to the ape!

Where is now the patient investigation and careful reasoning; where the adaptation of means to a definite end; where the simplifying of design to the uttermost, consistent with the attainment of object?—all of which we saw so prominently to the front in the case of every construction save that of dress? In their place we find absence of any design at all, except it be one to incommode the wearer; the greatest possible complexity of parts; a servile imitation of bad models; and an unceasing craving for change of style, not from any laudable desire to discover a better, but usually from a mere itch for change for change sake; or to be first in the race after some leader of fashion in Paris or elsewhere! Being a humble admirer of that "*creature* Darwin" (vide one of "E. L. G's." late effusions), I submit that in all this we are very much like monkeys!

I don't propose to speak further now on the general question of dress, but merely to make a few remarks on that atrocity—the hat! Oh, Messieurs Hat Manufacturers! will you not take pity on us, your abject slaves, and of your clemency bring out something in the way of adequate protection to our poor noddles in this fearful sweltering weather? A man may, if he will take some trouble about it, find *artistes* (I believe that's the term nowadays) willing to fashion covering for his body and feet after the customer's own plans; but it is otherwise as regards hats—in all that pertains to them, we are entirely at the maker's mercy. We have to take what he chooses to give us and be thankful—if we can. Here is my idea of what a head covering for civilians in a temperate climate should be. As I have only partially been able to reduce it to practice, no doubt a full trial might show where improvements could be made.

Colour—To be drab, or dust colour. This does not become so warm in the sunshine as black, while it does not soil so readily as white. In very hot, sunny weather, a white linen or calico cover with falling flap to protect the neck to be worn outside. Mem.—Black being the very worst possible colour, is almost universal for English hats.

Shape.—Difficult to give this without a drawing. It should be of the helmet kind, leaving a good air space between top of head and inside of crown. Peak in front, 2in. to 2½in. broad, sloping down about 45°. The peak or brim to be continued all round, increasing in breadth towards the rear. The greatest width to be over the nape of the neck, where it should not be less than 4in. It is of importance that the ears be fully protected from sun and rain, and it is here that every helmet, military or civil, that I have seen, misses it. With the monkey instinct strong upon them, the designers of these said helmets, in imitation of the Paris fashionists, cut away the material over the ears, just where it ought to have been left. But that no vagary is wonderful in dress matters, it might strike one as singular that hat-makers will persist in rolling up, or in some way removing the brim from the neighbourhood of the ears. The blue swollen ears of 'bus and cab-drivers show some of the effects of this practice. The underside of the brim, over the eyes, should be green, not liable to come off from wet or use.

Material.—I don't know the best. Would need much experimenting. However, it should be pretty thick, not heavy, and stiff, so as to protect the head in case of a tumble or a chance blow. Some hats I have weigh from less than 3½oz. to over 5½oz.

Sweat Band.—The usual glazed waterproof lining that receives the perspiration from the forehead I disapprove of. It is sometimes made of poisonous material, which can be absorbed into the system. I suffered in Germany once from this novel method of poisoning. I agree with Dr. Jaeger, that it should be of pure woollen stuff. I make it capable of removal for washing, &c.

Ventilation.—This must be carefully at
After many trials, I like the following
best:—A circular hole 1in. in diameter,
of the highest part of the crown. Thi
by a circular piece of the same mate
helmet is made of, about 2in. in diame
placed and raised from the top about
little blocks of leather of that thickn

neath it, all being secured in place by sewing, pinning, or cementing. Thus, the heated air can escape freely, and neither rain or sun's rays enter. The air inlets are four little rectangular zinc tubes about 2¼in. long by ½ by ⅛in. in cross section. These are set flat wise and vertically in the woollen sweat band, and not in contact with the head, the lower ends being a shade below it, and the upper ends even with its upper edge; thus a continual circulation of air is kept up.

The reason for placing them thus, where they draw air from below the brim instead of simply piercing the walls of the helmet above the band as is usually done, is that they act perfectly in this situation when the whole helmet is enveloped by the calico sun cover, whereas the holes *through* the material would be covered up and inactive just at the time when most wanted; also no matter how heavy the rain, it cannot enter the helmet through the inlets arranged as indicated. If desired, all the ventilators may be easily closed by sticking gummed paper over the internal orifices.

As regards appearance, I think that the flowing rounded outline of the above described head-gear is far superior to the straight-lined right-angled stove-pipe hat at present sanctioned by fashion. To make it properly is beyond my means of work; it can only be done as it ought by one in the trade, and they won't unless assured that its manufacture will pay. That's the difficulty.

It should be mentioned that the calico sun cover should have an opening in it corresponding to the ventilator in the crown of the helmet.

Edward M. Richards.

Grange, Enniscorthy, Ireland, July 27.

THE SEYBERT COMMISSION ON SPIRITUALISM.

[27689.]—In your leader of the 15th inst. *re* the "Seybert Commission on Spiritualism," you summarily dispose of the subject by the anathema "it is a sufficiently crushing exposure of a remarkable series of impostures." In the interests of science—and it is only from a scientific point of view that this subject should be treated—I desire most respectfully to state, without desiring to enter into controversial argument, that many English Mechanics will bear me out in my views, "That this is not a new subject. It is one that has engaged the attention of a vast number of persons. It would not be an exaggerated estimate of their number if stated that they are counted by millions. It is precisely accurate and true to say that they number among them minds of the highest calibre, quite as competent to weigh evidence as any of the Seybert Commission, and infinitely more experienced in regard to the subject with which they deal. The bulk of evidence already accumulated is enormous, and it challenges attention in a way that the Seybert Commission does not seem disposed to admit. It is no new subject that the Seybert Commission approaches, and there have been competent investigators before the appointment of this commission. Scientists will smile at the implied claim that spiritualism is now for the first time to be investigated. Those who do not smile will perhaps be angry, more especially when they remember the 200 pages devoted to the report, and the outcome of that mountain of labour. To scientists from the first it was evident that the commission would report against the facts of spiritualism. The composition of the committee did not encourage the hope that phenomena so delicate, so absolutely beyond control, so fugitive even under the best conditions, would be evoked successfully under conditions prescribed by some very hard-headed dogmatic men, of whom most had given proof of their quality as critics of matters psychical, and of whom scientists are not, therefore, disposed to expect any particular leniency in treating these obscure and little-understood phenomena."

"It is extremely easy so to arrange an investigation into these subjects as to prove a negative. Spiritualists have assuredly not challenged the Seybert Commission, nor the Society for Psychical Research, to appoint a committee of such men as those who form the elected body to investigate anew facts so well authenticated already, and to notify, if such should unfortunately be, by their failure to get such phenomena as will satisfy them, their belief that everybody else has been equally unfortunate. Scientists warn them, from a stand- n....

truth of what the Church graciously denominates demonology, and the ignorant and superstitious term mysticism and magic, or else humbug. If, however, these supersensuous facts should, on further inquiry, be proved to be untrue or unworthy of credit, a belief in them must evidently be regarded as a public calamity, and those men of learning and influence who make them the subject of study would be free from blame. Should, on the contrary, such facts be proved to be really supersensuous, or beyond the ordinary senses, the materialistic views upon which, at the present day, nearly all scientific labours are based, must be recognised as insufficient. Our conceptions of force and matter, of soul and brain, must be overturned, and—which is the most important of all, bearing in mind that this is actually the 19th century—the deleterious and customary basis of our present system of education can and must be replaced by a new one.

You remind us that "The Seybert Commission" then have corroborated what has been said by scientific men in this country, for in their summing up they say, "They did not in all their investigations discover a single novel fact, and are forced to the conclusion that spiritualism, so far at least as it has been shown before them, presents the melancholy spectacle of gross fraud perpetrated upon an uncritical portion of the community."

Such an opinion was foreseen, and it will be found when a few more such experiments have failed, as they most likely will in all cases, so long as committees are made up of such materials as they hitherto have been, that this examination by commission is sheer waste of time. It is most easy for a body of prejudiced and dogmatic men to so arrange an investigation as to effectively preclude the occurrence of any phenomena. It is a very difficult thing for even those who are open-minded and desirous of arriving at the truth to get phenomena to command, or when they want them. No amount of negative results of this kind, however, has any bearing on the facts that have already been amply proven. "The Seybert Commission" alike with some prominent and quite fair-minded persons in England, fails to get evidence that satisfies it. Very regrettable, that is all. The vast mass of people—a mighty multitude that cannot be numbered—who have got these proofs is not to be disposed of in that way. Genuine investigators are in no way surprised at the failure of the "Seybert Commission"; but such genuine investigators would be perplexed by the failure of any reasonable individual who acts fairly, to get sufficient evidence to prove, beyond a perhaps, the existence of an intelligence outside of, and independent of, a human brain.

In this century, the popular conception upon no matter what topic is undergoing development, and the term "uncritical portion of the community" is an invention, and the Seybert Commission, who invented the term, have a monopoly of it. However, a few years since, whilst in England, an uncritical member of the community and one of the most intelligent English Mechanics (M.I.M.E., &c.) I have ever had the honour to be associated with, gave a mass of statistics, and proved conclusively to me that psychical research amongst the more intelligent of English Mechanics was greatly upon the increase, and I had the honour to meet many individuals engaged in such investigations; such evidence placed at my disposal led me to give this matter scientific attention, more especially as the only injunction made was, "If you really wish to see whether spiritualism (or call it by any other name you wish, for the present is most unfashionable) is really only jugglery and imposture, try it by personal experiment." This I have done under the most absolute test conditions, and, in the words of Cromwell F. Varley, F.R.S., I have the honour to state, "I was a hard-hearted unbeliever." That the phenomena occur there is overwhelming evidence, and it is too late to deny their existence. Alfred Russell Wallace, F.R.S., confirms "That the phenomena of spiritualism in their entirety do not require further confirmation." Dr. Lockhart Robertson states, "Can no more doubt the psychical manifestations of *so-called* spiritualism than he would any other fact, as, for example, the fall of an apple to the ground, of which his senses informed him." The late Dr. Robert Chambers (of Edinburgh) stated, "I have for many years *known* that these phenomena are real as distinguished from impostures, and it is not

they were calculated

doubtful in the

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no bigger than a man's hand—it is modern spiritualism." Prof. Challis, the late Plumerian Professor of Astronomy at Cambridge, in the *Clerical Journal*, June, 1862, wrote, "I have been unable to resist the large amount of testimony to such facts, which have come from many independent sources and from a vast number of witnesses. . . . In short, the testimony has been so abundant and consentaneous, that either the facts must be admitted to be such as are reported, or the possibility of certifying facts by human testimony must be given up."

If further evidence be wanting regarding the capacity of the uncritical portion of the community, and their belief in the reality of some of the phenomena generally known as psychical or spiritualistic, the following goodly array of names, may possibly allow some of the indolently unprogressive to form an opinion.

Science.—The Earl of Crawford and Balcarres, F.R.S., President R.A.S.; W. Crookes, Fellow and Gold Medallist of the Royal Society; C. Varley, F.R.S., C.E.; A. R. Wallace, the eminent naturalist; W. F. Barrett, F.R.S.E., Professor of Physics in the Royal College of Science, Dublin; Dr. Lockhart Robertson, the late Dr. J. Elliotson, F.R.S., some time President of the Royal Medical and Chirurgical Society of London; Professor de Morgan, some time President of the Mathematical Society of London; Dr. William Gregory, F.R.S.E., some time Professor of Chemistry in the University of Edinburgh; Dr. Ashburner, Mr. Rutter, Dr. Herbert Mayo, F.R.A.S., &c.

Literature.—The Earl of Dunraven, J. A. Trollope, S. C. Hall, Gerald Massey, Sir R. Burton, Prof. Cassall, LL.D., Lord Brougham, Lord Lytton, Lord Lyndhurst, Archbishop Whately, Dr. R. Chambers, F.R.S.E., W. M. Thackeray, Nassau Senior, George Thompson, W. Howett, Serjeant Cox, Mrs. Browning, Hon. Roden Noel, &c.

No amount of assertion or prejudice can ignore the fact that the subject has acquired a hold on the educated world, and if evidence was wanting, the words of Camille Flammarion, the French astronomer and Minister of the Académie Française, might inspire confidence. This experienced investigator writes: "I do not hesitate to affirm my conviction, based upon personal examination of the subject, that any scientific man who declares the phenomena denominated, magnetic, somnambulic, mediumistic, and others not yet explained by science, to be 'impossible,' is one who speaks without knowing what he is talking about; and also any man accustomed, by his professional avocations, to scientific observations—provided that his mind be not biased by preconceived opinions, nor his mental vision blinded by that opposite kind of illusion, unhappily too common in the learned world, which consists in imagining that the laws of nature are already known to us, and that everything which appears to overstep the limits of our present formulas is impossible—may acquire a radical and absolute certainty of the facts alluded to.

Alfred Russell Wallace states: "My position, therefore, is that the phenomena of spiritualism in their entirety, do not require further confirmation. They are proved quite as well as any facts are proved in other sciences, and it is not denial or quibbling that can disprove any of them, but only fresh facts and accurate deductions from those facts. When the opponents of spiritualism can give a record of their researches approaching in duration and completeness to those of its advocates; and when they can discover and show in detail, either how phenomena are produced or how the many sane and able men here referred to have been deluded into a coincident belief that they have witnessed them, and when they can prove the correctness of their theory by producing a like belief in a body of equally sane and able unbelievers, then, and not till then, will it be necessary for spiritualists to produce fresh confirmation of facts which are, and always have been, sufficiently real and indisputable to satisfy any honest and persevering inquirer."—*Miracles and Modern Spiritualism.*

If a serious would-be inquirer would take the trouble to obtain an introduction to some experienced spiritualist, on whose good faith implicit reliance could be placed, all doubt as to imposture would vanish. My experience of the English Mechanic is that he hates to be left in the dark. He also hates to be wrongly advised, or to know less than his neighbour. Therefore, the sooner some of our friends ask for advice, if they have friends who are holding private circles, get permission to attend one, and see how to conduct séances and what to expect—it will then be just advisable, if interested in the matter, to try by

nal experiment for results, and in order to

n them, exhibit a fair amount of patience.

he results obtained by the light of reason.

l head and a clear judgment. Never

bandon the use of your senses. Do

very solemn investigation in a

sity or frivolity, and cultivate a

what is pure, good, and true.

Notwithstanding all assertions to the contrary it must not be forgotten, in the face of the mass of evidence at the disposal of those interested, that mediums, who are the instruments of an external agency, have more than once been confronted with conjurers that deceive by sleight of hand, and in the same manner that no man of science who has thoroughly and fairly investigated the phenomena has failed to become thoroughly convinced of their reality. So no conjurer who has been confronted with the same facts has been able to explain their occurrence by prestidigitation. Houdin, Jacobi, Bellachini, Hermann, Keller, and others have already confessed their powerlessness to produce under the same conditions what occurs without human intervention in the presence of a medium.

It was an English Mechanic (M.I.M.E., &c.) that shamed my dogmatism and upset my popular fallacies *re* the supersensuous, and as one of the uncritical portion of the community I have dared to quote and compile the opinions of others more diligent than myself. There are hundreds of English Mechanics at home who have investigated, and who still investigate, this supersensuous science. As it is unfashionable, such testimony is unrecorded. The actual uncritical portion of the community are those who still wade in the depths of bewilderment into which they are constantly being led by modern hearsay writers, and those ignorant of the literature of to-day, or the developments of the 19th-century either, and whose opinions as a rule upon supersensuous subjects leave the average intelligent observer in a horrid doubt as to the condition of such writer's minds about things in general. The name of the science which proposes to clear up modern doubts is but a mere question of nomenclature. Amongst those who may profess this science there may be careless observers, prejudiced recorders, and rash systematisers; their errors and defects may impede the progress of knowledge, but they will not stop it. "Spiritualism must be investigated by science, and I should be a coward if I did not openly express my convictions." These are the words of a greater authority than myself, and I have no hesitation to record them.

James V. R. Swann.

73, Moika, St. Petersburg.

SPIRITUALISM.

[27690.]—IN the year 1874, Mr. Crookes published his "Researches in the Phenomena of Spiritualism," being a reprint from the *Quarterly Journal of Science*. The first part of this book contains an account of investigations of Home's *psychic force*, illustrated by the medium, causing an accordion held by one hand only to perform in a musical manner. Also by the depression of a board suspended between a table and a balance, force being applied only at that point where it rested on the table. This experiment was afterwards varied by a cup of water being placed on the fixed end of the board, and when Home put his fingers in the water the balance was depressed. I have never seen an explanation of these phenomena. It would be worth while for the Seybert Committee to turn their attention towards the elucidation thereof. The second part of Mr. Crookes' book, treating of the materialisation of Katie King, is so utterly absurd, and the writer is so evidently "gone" as to be utterly unworthy of serious consideration. The experiments with Home seem, however, to have been conducted in a more scientific frame of mind, and if we are to conclude that all possible precautions were taken against trickery, I cannot see any feasible explanation of the phenomena recorded. Of course, if the apparatus had belonged to the *medium* there would be no difficulty; but it was otherwise—the tests were arranged by Mr. Crookes himself.

Sm.

"PETITIO PRINCIPII" MORE NAKED.

[27691.]—"SUPPOSE that" blackberry bushes each grow a king six times per annum. Also that it has rained astronomical societies 500,000 times oftener than either cats, dogs, or water. "If" kings exercise no influence on astronomy, how can there be, "in any shape or way," a Royal Astronomical Society, or a Fellow thereof?

Though not up to the sublime trash of "F.R.A.S.," on p. 510, that is a little nearer, I trust, than quoting, as I first meant, from the matchless parable "Water Babies," that "some people tell you" there are no such things as water babies. But this book is about water babies. If there were none, how could this book be about them? And if there is a book about them, how can there be none?

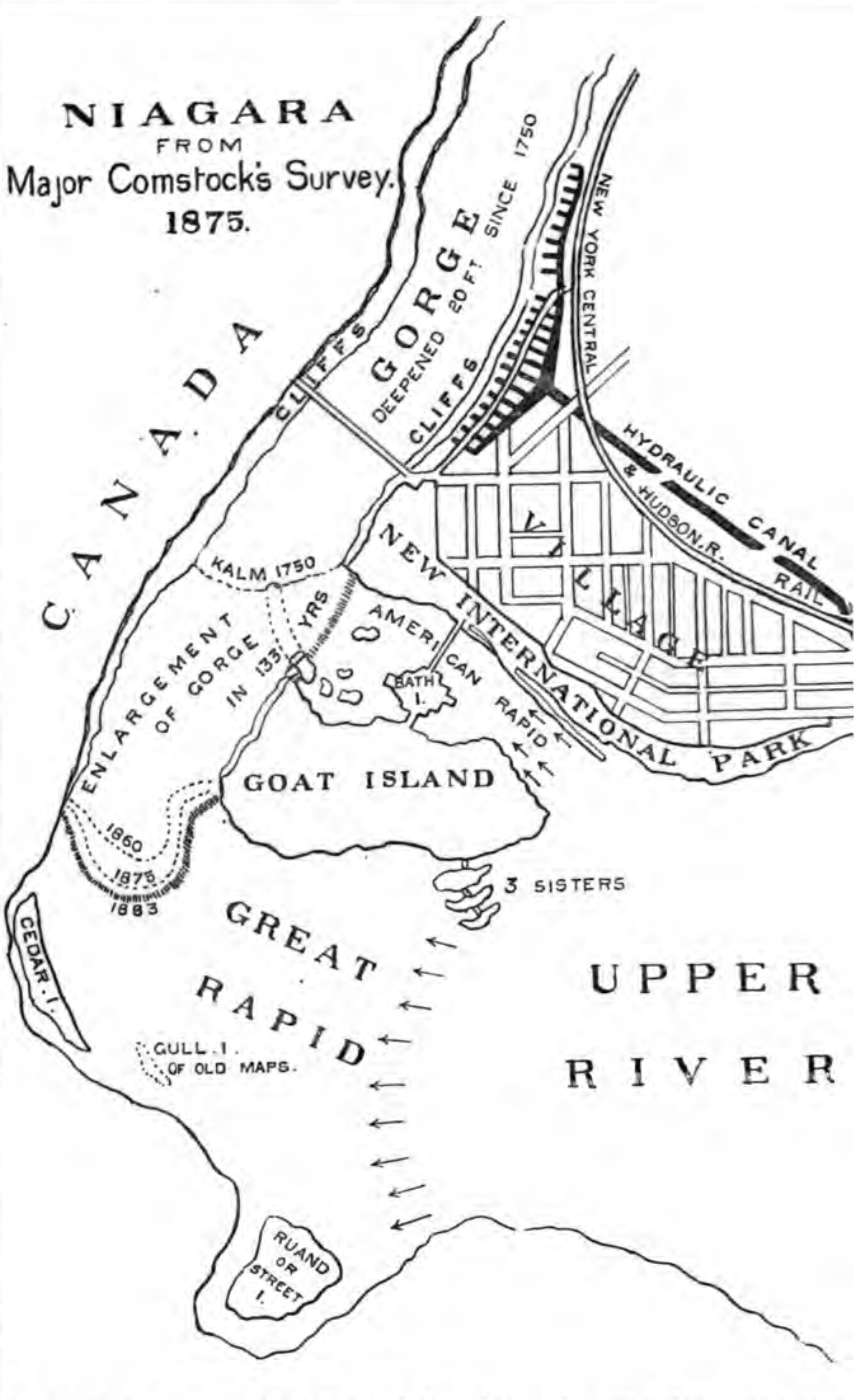
There is no "covert allusion" by me to anything of Whiston's (crazy or not), but constant, open reference to the patent facts of visible nature, including those that Newton and Halley (when secretary of the Royal Society—not Whiston in particular) saw they must connect with Noah's flood. If the facts are displeasing to anyone, he should say, like the atheist Comte, Nature is very bad. "It is well to remember sometimes, and to regret, the grave imperfection of an order which we cannot modify." (*Positive Polity*, Eng. ed. I. 410.) "Collision with a comet, for instance, is a danger from which it can never be proved that we are really free." And he goes on to persuade himself that this is good for "the human character." Waiting for a race not quite so quack-ridden as poor Victorian Britain, he could not quite venture on such Royal Astronomical quackery as ours.

As for the "mythical" Noachian deluge, your ".F.R.A.S." must know well with more reason could we insist the mythical Napoleon Bonaparte is a "solar hero," whose names and acts all "covertly" describe the sun's course through the Ecliptic. That a man of that name ever ruled is not half so sure as the sudden world-destruction, one day about fifty centuries ago. Mr. Howorth, lawyer and M.P., in his new book, "The Mammoth and the Flood," says:—"Wherever we turn in the Temperate regions of the world we seem to be on the track of this great catastrophe, which swept away the greater part of an ancient fauna, and which especially destroyed the larger and more unwieldy animals, allowing the smaller ones alone to escape," according to Darwin, however, destroyed "animals large and small, from Patagonia to Behring Straits, and which forms a great dividing line in the recent biological history of Australia as well as of Europe, of Siberia as well as America. This vast effect seems from inexorable evidence to have been due to the exertion of some cataclysmic force by which the earth's crust was greatly disturbed, not merely locally, but over a large part of its surface." [No; I believe only locally.) "It was in consequence of this dislocation that the loose, watery envelope which covers a large portion of the world was set in motion, and sweeping over the land, drowned, and then buried deep in gravel, loam, and clay, hecatombs of living beings, a vast cemetery of life, causing a deluge apparently unparalleled in extent and completeness in any other geological period—a catastrophe which may well claim, therefore, to be spoken of as "the great flood."

Of course, for Humanity (Comte's "Grand Etre") it must be so spoken of; but I see no ground for thinking it "unparalleled in extent and completeness" during previous geology. But Mr. Howorth proceeds to say he has only in this volume treated one side of the evidence, the "archæological and palæontological," and that there is a purely geological side, on which he promises another volume. The present one quotes, on an average, some three or four good authorities on each of its 460 pages, often a dozen on one page.

By the way, on cometary encounters, the English edition of Guillemin, "The Heavens," edited and revised by Lockyer and Proctor, with numerous notes initialled by the latter, and four other FF.R.A.S., affords us this choice tissue of blunders. At the table of "Periodic Comets," p. 248, "aphelion" is for perihelion, and *vice versâ*. Then, at p. 260, "the mass of comets appears such a small fraction of the mass of the terrestrial globe, that the shock would be quite imperceptible." (Halley, by the way, in the *Phil. Trans.* 1724, seems to have, in treating this very subject, first brought us the French word "choc"; but our language being then still living, the spelling was soon made "shock." Now that it is dead and rotting, when we import *machine* or *depot*, we cannot spell them *masheen* or *deppo*, which will show "a Foreign student" or "Nepnesh" (Replies, p. 517, how the chaos of English arises). But Guillemin (after a note) is left to proceed, "The mass of Donati's comet has been valued by MM. Faye and Roche at about the seven-hundredth part of the bulk (!) of the Earth." (Meaning, of course, mass of the Earth.) "That is," says M. Faye, "the weight of a sea of 40,000 square miles, 100 yards deep," &c. Calling the earth's mean density 5, any schoolboy can reckon in five minutes, that it is the weight of much nearer a million than half a million such seas. **E. L. G.**

RETROGRESSION OF NIAGARA.



[27692.]—THIS tracing from Major Comstock's survey of 1875 admits the earlier and later forms of the Horseshoe Fall, that of 1860 from O. W. Gray's "Map of Niagara and Orleans Counties," and the last of T. Evershed, given in *Nature*, 1885, p. 229. The place given both falls in 1750 is from Kalm's description. We must remember that since his time, besides this lengthening of the gorge, its floor has been so deepened as to abolish his "series of lesser falls one under another." The British Museum has two drawings, dated 1765, by one of which it appears that those lesser falls had in 15 years so receded as to coalesce and form "*The Lesser Fall at Niagara*," apparently about 20ft. high. The other drawing shows the great pair, nearly as Kalm described, an irregular crescent divided about the middle by a narrow islet (no wider than "Luna"), and its title is, "View of the Great Fall at Niagara, 140ft. high and 800ft. over; July, 1765." Thus the whole pair then occupied no greater width than the narrower of the two does now, by the testimony of both Kalm and this draughtsman. A later view by G. Beck, engraved by T. Cartwright, and published in 1805, seems to show the water immediately above the falls isolating the dividing islet from Goat Island; but as this water is quite smooth, and a slight rapid only appears farther up, almost behind Goat Island, this G. Beck does not seem very trustworthy.

E. L. G.

SPARKING COIL.

[27693.]—WHILST making a sparking coil, we had an experience, particulars of which may interest some of your readers, who may have had a similar failure without being able to divine the cause.

The coil had been treated in the ordinary way with paraffin wax of low melting-point; to increase its bulk for a mechanical reason, it was cast in a mould with a harder wax. Previously the coil had given a very good result; but, after this treatment, it was with difficulty that any spark could be obtained. We are under the impression that the cooling and contraction of the wax in the interior of the coil, after the setting of the harder exterior wax, must have left the mass of the wax in the coil full of fissures, which undoubtedly must have been vacua, as no air could penetrate the already hard external coating.

To test the accuracy of the aforesaid hypothesis and, if possible, remedy the defect, we remelted and removed the whole of the harder wax. T spark after this was as good as at fi

We would remark that the same cause mi tract from the efficacy of a coil with wax density, if the exterior were allowed to har by rapid cooling.

As this difficulty might occur in other ap we would point out the necessity of cooli slowly where wax is used for insulating pu

L. S. M. Pyke,
Harry T. Barnet

London, N.W., July 26.

EYEPIECES.

[27694.]—YOUR talented contributor, "F. in a recent number of the "E.M.," named more capable of giving a practical descrip certain eyepieces than himself. He mus me to dispute that statement. Meanwhile, described several of the forms used, wit proportions, and the purposes for which t adapted.

Figs. 1 and 2 are simply single lenses, rarely used now for the telescope, owing chromatic and spherical aberration due form, whether a concave (Fig. 1) or convex be used.

Field and opera-glasses still retain the lens as an eyepiece, either in its simple made compound. The simple bi-conv (Fig. 2) is a poor instrument when compar the combination which follows. F
and dead

workshops of brass finishers and mathematical instrument makers are the places to look for a solution of this problem.

One Deeply Interested.

PATENT PIPES.

[27701.]—A CORRESPONDENCE took place in the columns of the ENGLISH MECHANIC some months since on the merits of Col. Ross's patent pipe, and I was so much impressed with the theoretical reasons advanced by Col. Ross that I forthwith procured one. It certainly was until recently the sweetest pipe I ever smoked, the only objection I had to it was the frequent necessity for cleansing the sponge—a dirty process.

Some weeks since I was presented with a pipe which combines the advantages of Col. Ross's without its disagreeables. In appearance it is an ordinary straight-stemmed briar, with a bone mouthpiece; the bore of the stem is extra large, about $\frac{3}{16}$ diameter, and fitting into it there is a long cylinder of iron wire net; on this the volatile oils condense, so that not a drop reaches the mouth. After smoking for a few days, if I find the smoke getting strong in taste, I remove the wire cylinder and burn it perfectly clean in the flame of a spirit lamp or candle, and it is quite sweet again. The invention is so simple and so efficacious that I am sure many of "ours" will be glad to know of it. I only regret I cannot tell them where the pipe can be procured. **Doctor Medicinæ.**

MEASUREMENT OF MAGNIFYING POWER OF MICRO-OBJECTIVES.

[27702.]—WITH reference to this subject, I have to thank "Antares" (27544, p. 418), Mr. F. J. George (27544, p. 437), and "Gamma Sigma" (27560, p. 437) for replies. These thanks I have much pleasure in tendering, and I hope the two last-named gentlemen will not think me either ungrateful or stupid if I express the opinion that they have failed to realise the position—the position at least as *I* see it, and as I *wished* to clearly state it. My desire is to construct a table of the magnifications of my different objectives and eyepieces, and by this I mean, not the magnification as shown by an image projected by a camera on to the drawing-paper at a *fixed* distance of 10in. from the eye-lens, but the *actual* magnification of the image viewed by me in the focus of the eyepiece, whether the result of the 2in. o.g. and No. 1 ocular, or the $\frac{1}{10}$ and the No. 4. Take these two supposed combinations, and how unreasonable it would appear to be that, if the orthodox 10in. be correct for the first, it would be equally so for the second when (taking my own instrument) the distance between the object in focus and the eye-lens in the first instance, is 13in., and, in the second, $11\frac{1}{2}$in., the ocular being, of course, in each case pushed home. Mr. George (27559, p. 437) says: If I "reckon my 10in. from back lens of objective to the plane side of eye-lens of ocular, I shall not get *far wrong*" (the italics are mine). Exactly; and I quite believe my existing table, which I prepared some years ago, is not *very* far wrong; but it has occurred to me for a long time that anything short of absolute accuracy connected with the modern microscope is unworthy of an instrument which is regarded by those experienced in its use as identified with accuracy itself.

Coming now to the reply of "Antares" (27544, p. 418), he refers me to a communication by him on the subject in the "E.M." for May 26th, 1882, and for this reference "Antares" has my best thanks. I had not the number in question; but have procured it (first having it sent me, on loan, by a distant friend, who saw, and was interested in, the subject), and I can only say my 27482 would not have been written had I known that such an exposition was in existence. That the writer is thoroughly master of his subject is evident, and I consider myself unfortunate in not being able to turn to the succeeding letters of comment and inquiry which such a masterly paper was sure to have elicited. That being the case, I am going to ask "Antares," with your kind permission, to enlighten me on one or two points which his letter does not make quite clear—this want of clearness arising from my ignorance of matters which a writer like "Antares" would assume (unconsciously) must be clear to all, because so clear to himself.

1. He tells us that an alteration in the length of draw-tube of 1in. causes a change in the magnifying power of a $1\frac{1}{2}$in. o.g. of 0·7 times. Will "Antares" furnish the rule by which this is arrived at?

2. "The magnifying power of a $\frac{1}{4}$ is altered seven times by a change of 1in. in the draw-tube"; here, of course, the same rule would apply, and its application to these two instances would make the thing clear. In my way I should say that theoretically a $\frac{1}{4}$ at 10in. would magnify 80, and at 12in. 96, and this accords nearly enough with "Antares's" 100, but if the decrease in the power of the lens is in the ratio of the shortening of the tube, then the reduction of an inch of tube would involve a loss of 8 diameters in power, whereas we are told it is 7. I give this as an instance of the want of clearness to which I referred.

3. My instrnment is evidently the same size as that used by "Antares" (my body-tube measures $9\frac{1}{2}$in. from the top—the eyepiece removed—to the bottom of nose-piece), and, therefore, his suggestion that 12in. should be taken instead of 10in. as the fixed distance for measurements, and as more nearly corresponding with the distance between the conjugate foci, I can quite appreciate; and here I would ask, would he suggest that in making a table of magnifications from 2in. to $\frac{1}{20}$, I should in each case have a distance of 12in. between the stage micrometer in focus and the focus of the eye-lens?

4. If the difference in magnifying power per inch of draw tube is not to be worked out by a rule which he can furnish, will "Antares" kindly supply the information in the case of lenses of 2in., 1in., $\frac{1}{2}$in., $\frac{1}{4}$in., $\frac{1}{6}$in., $\frac{1}{10}$in., and $\frac{1}{20}$in. for, singularly enough, the only lens he uses in the examples he adduces in his table, which I possess, is the $\frac{1}{4}$in.

I hope I shall not be considered trespassing too far upon "Antares'" good nature, and upon space in the "E. M.," and I also hope if I am asking questions that appear simple, that our friend, in his kindness, will let me down gently.

Exeter. **F. R. Brokenshire.**

SCORPIONS.

[27703.]—I INCLOSE a cutting from my last Indian newspaper. I doubt if any collection in the whole world possesses a specimen of such formidable proportions; however, age diminished the virulence of their sting, and the creature's looks were far worse than his offensive powers, as with all crawling pests when past their prime.

"The *Deccan Times* says that, as one of the mechanics engaged at a scene of a recent accident on the Nizam's State Railway was in the act of adjusting some tackle, he perceived on one of the ropes, close to his hand, a huge black scorpion. It measured 11in. from the antennæ to the tip of the tail, and at its thickest part $5\frac{1}{2}$in. in circumference. It must have been of great age, for before it was killed it moved sluggishly, as old scorpions do."

Death frequently results from the violent inflammation following the puncture, a raging fever attended by agonising heat of the blood—truly a feeling of boiling oil flowing through the veins—tortures the victim for many hours, or until death, unless a proper remedy be promptly applied. Be it known that Ipecacuanha powder, moistened and administered as a poultice to the wound, acts like a charm very rapidly. I have heard of the scorpion's soft inside parts being pounded into a paste and used by the natives as an effective application. There are three or four species of scorpion in Asia and Africa, all more or less venomous. I am glad to say they have their natural enemies, the lizards, domestic poultry and peacocks of India seem to relish their occasional *bonne bouche*, while in Africa, troops of the large black babboon may be seen turning over the stones in quest of their dainty morsel. I should like to have heard Darwin's explanation of this curious habit—an acquired protective one, probably—as the whole monkey tribes do the same with the vermin they search for and capture on each other's bodies. I have often clipped off the horny point of a scorpion's weapon with a pair of scissors; thus I was enabled to handle him and watch his vicious manœuvres. The weather affects scorpions considerably. In cold, rainy times I have pulled one roughly out of my great coat pocket with a naked hand, yet was not stung. An obscure creeping weed was brought to my notice by a native, having the power of rendering the enemy harmless. The leaves were rubbed and bruised in the man's hand, then a large active specimen was caught and placed there, instantly he threw his long tail over his body, turned to escape, and then became instantly stupid. **Eos.**

PARASITES OF INSECTS.

[27704.]—THAT insects have their parasites is well known; but it may happen that many among your readers would like to see some for themselves. A few days since, examining one of the common house-flies, I found it infested with parasites. To-day—being Bank Holiday, and having, therefore, more leisure—I put a considerable series of them to the test, and found scarcely one without them, many having half a dozen, and one with at least a score.

The operation is very simple. The lid of an ordinary microscope live-cage is popped over a fly on the window-pane, a piece of card or paper slipped underneath, and our victim is thus very easily transferred to the live-cage without the slightest injury. It is illegal to torture him, so I beg my readers to beware of informers. I only use the word "victim" because, almost without exception, he has lately been found to be one. He must be arranged on his back—for I have only found the parasite on the under-side of the thorax, between the bases of the legs—and the glass pressed down just enough to prevent him from turning over. The most convenient objective is a $\frac{4}{10}$in.; but a 1in. will do very well. He is, of course, treated as an opaque object, and illuminated by sunlight for choice; but failing that, by diffused daylight, or a table-lamp and condenser.

The parasite that I have found in such numbers is an *acarus*, or itch-mite, very similar to the cheese or food-mite, but with flatter and wider legs and much shorter hairs. He stops *in situ* quietly enough if the fly is not squeezed too tight between the glasses, but displays an extraordinary amount of vitality if disturbed at his meals.

I had such an accident with the fly that had so many of these visitors, and as I had unfortunately injured the fly, I thought I would try to save the visitors. They were quite visible to the naked eye, but so lively that I was somewhat puzzled how to set about catching them. It struck me that if I took a piece of black paper, and described upon it a sort of magic circle with glycerine, it would puzzle them to escape if I could get them there once. I did get half-a-dozen within the charmed circle, and had a spot of glycerine on a slip ready to receive them. To my astonishment, they skedaddled across the wall of glycerine as though it was *terra-firma*—or firmer. I managed to catch a few with a bristle tipped with glycerine, and got them on the slip safe, I thought, for mounting, but before I could get the cover-glass on, most of them had given me the slip and got away.

As you see, I do not pretend to any profound scientific or much practical knowledge on the subject, but found it most interesting to the youngest members of my family, as well as of sound educational and religious value. Every insect that comes in our way is as carefully examined as possible, and released if not noxious. The circulation in the smallest spider is quite easily seen in its legs, while in the insects the trachea can often be traced, as well as the movements of the dorsal vessel which does duty for a heart.

I think it would interest many besides myself if some of "ours" who have more experience than myself would write about it, familiarly as far as possible, but giving scientific data where necessary. I will, therefore, add that while the fly is under examination, it is a favourable opportunity for seeing the pads or suckers on each foot, as also the mechanism of the tongue, so utterly different to the mounted specimens. The two lobes are seen to be kept folded flat face to face, to be very fleshy, and only expanded for sucking. Also may be seen very clearly on either side the rudiments of the second pair of wings to which every insect is entitled if he requires them; and here I would remark that I have observed an organ of marvellous beauty which I have not seen described. It is, of course, better seen in the blowfly. The white, semi-transparent knob is at the end of a stem or stalk. Near the base of this stalk is a cylindrical stem, with beautiful transverse markings, and this, when the fly is dissected, is found to be connected to a spherical knob of chitinous matter still more beautifully marked with transverse lines, between which are rows of lighter-coloured dots of perfect symmetry. **George Smith.**

26, Colebrooke-row, N., August 2nd.

ERRATA.—In letter 27652, 3rd paragraph, "11''" should be "11th"; 4th paragraph, "ρ a little S." should be "*p.* a little S."; 8th paragraph, "ρ" is printed for "*p.*" again; and last paragraph but one, "9'' and 8''" should be "9in. and 8in."—E. HOLMES.

The "Ab Intra" Bootmaking System.—A new system of bootmaking has been perfected by Mr. M. L. Lion and Mr. F. Cutlan, in which the method of securing the soles, uppers, and insoles together is the exact reverse of the ordinary wholesale system. In the "Ab Intra" system the tacks are deftly put into the insole by a handy machine, the flat heads of the nails being flush with the surface of the insole and towards the wearer's feet. The insole is then placed on the last with the points upwards, and the upper is pulled over them and made fast by means of a hollow tool, with which the operator presses down the leather over the point of each nail. The sole is then placed over the protruding points of the nails and hammered down, a few smart blows serving to secure the sole to the upper and insole. So perfectly are the three united that it requires tools and great force to separate them. The secret of this great cohesive power lies in the form of the nail, which has a shoulder near its point and in section resembles an open harpoon. Hence, when driven into leather, the latter closes over the shoulder of the nail and defies all but the most severe efforts to extract it. After the sole has been secured the boot is finished in the usual way, the time occupied in fixing the sole being about half that required in the ordinary machine-boot process.

pyrus on *pyrus*, or if this be not done the graft dies, whilst the stock may send out new shoots and flourish again. Our modern English has, no doubt, been the result of natural selection and survival of the fittest, and the Keltic element which runs through the whole of it is a guarantee of its nobility, and—humanly speaking—of its imperishability. I have had my say—and more than ever I intended—on this subject, and now I am going away for a month's holiday, where I may not be able to see the ENGLISH MECHANIC, and if "E. L. G." or "Reymond" are not satisfied with the position I have taken up, I shall be very pleased, if they will advertise their addresses, to communicate with them upon the subject, as I think it is a matter in which the majority of "ours" have little interest, unless, indeed, Mr. Editor is willing to allow this discussion—which does not bear on the original query—to proceed.—E. S. H.

[62741.]—**Cameras without Lenses.**—Surely the merest tiro in optics ought to know that it is impossible to obtain a "sharp" picture by the use of a pinhole instead of a lens, and that the smaller the scale of the picture the less indistinct will be the outlines. With a good lens each point in the object is represented by a "pencil of rays" brought apparently to a point by the lens; but with a pinhole each point of the object is represented by the thick end of the pencil: the further off from the pinhole the thicker will be the "splodge."—GAMMA SIGMA.

[62753.]—**Deafness.**—TO "EOS."—In writing on this subject, "Eos" says: "Medical electricity has achieved many remarkable triumphs over the aurists." I am particularly interested in deafness, and would be very much obliged to "Eos" if he will kindly say where I can find any information on the treatment of deafness by electricity. A list of works on the subject will much oblige.—DULNESS.

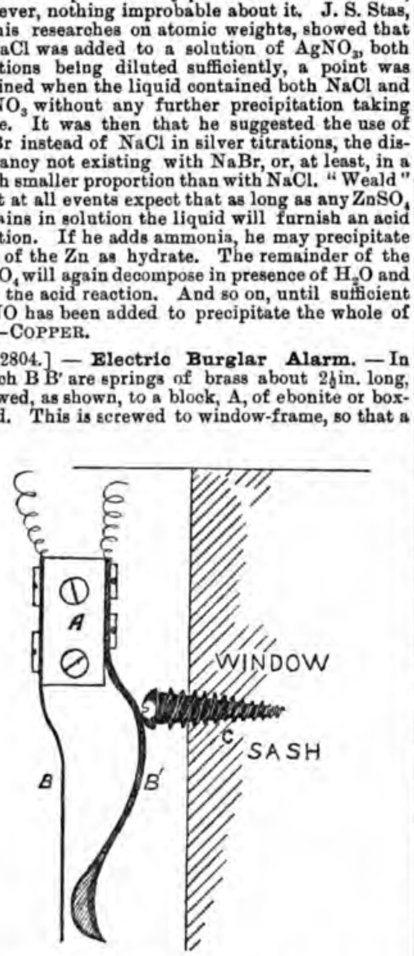
[62766.]—**Miners' Tools and Smithwork.**—I daresay that under the circumstances as described by "Silke" (see page 518) such a hammer may be useful. By the way, I have never written that iron or steel is to be hammered away at after it goes black. This necessitates so many reheatings as to account for so few smiths doing the material justice. Working solely with charcoal is a great benefit to iron and steel, repeated heats being beneficial in such a case. Memo. as to tempering cast steel more especially: Never dip into cold water; make it lukewarm if the dipping tub be not already so. Avoid as far as possible varying diameters in the part to be cooled, and don't allow any junction of varying diameters to end in a sharp corner; round it off. A piece of iron or steel, if attempted to be straightened cold the first thing in the early morn, is almost certain to fly. He will, I think, find that anvils are usually loose upon the central stud, and do not bed firmly upon their four prongs, as a smith likes to hear his peculiar harmony.—A., Liverpool, July 27th.

[62773.]—**Sundial.**—In planning his structure, p. 518, "W. J. R." forgets that, in summer and winter, the sun's declination reaches 23½°. His cross will be of no use in either December or June, unless about thrice the depth, perpendicular to Fig. 2, that he draws it. In fact, to have any shadow available at 9 and 3 o'clock in those months he requires a depth = tan. 24° × *af*, or say nearly half *af*. And if he gives this depth, and then equal width to each arm (so that their end faces may be squares, as now drawn), he will find a stone cross serving throughout the year look sturdier, and decidedly more elegant than this of his, only useful in March and September (at least through no other whole month, I think). I will send, next week, what Mr. Doyle mentions. In any other material than stone the form of Fig. 2, p. 518, would be stout enough, and look very well; but the depth still has to be made about half of *af*, or the shadows of those edges will not be long enough to fall, one on the other, at 9 or 3 o'clock on the solstitial seasons.—E. L. G.

[62797.]—**Filling Worn Brasses with White Metal.**—It is a practical method; but I should say it would be best to remove brasses altogether, and cast the bearings solely in white metal. To proceed, take two pieces of board any size, and cut out a half-circle same radius as shaft; then fasten narrow strips of wood about ¼in. thick on one side of board, allowing about ½in. from hole to form flange; then put one piece of board on either side of pedestal, fitting close up to it and also to the shaft, with the strips of wood inside. Putty up between pedestal and board, so as to prevent any possible escape of metal. Then proceed to melt metal and run in. If you want a cap, lay a strip of iron about ⅛in. thick on top of bearing, turn the boards upside down, putty up, and run in metal. In the shop in which I work most of the bearings are made in this way, and do some good work too. We have both bearings of the flywheel of a 7H.P. engine, which weighs about 15cwt., and running at 150 revolutions per minute, which have been in constant use about six years without recasting; and also all grindstone bearings, several of which weigh upwards of 1½ ton, and no boring or fitting required.—T. TIDMAN.

[62800.]—**Neutral Solution.**—"Weald" need not be surprised at not being able to obtain a solution of $ZnSO_4$ which will not give an acid reaction. Sulphate of zinc, like some other salts, always gives an acid dissolution. Chevreul and Berthelot had noticed and investigated this phenomenon in the case of salts formed by the weaker acids. They came to the conclusion that water had a decomposing action on the salts dissolved. A basic salt was formed, and some of the constituent acid would be found in the liquid, and traced by means of litmus paper. Berthelot, however (*Comptes Rendus* t. LXXVII.), in his celebrated researches on thermo-chemistry, though fully admitting the fact in the case of weak acids, refuses to do so where acids such as H_2SO_4 and the strong mineral acids are concerned. A. Würtz, however, expresses his opinion that water has the same action in the case of strong acids, and facts seem to bear him out. When Na_2SO_4 is dissolved in water, for example, a trace of NaHO, and a trace of $NaHSO_4$, or of H_2SO_4 should be found in the liquid. This, however, has not been experimentally proved so far. There is, however, nothing improbable about it. J. S. Stas, in his researches on atomic weights, showed that if NaCl was added to a solution of $AgNO_3$, both solutions being diluted sufficiently, a point was attained when the liquid contained both NaCl and $AgNO_3$ without any further precipitation taking place. It was then that he suggested the use of NaBr instead of NaCl in silver titrations, the discrepancy not existing with NaBr, or, at least, in a much smaller proportion than with NaCl. "Weald" must at all events expect that as long as any $ZnSO_4$ remains in solution the liquid will furnish an acid reaction. If he adds ammonia, he may precipitate part of the Zn as hydrate. The remainder of the $ZnSO_4$ will again decompose in presence of H_2O and give the acid reaction. And so on, until sufficient H_4NO has been added to precipitate the whole of Zn.—COPPER.

[62804.] — **Electric Burglar Alarm.** — In sketch B B' are springs of brass about 2½in. long, screwed, as shown, to a block, A, of ebonite or boxwood. This is screwed to window-frame, so that a round-headed screw, C, in the window-sash presses springs together as window is moved up or down. A switch is required to prevent bell ringing during day.—W. PERREN MAYCOCK.

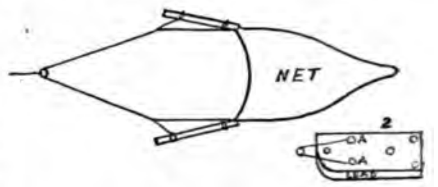


[62809.]—**Partial Paralysis from Knee Downwards.**—Medical electricity does wonders in such cases. How did it originate? What is your age and calling? Go to a professional electrician of repute; by looking into "Medical Directory" you can find one. If you cannot afford the fees, let me hear further particulars, and I will put you in the way of self-treatment.—EOS.

[62816.]—**Electric Bell.**—As you say, it must be owing to dryness of the earth; still, if your earth-plates are sufficiently deep there should be no lack of moisture. A water or gas-pipe connection could hardly fail you in this respect. For small currents, pure water is practically an insulator, unless you have a large surface of metal contact, which is not the case when you dip in the ends of two wires.—W. PERREN MAYCOCK.

[62816.]—**Electric Bell.**—Pure water is estimated to offer three million times the resistance of copper to the passage of the electric current. It is well known that an imperfect conductor can compensate for its defective state of conduction by increase of volume. Take, for instance, iron and copper. Iron offers seven times the resistance of copper to the passage of current; but by proportionally increasing the size of the iron wire, a current of electricity will be transmitted through it as readily as through the better conducting metal. In the same manner, by bringing into conducting action a large body of interposed moist earth, the electricity which would not pass through a small quantity is transmitted without any apparent resistance when a large sectional area is included between the plates buried in the earth. If you sink your plates deeper in the earth, where it keeps moist, you will not be troubled by the bell stopping.—W. F. C. WARD.

[62820.]—**Trawl Net.**—Make the boards, or "otters," as they are called, 2ft. by 1ft. by 1in. thick; shoe them with thick keel of lead; round off front bottom corner; bore holes, and place rope slings so that the boards may travel at an angle of 30° from right-ahead line; have a long bridle—the longer the better—put small corks on head rope, and lead ferrules on foot rope. The way you show of rigging boards would not do at all. I found boards of beech do well, as they are heavy. The sling can be attached to boards, as shown in 1, or at A A, as shown in 2.—AEI.



[62820.]—**Trawl Net.**—"Rolando's" sketch is a rough representation of an otter-trawl. The size he speaks of, 9ft., is very small. A 20ft. sailing-boat of any power would tow a trawl from 15ft. to 25ft. across the mouth. The mouth of the net is kept open by corks on the head rope, and the foot rope is kept down by pieces of sheet lead wrapped round it at intervals. The tow-rope is connected with the otter-boards by two ropes called spans. These have an eye in each end, one being attached to the bridle of the otters, and the other joined to the tow-rope by a shackle. Each span should be half as many fathoms in length as there are feet in the mouth of the net—that is, if the mouth is 20ft. wide, each span should be 10 fathoms long. Beware of using new rope for the spans, or, if this is necessary, all the turns should be well taken out of it, or the two spans will lay up together, and give endless trouble. The otter-boards are weighted with iron on their lower edge, and, if the water is deep, extra lead plates are screwed on. The otter-boards are slung by a bridle, like the belly-band of a kite. This makes them sheer outwards as they are hauled through the water, and thus keep the net open. The size of the mesh should not be less than 1¾in. from knot to knot. An otter trawl is a most handy and efficient net; but it requires careful adjustment of the weights, &c., to make it work satisfactorily.—FAL.

[62820.] — **Trawl Net.** — The arrangement referred to by "Rolando" is called an "otter trawl," from the similarity of the boards used to that of the "otter" used in fly-fishing. To each side of a bag net like that used with the beam trawl there is added a piece of net about 3ft. deep and 10ft. to 30ft. long, according to towing power available. These pieces form wings or prolongations of the sides of the bag, and their lower edges are in a line with the bottom or "breast" of the bag, along which and the wings is fastened a leaded breast rope of about 1in. to 1½in. circumference. Similarly along the upper edge of wings and bag there is a lighter rope with casts strung on it. The ends of these ropes are fixed respectively to the bottom and top of the otter boards, which are stoutly made of some heavy wood, and shod on the bottom with sledge-shaped irons. For attaching the hauling gear each board has four holes, one in each corner. The ends of a stout bit of inch rope are fastened in the two forward holes, and the ends of a somewhat longer piece to the two after holes. The bight of the after strap is then passed through that of the forward one, and a lashing or hitch put on so as to keep all the four parts attached to the board at the proper length, and the whole art and mystery of otter trawling depends largely on the proper setting of these straps. The action of the water on the boards is like that of the wind on a kite, and they must be so set that when drawn through the water they will be driven apart so as to spread the net, and downwards to help to keep it on the bottom, and if when the net is out the bridles are seen to be close together instead of separated like a thin letter Y, or if one of the boards be observed foaming along on the surface astern, there is probably something wrong in the lengths of the straps. Each board is attached by the straps to about 20 or 30 fathoms of bridle, and the ends of the bridles to a warp. The length of bridles and warp should be at least four times the depth of the water. I have one 40ft. otter trawl with boards about 22in. by 14in., and 1¼in. bridles suitable for an open sail-boat, and one 60ft., with boards about 36 by 20, for use with a more powerful craft. They have both brought up many a good haul of soles, plaice, &c. The otter trawl is, however, not so efficient, I think, as the beam trawl, particularly in deep water. I have never been quite satisfied with its performance in water over 10 fathoms. The speed for towing a trawl which I find best is about two knots an hour, or less. It is scarcely necessary to add that the net when fishing does not actually scrape more than perhaps half its total width as it hangs in a bight astern of the boards.—J. Brown, Belfast.

[62827.]—**Violin Soundpost**—Ought to be about ⅛in. behind foot of bridge on side opposite to that where the bass bar is (under E string). It is a solid post, and is never glued in position. See that it stands vertically.—Copper.

[62827.]—**Violin Soundpost.**—Just by way of additional information to the excellent advice given by various correspondents, on p. 520, I may say that the querist can purchase a soundpost setter (price 1s.) from any respectable music shop. He will find this a very useful article for adjusting the soundpost. I do not consider it necessary to use any glue.—G. Fryer.

[62832.]—**Bending Zinc Tubes**—Has "A Tinman" tried filling his tubes first with melted rosin? I have often seen tubes bent in that way, in the case of iron and brass, and it does the work well, even with very thin sheet-metal. Sand gives good results, but is not as reliable. Be sure your tubes are strongly soldered, and do not make the rosin too hot. I daresay this plan will succeed with zinc as it does with other metals. I would advise "Tinman" to do the bending while the metal is still warm. The best temperature is between 130° and 150° Centigrade. Keep in mind, however, that at 205° zinc becomes very brittle. You will, of course, not be able to attain 205° if you use rosin, which melts at 135° Centigrade. With sand, if you can plug the tubes at both ends, you will have the best chance. I should try rosin, and bend as soon as thoroughly set.—Copper.

[62835.]—**Telephone Switch.**—You do not mention what form of telephone you have; still, I presume it has some kind of call-bell. It is an easy matter to arrange a light wire trigger, so that the movement of the call-bell hammer shall release trigger, and so complete an ordinary bell circuit in your bedroom.—W. Perren Maycock.

[62837.]—**Current Break.** — Presuming that the hammer-spring is firmly fixed to its support, there must be a dirty or loose connection in your circuit—very likely a wire broken, and shifting about in the silk or G.P. covering.—W. Perren Maycock.

[62846.]—**Zeuner's Slide-Valve Diagram.**—This is a graphic method of determining the various elements of a slide-valve, such as lap, lead, angle of eccentric, &c. Zeuner has published a book on the subject, which has, I believe, been translated into every language. I know there is an English translation, but do not remember name of publisher. My copy is French. Zeuner's work requires a certain amount of mathematical knowledge, as he makes use of mathematics all through. Shall be pleased to give any more information if required.—Copper.

[62849.]—**Test for Arsenic.**—1. Boil a small quantity of the suspected paper with 50cc. of water acidulated with 10cc. of pure hydrochloric acid. In a small beaker place 40cc. of water and 10cc. hydrochloric acid; boil this mixture with clean copper foil; if the copper foil remains clean and bright it may be taken for granted that the materials are pure. Now add about 20cc. of the above solution, and boil for about half an hour; if arsenic is present it will be precipitated on the foil in the shape of a steel-grey coating of metallic arsenic. The copper may be dried and heated in a small tube, when the arsenic will sublime in a steel-coloured ring. 2. Pass sulphuretted hydrogen through a portion of the above solution; if arsenic is present it will give a yellow precipitate of arsenious sulphide, soluble in ammonium and potassium hydrates.—Principia.

[62849.]—**Test for Arsenic.**—I do not think that there is any simple test for arsenic, as that metalloid is generally found in relatively small quantities, and requires in consequence careful manipulation to be detected. The only reliable way is to use Marsh's apparatus. This, of course, supposes the operator to be accustomed to analytical work. If such is the case, he can refer to any treatise on analytical chemistry, such as Fresenius. There is also a method used in blow-pipe assaying, and which consists in fusing the suspected substance with a mixture of Na_2CO_3 and KCN in a little tube closed at one end. This would answer with paper very well, an arsenical mirror being formed in cool part of tube. This method was improved by R. Fresenius and S. V. Babo, and is altogether trustworthy as modified by them. Quarter of a milligramme of arsenic sulphide will give a distinct reaction. It has given me excellent results. If paper to be tried contains a good proportion of arsenic, burning it will give a strong smell of garlic.—Copper.

[62849.] —**Test for Arsenic.** — The following from Watts's "Dictionary" may be useful: it is Bettendorff's test. When a solution of stannous chloride in fuming hydrochloric acid is added to a solution of arsenious or arsenic oxide in the same acid, a brown precipitate is formed, which, after proper washing and drying, consists of metallic arsenic mixed with a small quantity of stannic oxide. In an aqueous solution of arsenious or arsenic acid, stannous chloride produces no precipitate; but on adding strong hydrochloric acid till the liquid fumes slightly, precipitation takes place. Arseniferous hydrochloric acid of specific gravity 1·182 to 1·135 gives an immediate precipitate; the same diluted to specific gravity 1·100 no precipitation takes place. From this it may be inferred that the reaction occurs only between stannous chloride and arsenious chloride; further, that in a solution of arsenious acid in hydrochloric acid of specific gravity 1·115 part of the arsenic is present as chloride, but that hydrochloric acid of specific gravity 1·100 dissolves arsenious acid as such, without converting it into chloride. The reaction above described is extremely delicate and capable of detecting one part of arsenic in a million parts of solution. On antimony compounds stannous chloride exerts no reducing action, even after prolonged heating; hence, the above-described reaction may be used to detect arsenic in antimony compounds, the solution having been previously saturated with hydrochloric acid. Another useful application of the same reaction is to the preparation of hydrochloric acid free from arsenic: 412 grammes of specific gravity 1·164 were mixed with a fuming solution of stannous chloride, the precipitate separated by filtration, and after twenty-four hours the hydrochloric acid distilled, the receiver being changed after the first tenth had passed over, and the remainder distilled nearly to dryness. The acid thus obtained gave not the slightest indications of arsenic, either by Marsh's test or by precipitation with hydrogen sulphide. In testing for arsenic acid with silver nitrate, the delicacy of the reaction is impaired by the solubility of silver arsenate, not only in free nitric acid and free ammonia, but also in ammonia nitrate. According to C. Avery (*Sill. Am. J.* [2] xlviii. 25), the reaction is greatly facilitated by adding to the solution of arsenic acid in nitric acid a few drops of a strong solution of an alkaline acetate, and then a drop or two of ammoniacal silver nitrate. Another very good mode of testing is to drop the nitric acid solution of arsenic on recently-prepared silver carbonate, the red silver arsenate then showing itself very conspicuous on the white ground. Metallic arsenic and arsenious acid are easily oxidised by a mixture of potassium chlorate and nitric acid to arsenic acid, which may then be estimated as ammonio-magnesian arsenate.—A. G. H.

[62850.]—**Tar Pavement.**—In reply to "I. A. O. G." an excellent pathway has been made within the last year in my immediate neighbourhood thus. Original pathways were of very common dark greyish loose gravel; these had a kerbstone laid with an elevation of 5 or 6in. above the existing paths they were raked tolerably smooth, then had about 4in. of shingle which would pass through a 1in. ring put on, having been been previously put into boiling tar and well stirred; these were taken hot out of the cauldron and at once laid down as evenly as possible by hand and left exposed for two or three days. Then more tar was boiled, and finer shingle that would pass through a ½in. mesh were stirred in and put on the coarser ones previously laid down and left for a day; finally some powdered shell was dusted on the top and immediately a tolerably heavy roller was run several times over it until it presented a perfectly smooth surface. The paths have continued in splendid condition ever since.—Gamma Sigma.

[62853.]—**Siamese Temples and Lightning.**—I have not been in Siam; I only know that interesting and rather enlightened people from books. You will meet with several modern accounts at the London libraries. The Siamese being Buddhists, I should think their tall temple spires are of the incurved cone form, a favourite style of ornament with other Indo-Chinese races. I mean a very sharp cone, with a long narrow segment of a circle removed from the base line upwards; the fashionable hat of Burmese nobles, male and female alike, is of this shape. Although the above lofty structures are surmounted by copper balls, coated with sheet gold, I never saw damage by lightning.—Eos.

[62857.]—**Solution for Batteries.**—There is no known excitant so good as dilute sulphuric acid, and no depolariser better than chromic acid, up to [illegible] and for the purpose you require. No other would give you anything like 2 volts per cell. To get the same E.M.F. with any other less corrosive or "cleaner or cheaper solution," you would need at least twice the number of cells.—S. Bottone.

[62857.]—**Solution for Batteries.**—It will be difficult to find a solution that will keep a battery driving a motor at a uniform speed for nine or ten hours at a stretch. Chromic and sulphuric acids are the best that could be commended. Fuller's cell might suit; but it is far from being cheap, and its solution is no cleaner than any of the others. So far as the clean solution is concerned, it may be said that they are all dirty.—Bobadil.

[62857.]—**Polishing Pebbles.**—Here are a few hints which may be useful, and if the querist should happen to be at the seaside this autumn, he can see the work done. The apparatus which the lapidaries, who abound at every seaside town, use for cutting and polishing pebbles, is usually of the roughest kind. The tools required are—a lathe of the most simple description, a piece of sheet iron or tin plate about 4in. in diameter, rounded and fitted to the lathe like a circular saw, a tool like a butcher's steel, with a square point tempered hard, a slab of Bath stone (flag), and a small piece of Water-of-Ayr stone. The circular plate dips into a trough containing a mixture of emery, quartz, sand, and water. With it the pebbles may be readily sawn into slices. The slices must then be affixed to a wooden face-plate by means of a cement composed of resin, shellac, and Venice turpentine. You will thus be enabled to turn them to the required shape. They are polished by rubbing on a flag of Bath stone with a little fine emery. This will make them pretty smooth. To get a fine polish rub them in the same manner, using putty-powder instead of emery, or you may rub with the Water-of-Ayr stone. To give the operator a command of the stone he is polishing it is usual to fix it to the centre of a flat piece of wood about 2ft. long, with the cement before mentioned. The stone must be kept wet while it is being operated upon. Many of the pebbles found on the seashore contain fossil remains, which are brought out in a striking manner by polishing; and as the substance in which the fossils are imbedded is frequently semi-transparent, the pebbles may be dried and used as photographic negatives.—W. J.

[62859.]—**Heating Water.**—Of course the "given temperature" must not be much above 200°. It is purely a question of quantity to be heated in a given time, and depends greatly on the circulation in the pipes. Try ¼ square foot of pipe surface to cubic foot of water.—T. C., Bristol.

[62859.]—**Heating Water.**—The surface of pipe required would depend on the time in which you required to raise the water in tank to a certain temperature, the initial temperature of water in tank, and the temperature of atmosphere if tank was not well lagged, and amount of water in tank. As long as the heat transmitted from the pipe to water in tank were greater than the loss by radiation from the tank, the temperature of water in tank would continue to rise. When you have found the amount of heat required to be transmitted in a certain time, to raise temperature of water to the required point, you can find the surface necessary to transmit that amount of heat in the time.

q = thermal units of heat transmitted per hour per square feet heating surface
a = a constant = 160 to 200
t^1 = temperature of water in pipes
t^2 = temperature of water in tank

$$q = \frac{(t^1 - t^2)^2}{a}$$

But t^2 would gradually rise. If you work out the result for every 5° rise of temperature, the result will be close enough for all requirements.—Elag.

[62861.]—**Chloride of Calcium Crystals.**—This salt is extremely soluble in water. To obtain pure crystals it must be borne in mind that a concentrated solution of $CaCl_2$ dissolves appreciable quantities of CaH_2O_2; make sure, by adding HCl till litmus paper just gives an acid reaction, that such is not the case. Grimshaw (*Chemical News*, table XXX.) describes this combination of $CaCl_2$, and gives the formula as $O\,\frac{CaOH}{CaCl} + 7H_2O$. I mention this fact because the marble you have dissolved may contain iron; in that case, it is necessary to put a small quantity of CaH_2O_2 (slaked lime) in the solution. This will precipitate any Fe_2Cl_6 which may exist in solution; but a small quantity of CaH_2O_2 will also be taken up, and must be transferred, as above, into $CaCl_2$. The liquid is now evaporated very considerably, and set aside to cool; large crystals will form if this evaporation has been carried on far enough. They correspond to the formula $CaCl_2 + 6H_2O$; they are extremely deliquescent, and you will find some difficulty in keeping them. I would be inclined to doubt that it could be done otherwise than by putting the crystals in sealed glass tubes. Chloride of calcium can be dissolved in alcohol; this liquid at 80° Centigrade will dissolve 70 per cent. of its weight. The liquid evaporated yields crystals which contain 59 per cent. of alcohol, the alcohol taking the place of water of crystallisation; at 29½° C. water dissolves 50·67 parts of $CaCl_2$. There is one point on which it is necessary to draw your attention: there is a crystalline form of $CaCl_2$ which only retains 4 molecules of water. It is produced from sursaturated solutions of the salt only. According to Lefevre 350 grammes of $CaCl_2 + 6H_2O$ (crystallised) are to be dissolved in 50 c.c. of water at 40° C. After cooling, the solution will yield crystals if a small crystal of $CaCl_2 + 6H_2O$ is dropped into it; without this addition the crystallisation will not take place. In your experiments you may have produced a sursaturated solution, and this would account for your failing to obtain crystals. The crystals of $CaCl_2 + 4H_2O$ are in the shape of large plates, while $CaCl_2 + 6H_2O$ are rhombic.—COPPER.

[62864.]—**Face-Plate.**—Make a mark on face-plate half the travel of surfacing-slide from centre. Now bring the slide back and fix a scriber or sharp-pointed tool in rest, and bring scriber and mark just to touch nearest to you. Now turn spindle half round and travel rest across to mark, and adjust until mark and scriber coincide.—T. C., Bristol.

[62866.]—**Hydrochloric Acid.**—I do not believe that there is any commercial way of producing HCl otherwise than by converting NaCl into Na_2SO_4 by means of H_2SO_4. It is perhaps a by-product still in England; but on the Continent, where Solway's ammonia process has come into force for manufacturing Na_2CO_3, it is getting scarce. In fact, it has been going up in price, in Belgium notedly. Does it not strike the querist that the production of a solution of Cl in water and its subsequent treatment by electricity would make HCl a rather expensive chemical. It can be bought actually in Belgium, delivered at works, for under £1 per ton. Three years ago I bought large quantities for 15s. per ton delivered.—COPPER.

[62866.]—**Hydrochloric Acid.**—To manufacture this without its being a by-product is easy enough, without having recourse to such an expensive method of electric combination. Whether any but a madman would attempt to prepare this commercially as a direct product, when it is one of the cheapest of waste productions, is another question. Annexed are a few of the methods by which hydrochloric acid (HCl) and its solution may be obtained directly: 1st. By the action of daylight on a mixture of equal volumes hydrogen and chlorine. 2nd. By the action of sulphuric acid on common salt, aided by heat. 3rd. By exposing a solution of chlorine in water to sunlight.—S. BOTTONE.

[62867.]—**Troublesome Zinc Rod.**—The white substance is probably zinc oxychloride.—PRINCIPIA.

[62867.]—**Troublesome Zinc Rod.**—This query should have been headed "How to make a mess in a battery." The magnesia has been liberated by the action of the zinc and cakes round the zinc. To avoid it, throw away the existing solution, and make up a fresh solution. If you think the solution is acid, and requires neutralising, do so by immersing in it a few strips of zinc until no more are dissolved.—S. BOTTONE.

[62872.]—**Oil Gas.**—A few printer's mistakes have crept into this query, which kindly allow me to correct. It is meant that the *total* production of coal gas from the two furnaces or six retorts would be the quantity stated per 12 hours, and not from each. The saving upon 500 lights should read 800-10ths (pence). or 6s. 8d. per day. For "does not go as far in the way of illuming" read "does not go as far *as* in the way of illuminating."—MARIENBERG.

[62873.]—**Leyden Jar and Fulminating Pane.**—There is no fault either in coil or jar, under the circumstances, as described. When a coil is worked in connection with a jar, the charge which the jar receives is at once discharged through the coil. This is why no trace of electricity is found afterwards in the jar. There is but little increase in the length of a spark from a jar charged from a coil. The sparks are seen to be thick and bushy. The same remarks apply to the fulminating pane.—BOBADIL.

[62873.]—**Leyden Jar and Fulminating Pane.**—I send in this week an article on condensers, which will probably appear in our next issue, in which a full account of all that is necessary to secure good results is given. I may point out that to charge a Leyden jar by the coil the jar must be insulated; one of the electrodes of the coil being attached to the knob of the jar, the other some little distance from the outside of the coating of the jar. The jar can be insulated by standing it on a sheet of good ebonite. To charge a fulminating pane, this latter should stand upright on an ebonite foot, one electrode be placed in contact with one coating, and the other electrode placed about ¼in. off. The pane will soon charge and "flash" over. —S. BOTTONE.

[62873.]—**Leyden Jar and Fulminating Pane.**—I should have said that there was a crack or small hole in your jar; but as you have made them "of all sizes," I suppose this cannot have been the cause of failure. It is not particularly easy in practice to charge a jar with an induction coil; you want a regular *frictional* electrical machine, which would soon charge the jar. Positive electricity goes into the knob, and repels positive from the outside; therefore the *outside* tinfoil must be in connection with the earth—don't forget that. I never found any difficulty in making them, so I expect you will require a machine, not a coil. The same applies to the fulminating pane, which you have all right, as far as construction goes. I presume you know that the *glass* of both jar and pane must be scrupulously clean and dry, *hot* if possible.—R. A. R. BENNETT.

[62874.]—**Medical Electricity.**—Here is what Dr. Garratt says in his book on the relative value of batteries:—"Daniell's is now so improved that it is the most permanent and even-working battery known, and for medical purposes is invaluable, particularly for the so-called *constant galvanic current*." Again he says: "Some thirty to fifty of these cups connected consecutively form a battery sufficiently powerful for any remedial purposes, and yet, if well managed, will run for half a year in good working order without replenishing, except with water." As this was written 20 years ago, you will probably meet with some more portable and equally efficient appliance at the electrical instrument makers.—EOS.

[62874.]—**Medical Electricity.**—TO MR. BOTTONE AND "EOS."—It is perfectly possible to build a Daniell battery that shall serve well as a medical battery, and give a large current of low tension and great constancy. To this end will be needed at least 24 quart cells. If these be connected in two sets of 12 in series, an E.M.F. of about 12 volts will result, and this will be sufficient to send a current through the skin, if moistened. At Dr. Caplin's we used to employ 12 cells of the Walker type (two platinised graphites, 8in. by 6in., and one zinc, excited by dilute sulphuric acid, 1 to 10 of water). These gave a very good current for an hour at a time, and recovered a considerable portion of their power if the plates were withdrawn from the solution for a few minutes. The Leclanché type does not do: it "runs down" in about 15 minutes.—S. BOTTONE.

[62875.]—**Painting Furniture.**—These lines are drawn with what are called fine liners—that is, brushes known as fine liners. Sable is best. Take the brush with your forefinger and thumb, the other three fingers bearing to the edge of the mark you have to do. Commencing at the distance you wish the lines to be in from the edge, draw the brush backwards, gauging the distance with your hand. When you refill the brush and start again, let your brush drop a little way back on the old line; but do not let it drop all at once, but have it on the move, otherwise you will have a fat line just there. Make your lining colours to dry quickly. Some use them in distemper, as it is termed. If you are about to try, have a brush handle 4ft. or 5ft. long, paint it, and then draw some fine lines up through it (straight, of course), gauging it with your fingers. When you can accomplish this well, you can try your hand on furniture. Draw the lines quickly.—J. C.

[62876.]—**Induction Coil.**—The advantage obtained by dividing the secondary into sections is more through insulation of the secondary. In a coil without sections the greatest difference of potential is between the inside and the outside layers, the poles coming from them. In this arrangement it is almost impossible to have thorough insulation. The greatest care is needed to keep the electricity of the inmost layer of wire from leaping into the primary coil, and even though this is done there is a Leyden jar action between the inmost layer of the secondary and the outmost layer of the primary coil. To get over this defect sections are employed. The length of spark obtainable from a coil with Dyer's quantity of wire is about ¾in.—BOBADIL.

[62876.]—**Induction Coil (Sections in).**—The advantage in having vertical sections in an induction coil is that by that mode of construction, those portions of the secondary wire which find themselves in the most exalted and contrary electrical conditions are just those which are farthest apart, and best insulated from each other. A coil consisting of the quantities and gauges of wire mentioned in yours of last week would give, if properly fitted with condenser, a spark about ¼in. long, when excited by a single-cell bichromate or chromic-acid battery, exposing about 16sq.in. of negative surface. I must point out that "Dyer" in his last edition of his work on "Intensity Coils" says 6oz. of No. 38, and not 32.—S. BOTTONE.

[62877.]—**Faulty Electric Bell.**—The salt which forms on the battery terminals is copper oxychloride (Brunswick green). When copper is digested in a solution of ammonium chloride (sal ammoniac), or hydrochloric acid, and is exposed to the air, it forms the above salt. It is caused by "creeping" salts getting at the brass, and so corroding it. Coat the carbon or zinc with a layer of paraffin wax just below terminal.—PRINCIPIA.

[62877.]—**Faulty Electric Bell.**—The blue substance on the binding screws is caused by the battery solution creeping up the zinc or carbon and destroying the connection. This is a frequent source of trouble. The querist does not say which battery he uses, but he might try thoroughly cleaning the faulty screws, giving the head of the carbon a good coat of Brunswick black, or steeping it in melting paraffin wax. If the zinc be a rod, Brunswick black it about the end near its binding screw; if a cylinder, all round the top edge.—BOBADIL.

[62878.]—**Dynamo.**—TO MR. BOTTONE.—Wire on armature 5 to 6lb. No. 16, wire on F.M. 20lb. No. 20 in series, the whole in shunt with the brushes; pulley about 3½in. diameter, speed from 1,600 to 2,400 per minute, according to goodness and softness of iron, &c.—S. BOTTONE.

[62881.]—**Marine Engines.**—You will find the information required in "The Practical Engineer's Handbook," by Hutton, published by C. Lockwood and Co., London, which is, without doubt, the best handbook for general engineers as well as marine engineers. It is crammed full of reliable practical information, of a sort seldom found in books, about mill-engines, locomotive and marine engines, and other engineering work. —ALBERT POWELL.

[62882.]—**Niaudet's Battery.**—A plate of zinc is placed in a solution containing 24 per cent. of common salt in water. The carbon plate stands in a porous cell packed with fragments of carbon and chloride of lime. Initial E.M.F. about 1·65 volt, which falls to 1·5 volt. The resistance of the common form is 5 ohms per cell; hence the current on the short circuit ⅓ of an ampère. Action only goes on when the circuit is closed, and lasts for several months if used intermittently. The cells must be hermetically sealed with pitch or marine glue.—S. BOTTONE.

[62882.]—**Niaudet's Battery.**—Cazin ("Traité Théorique des Piles Electriques) gives a very high character to this battery. It seems by his account to keep its strength well. I take the following statements from his work, and hope they may be useful to querist:—Freshly-charged E.M.F. is 1·6 volt; after several months open circuit, 1·5 volt. This battery polarises to a certain extent, and the E.M.F. of polarisation may attain ⅕th of the total E.M.F. The battery recovers, however, very rapidly its power if set at rest. An element working on a circuit having a resistance of 1 ohm had lost 18 per cent. of its E.M.F. after 40 minutes. After a rest of 40 minutes 7 per cent. was regained, and at the expiration of two hours the E.M.F. was the same as before starting.—COPPER.

[62884.]—**Musty Butter.**—Melt the butter in a water-bath with animal charcoal, coarsely powdered and well sifted from dust; skim, remove, and strain through flannel; then salt.—W. A.

[62884.]—**Musty Butter.**—"B. E." might try squeezing the butter through a strainer and allowing it to fall into water, where it may be washed in its finely-divided state with solution of boracic acid; but if it has a really musty taste, I question if anything will improve it. When butter becomes rancid, it may be improved by treating with strainer as above described, and putting soda bicarb. in the water, which takes up the free fatty acids that cause the rancidity. I have lately seen strainers somewhat like large lemon-squeezers, that would be very suitable for the purpose.—DOCTOR MEDICINÆ.

[62886.]—**Flux.**—I remember reading that silicon was necessary to make the iron fluid enough. I think I saw it in *Engineering* some months since. —T. C., Bristol.

[62886.]—**Flux.**—Dr. Percy says that wrought iron is not fusible, except at temperatures rarely attainable in furnaces. The experience of every ironworker corroborates the statement of Dr. Percy; but the querist wants a flux to make melted wrought iron more liquid (!), and says it is possible. I am afraid "Troughener" has made some mistake.—NUN. DOR.

[62886.]—**Flux.**—Has "Troughener" tried fluorspar ($CaFl_2$)? It is a very powerful flux. I am afraid, however, that he will find some difficulty in getting wrought iron sufficiently fluid to run into moulds. Büchner ("Lehrbuch der Unorganischen Chemie") gives the following process, of which I translate the description:—"Wire is cut up into small pieces, mixed with Fe_2O_3, and placed in a Hessian crucible. A covering of green glass is placed on the mixture, and the lid of the crucible luted on. The crucible is then subjected to the greatest heat obtainable in a Selfström gas blast furnace. The oxygen of Fe_2O_3 burns the carbon in wire, and the oxide in excess dissolves in the glass. It is possible to produce ingots of

[62926.]—**Mechanical Diesinking.**—In a letter in *Times* of 25th July Mr. Poynter, in commenting on the deficiencies of the new coinage, says: "Surely they have at the Mint machinery by which faithful reproductions of Mr. Boehm's relief could have been made; this is a point on which modern mechanical skill has left us no difficulties." A short description of such machine or reference to book, &c., giving a full account of it, or especially where in London it could be seen, would greatly oblige writer, who has last eight vols., but can find nothing suitable for above contained therein.—W. M.

[62927.]—**Tank Locomotives.**—Can any reader give particulars of the following?—G.N.: 116, 122, 241, 274, 513, 523, 622, 695. G.W.: 5, 1401, 615, 464, 455, 977, 1447, 628, 333, 222, 520, 1163, 1478, 538, 845, 1834, 545, 568, 830, 841. I should also like to know the numbers of all the engines which belong to the same classes as the above. —V. J.B.

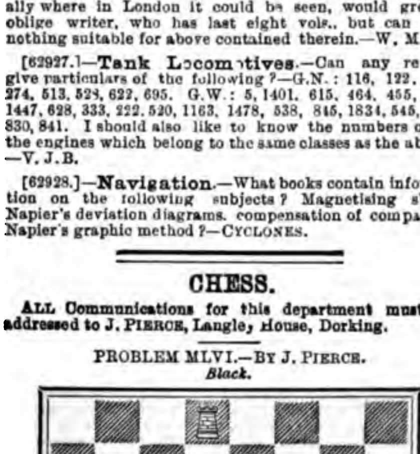
[62928.]—**Navigation.**—What books contain information on the following subjects? Magnetising ships, Napier's deviation diagrams, compensation of compasses, Napier's graphic method?—CYCLONES.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MLVI.—BY J. PIERCE.

Black.



White. [7 + 5

White to play and mate in three moves.

SOLUTION TO 1,054.

White.	*Black.*
1. Q-Kt 5.	1. B takes Q (*a*).
2. P-Q 4 (ch)	2. P takes P (*e.p.*)
3. R mates	
	(*a*) 1. Kt (Kt 3) B 5 (*b*)
2. Q takes P (ch), &c.	
	(*b*) 1. P-K 6 (*c*)
2. R-R 4, &c.	
	(*c*) 1. P-R 6 (*d*)
2. Q takes Kt (Kt 3), &c.	
	(*d*) 1. Any other
2. Q-Kt 2, &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,052 by H. Hosey-Davis, Hensing, and G. A. A. Walker; to 1053 by H. Hosey-Davis and G. A. A. Walker.

OTHELLO.—Name entered for new Tourney. As soon as ever we have twelve competitors tourney will begin; at present there are four only. As the prizes are valuable, and there is no entrance fee, unless there are at least twelve entries within a fortnight the offer will be withdrawn.

A. DEAN.—Name entered. We have considered your proposal on previous occasion, and we think more is to be said against than for it.

H. F. L. M.—Many thanks for B. O. P. and for notice.

A. DEAN.—We think in your attempt at 1054 you have overlooked the force of the defence 1 $\frac{\quad}{\text{B-B 5.}}$ How does white then proceed?

HENSING.—Thanks for problem. Always glad to hear from you.

OUT of the eight competitors who obtained full marks in Tourney B, six have still obtained full marks in the further competition in problems of three and four moves. We have considered, therefore, as they have all done so well, that they are all deserving of the first prize, which has now been awarded to each. We append their names: T. H. Billington, I. M. Brown, E. G. Cooper, H. Hosey-Davis, T. L. Robins, and G. A. A. Walker.

We beg to draw attention to a three-move solution Tourney, a two-move solution Tourney, and a problem Tourney about to be started by the *Sheffield Independent*. Prizes to the value of £25 are to be competed for. Full particulars may be obtained by applying to the Chess Editor, 9, Victoria-terrace, Clontarf, Dublin.

Electric and Magnetic Apparatus.—Messrs. King, Mendham, and Co., of Bristol, have issued a new price list of the electric and magnetic apparatus manufactured by them, in which prices have been reduced where possible. Intended mainly for the use of the trade and shippers, this catalogue of 140 pages will be useful to the student and the amateur, as it contains lists of parts of apparatus required for the making up of experimental appliances, and also a complete catalogue of useful works on electricity and magnetism.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,025.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: Nos. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 3, and unacknowledged elsewhere:—

W. G. PENNY.—J. Alexander.—A. Snowdon.—Rosario.—H. J. W.—Nomoplast.—Cassell and Co., Ltd.—C. Harley. W. R. Girlington.—East Coast.—Fred George.—G. T. Pardoe.—E. D. H. P.—T. Richardson.—Bona-Fide.—J. T. —One in a Fix.—A Fellow of the Royal Astronomical Society.—S. Bottone.

ANXIOUS MUSICIAN. (In some cases suitable stops are indicated, especially in educational works; but as a rule the selection is left to the taste of the organist. For the rest of your queries, we must really refer you to one of the cheap "tutors," and the back volumes for illustrations of the parts referred to. "Gemshorn" means "goat's horn," "chamois horn," and is a 4ft. stop of metal. "Salicional" is from the Latin "salicetum," a "place planted with willows," which are thin, and is a small scale metal stop. "Bourdon" is French for "drone," and it is usually applied to stopped pipes of wood, having the 16ft. tone. "Diapason" is Greek for "through all." It is of 8ft. tone, and is the chief stop in the organ.)—CONCERTINA. (It is omitted because it is desired to keep down the number of notes, and the A can be more usefully spared from such instruments than other notes.)—CYCLONES. (Very well; the query will be inserted.)—S. H. (We answered you in this column not long ago. A good depilatory is made by mixing three parts of sulphide of sodium in crystals with ten parts of powdered quicklime and ten parts of starch, made into a paste with water. A strong solution of sulphide of barium made into a paste with starch powder and applied at once is also effective. No depilatory is really effective unless it destroys the roots, and that is done nowadays by passing a minute electric spark through the root of each hair, which takes time. A rougher but equally effective method is to pull the hairs out, and that is done by means of ordinary pitch plasters.)—A BUGLER. (We know nothing about them. Why not inquire of those possessing them? If they are made, no doubt they are also sold.)—A MUSICAL. (See a reply on page 492. There are some directions for making dulcimers on p. 97, No. 914.)—C. T. R. (Why not look up the subject in recent volumes? You might possibly find that your simplified arrangement for screw-cutting is old; but at any rate, as you have been advised to patent it, you can obtain protection nowadays for a little more than a sovereign, which will extend over ten months, and in that time you will be able to ascertain whether there is anything in your invention or not. You can hardly expect us to use our space in order to instruct you as to what is required.)—CHAS. READER. (We believe we have given all the processes to which you refer—one of them on p. 433, so recently as July 8. See p. 432, last volume, and the indices generally. You must make your own estimate as to cost.)—CARLOS. (The degree of B.Sc. is given only by Glasgow, Edinburgh, and London, and you will find full particulars in the respective "calendars" of those universities. A "university" education is not necessary—something more is required. There is much information in back volumes.)—PRIMROSE. (We have frequently given the information, which, moreover, you could obtain first-hand by inquiry at the Mercantile Marine Office in Dublin, where examinations are held on the first Monday in each month, which answers your second question. The answer to the first question depends on your acquirements. A candidate for a marine engineer's certificate must have served three years in an engineers' shop on the actual making or repairing of engines, and also one year at sea in the engine-room; or as an alternative to the three years' shop practice, he must have served at least four years at sea. You will understand from that the reason we do not answer your other questions, but refer you to Reed's "Engineer's Handbook," T. Reed and Co., Sunderland, for all information about examination papers, &c.)—AL FARD. (You may probably find the information required in "Weather Warnings for Watchers," published by Houlston and Sons, or in back volumes.) —FROZEN AND BAKED. (We are not aware that the idea has been mooted in this country, and a reference to the letter of our correspondent will show that the subject was brought up in connection with a meeting of the Illinois State Architects' Institution. There is the Willesden Paper Co. here, and no doubt other firms are ready to supply paper of the kind required—to order.) —TIMBRE. (We suspect that plans and details will have to be purchased of those who are prepared to supply them. They are scarcely likely to give this prospective trade away into the hands of other builders. 2. It is an American paper, and must no doubt be subscribed for annually. We do not recollect the price.)—T. S. MIDDLETON. (You have only to get so many people (say, seven) to put their names down for shares, and then register the company; but in such matters you should obtain the services of those who understand the intricacies of the subject, or, at all events, procure the Acts governing them.)—XENIA. (From the deputy-master of the Mint, we suppose; but we understand that they have all been withdrawn. 2. No "inexpensive" book on the subject. J. G. Wood's "Insects at Home," 10s. 6d., Longmans, will perhaps suit you.)—CH. HUNTER. (Read Sprague's "Electricity," and any of the manuals on electric-lighting, as well as your back volumes.)—A. W. (It will no doubt be published in the *Journal* of the Society; but we presume you are aware that he has already described the method in our columns.)—W. A. W. (Seidlitz powders are usually made up as follows:—In the blue paper, Potassio-tartrate of soda (Rochelle salt) 2 drachms, bicarbonate of soda 40gr.; in the white paper, 35gr. of tartaric acid. They certainly have a different effect to soda-water, for as a rule that is nothing but water aërated with carbonic-acid gas.)—BOTANIC BEER. (See indices. You seem to have discovered what others have found out, that fermented drinks of the kind will not keep without the addition of alcohol.)—A AMATEUR. (You will find details of such contrivances in almost any back volume, in recent numbers, and perhaps in this.)—A. T. L. (You can procure such lenses from almost any of those firms who advertise lenses or optical work in our columns.)—J. M. (The plaster is poured into the mould in a rather thin state, and the mould is then rotated until the plaster sets.)—SPEED. (Query altogether unsuitable, and against the rules. You can see a variety of such machines at any of the large printers' brokers.)—H. WALKER. (Very likely two would be sufficient if well-polished reflectors were used. There is no better oil than paraffin for the purpose, and the circular wicks with the button in the flame give the whitest light.)—GWALIA. (You will find directions for making gelatino-bromide plates in No. 1025, and other methods in back volumes.)

A New Washable Truss.—An Important Invention.—Harness Xylonite Truss is the most perfect appliance ever invented. It gives complete comfort and support without irritation. It has a beautifully smooth, flesh-coloured surface, and is guaranteed to last a lifetime.—Address: MEDICAL BATTERY COMPANY (Limited), 52 OXFORD STREET, LONDON, W.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.).

Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XI., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

Advertisements must reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, AUGUST 12, 1887.

MICROSCOPICAL ADVANCES.—XXII.

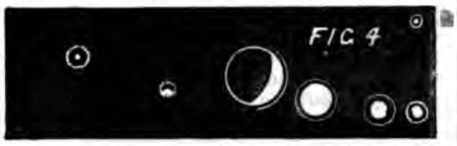
By Dr. Royston-Pigott, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians; Fell. Cambridge Phil. Society; formerly Fellow of St. Peter's College, Cambridge.

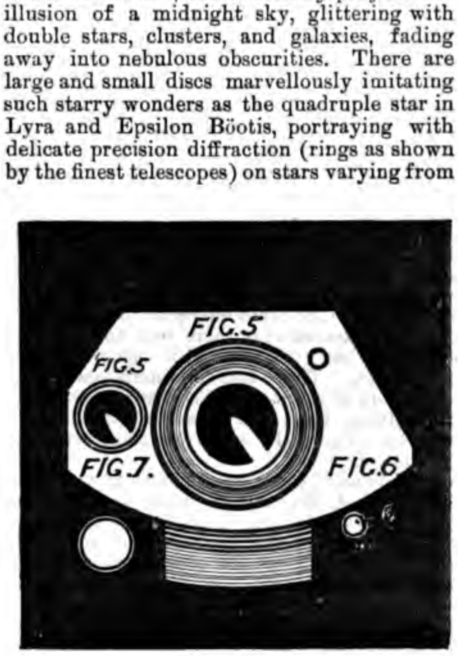
Diffraction Ancient and Modern.

Destruction of Mercurial Spurious Discs and the Apparition of a New Test Diffraction Ring of Light about One-Millionth of an Inch thick.

THE phenomena attending the minutest pure mercurial globules, vertically illuminated through the object-glass, are not easily exhausted. A very pretty one is a most delicate new-moon crescent (Fig. 3), where the lamp is moved sideways, the flame being broadside on. A full-moon disc can thus be attenuated almost indefinitely.

The experimenter should be forewarned that in using there globules mounted dry, there are four surfaces which are apt to reflect the lamp flame—two for the cover-glass and two for the slide. But the insinuation of oils causes brilliant star discs to shine upon an intensely black ground (Fig. 4). A little blue light occasionally used also below instantly renders the full globule visible upon a blue-black field, and admirably projects the illusion of a midnight sky, glittering with double stars, clusters, and galaxies, fading away into nebulous obscurities. There are large and small discs marvellously imitating such starry wonders as the quadruple star in Lyra and Epsilon Böotis, portraying with delicate precision diffraction (rings as shown by the finest telescopes) on stars varying from the 7th down to the 15th magnitudes; but fortunately free from those aërial difficulties—tremor, haze, and cloud, which waste sidereal nights.





The limbs of these discs, on the contrary, are perfectly true in outline, their appearance often planetary with minute attendants like companion stars, which heighten the interest of the mimic scene.

Attempting the estimation of some of these marvels of the minute, as I had just received from Mr. Browning my micrometer furnished with several new spider lines, I found their thickness were, in fractions of an inch—

No. 1 (coarse), No. 2 (medium), No. 3 (fine).
Diam. 1-5,000th, 1-8,000th, 1-10,000th.
No. 4 is also 1-8,000th. But as the eye-lens magnified exactly ten times, and the object-glass a hundred times at the focal plane in which they traversed,

No. 1 spider line represented 1-500,000th.
No. 2 showed the thickness of 1-800,000th.
No. 3 .... 1,000,000th.

The usual positive micrometer eyepiece was discarded, as spoiling the definition: a 1in. plano-convex was inserted for the eye-lens, and a 3in. plano-convex for the field-glass. The tube of the microscope was then lengthened to nearly 15in., until a 1-16th object-glass with this eyepiece magnified exactly 1,000 times.

My spider lines now represented magnitudes from the 2-1,000,000 to the 1-1,000,000, or 2𝔪 to 𝔪. Whilst the one hundred thousandth or 10𝔪 was represented by separating the spider lines ten divisions of the micrometer head.

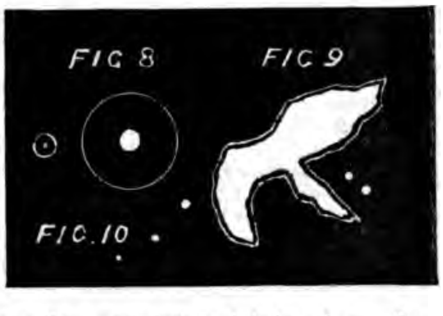
By this arrangement I had the ready means of forming estimates of magnitude. By means of these webs measurements were also attempted of some extremely delicate discs produced by contact surfaces. The ratio of the contact surface to the diameter seemed very nearly constant—viz., as nine to ten.

Suspended from the surface of the cover the drop is approximately spherical; but, lying upon a flat surface, it becomes somewhat ellipsoidal and flattened—a subject much investigated by my friend, Professor Bashforth. In every case the brilliant contact disc adherent to the cover is always less than the globule, and the ratio is sufficiently near for the purpose in hand—the definition of a sharp and most minute disc of light free from spurious diffraction enlargement.

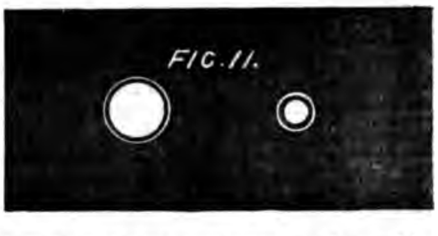
It would appear that whether these real discs are observed, or images in the spherical surface of free globules resting on the slide, or, indeed, both floating about in oil, both miniatures and realities are equally well seen. But this seems to be due to the peculiar conditions of illumination; the illuminating and defining rays are identical, excepting only in direction. This appears to reduce and almost extinguish diffraction: for a chief source of it is removed—the inflexion of light impinging upon sharp edges placed in the course of the rays. The instant full light is introduced below these very minute bodies they appear "drowned." If both downward and upward light be employed at once (the latter should be much more feeble), the minute central disc is observable, whilst the outline of the globule producing the image may be scarcely perceptible.

A common size of these mercurial objects was 1-20,000th. In these bodies, when the upper surface was free and *dry*, the image of the nose of the microscope and the illuminated front lens was very considerable, and about $\frac{1}{3}\delta$; but if the flame were presented broadside on, its image then filled the objective front lens. *Then could be seen the most absolutely minute black specks on the mercurial surface perfectly well defined.* So soon as a globule was found to touch the cover, a perfectly round disc was formed (Fig. 6); but outside this, and less than the globule, appeared again my extremely fine diffraction ring (if the glass were good enough), as fine, or I should say much finer, than my finest spider line, representing the millionth (𝔪), or *microscopical unit.** And there was this remarkable fact: that whether the disc was large or small, whether round, oval, or distorted by unequal pressure, the Test Ring was constantly the same in thickness, and followed the illuminated disc precisely in all its meanderings exactly at the same distance (Fig. 7), estimated at 1-100,000th. This fundamental fact was more beautifully demonstrated by turning on a little blue light from below, so as to exhibit the contour of the black-looking globule, upon which it shone as on black velvet with enhanced lustre and decision of form (Fig. 7). Every disc presented the same phenomenon, independent of its size.

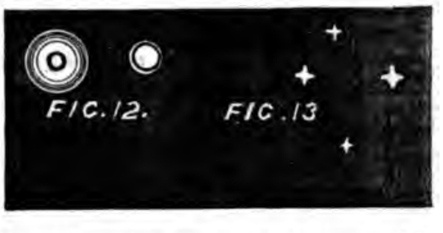
Since the brilliant test ring preserves the same appearance independently of the size of the mercurial mirror, most minute flattened globules display the same test ring, provided the illumination is sufficiently intense upon them and darkened below them. Immersed in oil, the globules which rest on the slide and do not make contact with the cover glass, present an optical image *which is always the one-eighth of the full diameter of the globule* (Fig. 8); consequently, if a globule is 1-120,000th of an inch, this image will nearly be a millionth in diameter; but they are all entirely robbed of their spurious diffraction discs.



Again, round specks of light can be plainly descried in globules of various sizes, which comparing them with the standard spider web, cannot be estimated at much larger than 1-500,000th of an inch.*



Accustomed observers of sparkling clusters can easily distinguish still more minute magnitudes. Many of these mercurial stars appear much more delicate than the celebrated Debilissima of Herschel in Lyra. Perhaps owing to the admixture of lead, the mercurial particles on being struck spurtled into coherent streaks with this surprising advantage: Very irregular or even elongated discs were compressed by the exuding paraffin or oil (as stated already) at the same time displaying the crucial fringe or diffraction test line of the most astonishing degree of attenuation.



A Powell and Lealand dry one-eighth of superb quality, using a C eyepiece and 12in. of tube, gave evidence that the minute circular *discs of flattened globules could not in*

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* My test ring disappears when light is transmitted below.

* Three independent observers have declared th be obviously less than the finest web—i.e., less th millionth of an inch.

any way be regarded as spurious. For on turning on a little blue light below, the true outline of, the whole metallic globule could be discovered, somewhat larger than the microscopic circular mirror, besides serving as before said, as a black background for more brightly defining the magnificenty thin diffraction Ring already described.

Until this experiment, I should have been (according to the received theory) quite indisposed to believe that such minutes discs of light could be thus at all defined (Fig. 10). In my solar experiments, with a miniatured sun I found the enlarged image of the solar disc above four times the theoretical size (*Phil. Tr.* ii. 1870), but here all is changed.

One circumstance is worthy of consideration: in illuminating the globules by using the object-glass as a condenser, the very same rays which are projected upon the particle are also reflected by it, and returned upwards as visual rays, and this circumstance favours the supreme sharpness of definition seen in dry globules, so minute as the 1,200,000ths, yet presenting images (one-third of that size) of the front lens illuminated downwards through the axis of the objective. In this case the spurious disc seems to have no existence. The larger discs look as clean as though punched out of metal (Fig. 11). It is a pretty experiment to watch the reduction of these artificial star discs to one-eighth their former size of star discs, by the insinuation of petroleum. The following are some of the measurements made by micrometer of dry globules exposed when freshly made under a glass cover.

	Dry Mercurial Globules. Full Size by Micror.		Size of Contact Discs.
	9·65	....	9·17
	10·45	....	9·45
	12·99	....	11·24
Mean	11·03	Mean	9·95

Difference 1·08.

The cover-contact disc was, therefore, nearly 9-10ths of the full diameter of the globule. But when the same kind of dry globule adheres to the slide only, and not to the cover—the image seen—that of the facet lens, was only one-third.[*]

It should be recollected that, in general, such starry clusters adhere both to the cover and slide, and are often produced by pressure of the cover. In this case, a nebulous glow indicates a substratum of other groups lying just below the upper focal plane, which at once appear on lowering the focus as part of the same cluster.

It is evident, in this case, that the upper discs are, then, upper contact discs, consisting of minute circular plane mirrors, whilst the lower are formed by minute images reflected by the approximately spherical free surfaces of the particles adhering to the slide in the lowest plane. And this fact appears to dispose of the objection to images and miniatures already alluded to, both orders, adherent discs and reflected points, appearing equally clear and bright.

The high power definition of these vertically illuminated spherules well repays attentive observations. Objectively illuminated, as described, the three fundamental characteristics of optical amplification are satisfactorily displayed.

1. Diffraction.
2. Spherical Aberration.
3. Chromatic compensation.

Diffraction.—At the best possible focus and correction of the glass transmitting brilliant converging light, *diffraction is very much reduced.* One ring only is seen, and any thickness and colour of this ring are unfavourable evidences of the objective's quality. The *whiteness* or orange-red colour of the discs themselves are also trustworthy signs of greater or less excellence.

If the glass be second-rate only, the edge of the disc is not sharp and clear, and it looks smoky, blurred, and planetary; whereas the most perfect glass shows it *flat*, clean, and vividly white, using a blue-glass chimney to neutralise the yellow rays of the paraffin lamp. And this pure disc suddenly and *similarly* vanishes out of sight, with an extremely slight change of focus either way. These sudden changes are tests also of the *spherical aberration* being cured.

A glass corrected in the most perfect manner develops *at the best focus* the finest diffraction ring—one only—surrounding the discs, which instantly vanishes focally, giving place to a blue spot on one side and a ruby spot on the other side of the focal plane of this test ring.

The most careful study of this wonderfully attenuated diffraction-fringe of light convinces me that it does not exceed in thickness the microscopic unit 𝔪 already mentioned.[*] In inferior glasses it may become as thick as 10 𝔪, or even more—with no certain outline—but shaded off and irregularly coloured, broken in patches, and distorted in form, and often totally invisible.

My experience of the best glasses is that the slightest over- or under-correction prevents the phenomenon of the alternation of the blue and ruby coloured spots in different focal planes, and instead thereof the white disc is seen dimly in a whitish halo, which contracts and destroys the disc with a particular change of focus; or, if the disc be small, transforms it into a cross, more or less coloured, and of course more or less minute.[†]

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE autumn meeting of the Institution of Mechanical Engineers was held last week at Edinburgh, under the presidency of Mr. E. H. Carbutt, a large and influential local committee, with the Marquis of Tweeddale as chairman, welcoming the members in the University Library. After the usual introductions and preliminaries, the members and their friends adjourned to the Natural History Lecture Theatre, where Mr. E. Malcolm Wood read his paper on the Forth Bridge, which led to a discussion on the effects of temperature and wind pressure. The total length of the Forth Bridge will be 8,300ft., or 380ft. over a mile and a half, and in its huge length there are two main spans of 1,700ft. each, two side spans of 675ft. each, and three intervening piers, while from the base of the deepest to the top of the cantilevers the total height is 450ft., or only 10ft. less than the great pyramid of Egypt. For a length of 500ft. in the centre of each of the main spans there is a clear headway of 150ft. above high water. The bridge, in addition to its own weight, is being constructed to support a load equivalent to one ton per foot run on each line of railway, and also to withstand a lateral wind-pressure of 56lb. per square foot of exposed surface both of train and structure. Ever since the commencement the work has progressed without interruption, and has gradually assumed the gigantic proportions of the present time. Over 3 000 hands have been employed continuously for the last year, and during the present summer months the number has been increased to 3,600.

Of main spans the estimated surface exposed to a point-blank wind amounts to a little more than 7½ acres. The pressure of 56lb. per square foot on its surface would therefore be equivalent to a total of more than 8,000 tons. Effects of temperature will be provided for in the rails, and at the junctions of the central girders with the cantilevers. The bearings on both the main piers and under the weighted ends of the cantilevers have provision made for allowing movements due to the change of temperature and to the elasticity of the cantilevers under lateral pressure. The maximum pressure on the base of the piers will be a little over 6 tons per square foot. Tubular members are used for compression, and open-braced box-forms for tension members. The President, commenting on the paper, said that until the members had seen the bridge they could hardly appreciate its magnitude. The span was four times that of the Menai-bridge, of which they were so immensely proud at one time. He was glad to see there were no unnecessary platforms about the structure, and, although great credit was due to Sir John Fowler and Mr. Baker for the design, they were still, he had no doubt, indebted to all the engineers on the staff for many details in the erection of this bridge. The Marquis of Tweeddale said he must express on the part of the company of which he was chairman the obligation that they were under to the Institution for giving him an opportunity of becoming better acquainted with the bridge than ever he had been before. They should, he thought, all be proud of this building, because it was a triumph of mechanical engineering. He said subsequently, in corroboration of another speaker, that bridges on this principle were known in the East—the wooden bridge over the Sutlej having a span of 200ft. In replying to questions, the author of the paper said that in the construction of the bridge expansion was fully provided for in the ratio of about 1in. to 100ft., or 18in. on the span. A year's record showed the variation caused by expansion to have been ½in. in 100ft. The highest wind-pressure yet registered by the large gauge was 35½lb. to the square foot.

The next paper was by Mr. Arrol, of Glasgow, one of the contractors, and described the machine tools and ingenious devices for carrying out the work, which were shown by diagrams. Mr. Arrol was highly complimented by many of those present, and in reply to questions stated that the speed of drilling was mainly governed by the speed of travel of the driving-ropes; but Mr. Barrow, who had previously taken notes, said that, as a general rule, holes 1in. in diameter can be drilled 1in. deep in one minute. Mr. Arrol stated that ropes running at 1,500 to 1,600ft. per minute could be trusted to last for two years; and with regard to the power required in riveting, that varied with circumstances, and amongst other things a good deal depended on the heat of the rivet. It required more power to close steel than iron rivets. He always allowed the former a machine an inch bigger than the latter. For instance, a 9in. machine would do for iron rivets, but steel rivets of the same size required a 10in. machine. They used ordinary furnaces mostly, but for some positions they had crude oil heating apparatus. In answer to the objection as to the leather in the hydraulic apparatus, he could only echo the remark of the shoemaker, and say there was nothing like it. They had tried metallic packing without success. They had accumulators for each section of the work. They were mostly of the ordinary type, but steam accumulators had been adopted in some positions with great success.

The third paper on the first day was that by Mr. F. J. Rowan, of Glasgow, on "Electro-Magnetic Machine Tools," in which electro-magnets and the current are employed for riveting, drilling, and other work in parts not easily accessible. An electric motor, for instance, drives a gearing and cam which lifts a hammer against a spring, and appliances for drilling holes are readily devised. Caulking and chipping have also been accomplished by electro-magnetic tools. Replying to the suggestion that in the case of ship work there would be risk of magnetising the vessel, Mr. Rowan pointed out that the effect would occur only on certain parts, and there would be so many of them that they would tend to neutralise one another. The discussion on this paper being concluded, the members proceeded by special train to Newhalls, and there dividing into sections proceeded respectively to the workshops, and by steamer to view the three great cantilever piers of the bridge. The parties having changed places, the members returned to Edinburgh, and proceeded to discuss the annual dinner. On the second day the first paper was descriptive of the "Electric Light on the Isle of May," some details of which will be found on p. 370 of the last volume. The author, Mr. David A. Stevenson, believes that it is the most powerful light in the world, and, in concluding the paper, said that surprise has frequently been expressed by masters of vessels and by residents on the neighbouring shores who live in view of the Isle of May light, that this light, which is so extremely brilliant in clear weather as to cast shadows at a distance of ten and fifteen miles, is so cut down by fog that some even go the length of believing the old oil-light was better in fog. That, it need hardly be said, is a mistake, inasmuch as the electric arc has been proved both by experiment in natural and artificial fog, and also by observations on existing lighthouses lighted by electricity, to be, in all circumstances of weather, the most penetrating. Every night at 12 o'clock the lightkeepers at St. Abb's Head, twenty-two miles distant, where there is a first-order flashing light, and one of the most powerful oil lights in the service, observe the Isle of May light, while the keepers there also observe the St. Abb's Head light. The result of the last five months' observations is that the Isle of May light is seen one-third oftener from St. Abb's Head than the St. Abb's Head light is seen from the Isle of May. It is perfectly true, however, that the superiority which is so apparent in clear and rainy weather is very much reduced in hazy weather, and practically disappears in very dense fog. Looking to this fact and to the large first cost and annual maintenance, the author feels that the conclusion arrived at by the Trinity House is sound—namely, that electricity should be used only for important landfall lights. If, however, the most powerful light is desired independently of cost, then the electric arc has no rival. An interesting discussion took place, mainly on the relative and comparative advantages of gas, oil, and electricity from the points of view of cost and utility to the mariner, but nothing novel was elicited. Mr. F. S. Kelsey's paper on the Tay Bridge was a suitable preparation for the visit which was paid to Dundee and the bridge on the third day of the meeting. A paper, by Mr. C. A. Stevenson, on the "Dredging of the Lower Estuary of the Clyde," dealt with purely technical matters; but in the course of the discussion, which referred chiefly to items of cost, Mr. Daniel Adamson, of Manchester, said that dredging was the cheapest mode of excavation known to mankind, and it was the method considered best fitted to do the excavating work of the Manchester Ship Canal. He thought it was a most encouraging thing that they had been able to do this kind of work so cheaply, and it was satisfactory to Scotland that so much was being done towards increasing the volume of the Clyde. This paper concluded the business of the meeting, that on the "Position and Prospect of Electricity as Applied to Engineering" being postponed to the January meeting in London. About two hundred of the members then paid a visit to the famous Carron Ironworks, and inspected first the stove-brick works, where the bricks produced in the works are manufactured from fireclay procured from the adjoining colliery. The Heavy Foundry, which is undergoing great modifications and enlargements, and where castings up to 30 tons are turned out, was next visited; and the party then proceeded to the blast furnaces. Two of the four furnaces have closed tops, and are fitted with regenerative hot-blast stoves, and have a weekly output of 220 tons, as against 180 tons produced from the two open-topped furnaces which work with pipe stoves. It was explained that, as the furnaces work on raw coal, the large surplus of gas in excess of that required for heating the blast to a temperature of 1,400° to 1,500° Fahr., and raising the steam for the blowing engines, is being utilised as fuel in other departments. Ultimately, no raw coal will be used in the works except that put into the blast furnaces, and with this object it is proposed shortly to blow in another furnace; but before doing so certain improvements are being carried out which, it is hoped, will still further reduce the cost of production, and yield a full supply of gas for all departments of the works. After inspecting the other portions of the works the party returned to Edinburgh, where, in the evening, the Lord Provost, magistrates, and council gave a conversazione, and Sir W. Thomson delivered a lecture on "Ship Waves." He first explained the series of waves—those of water, light, sound, and of earthquakes. Generally defined, he said, a wave was a progression through matter in a state of motion. The distinction between the progress of matter from one place to another and the progress of a wave from one place to another was well illustrated by the very smallest example of waves that we had—namely, waves of light. Of all the beautiful forms of water-waves—ship waves—with which they were concerned then—were perhaps the most beautiful. In mathematical science they possessed a special and intense interest, partly from the difficulty of the problem they constituted, and partly from the peculiar complexity of the circumstances concerned in the configuration which was seen. Sir W. Thomson went on to deal at length with canal waves, taking as a basis of his remarks the researches of Mr. Scott Russell in 1834, and therefore including the assumption that the water was, as a perfect fluid, absolutely free from viscosity. He called attention to the ordinary waves of a sea steamer, and pointed out that in a canal the same phenomena were observable, though in a much simpler form. In a canal the rear of the procession of waves travelled at half the speed of the boat if the water was very deep—that was to say, of a depth at least equal to the wave's length. In other words, the procession of waves lengthened backwards relatively to the boat, at half the speed of the boat. But this wonderful result was to be noted: If the motion of the boat was more rapid than the most rapid possible wave in the canal, it would not leave a procession of waves behind it at all. It would only make "humps" or "hillocks," and a crisis was approached in a tumultuous manner. Sir W. Thomson here quoted from Mr. Scott Russell to show that when the velocity of the boat became much increased there resulted a considerable reduction of the wave surge. Dealing next with sea ship waves, Sir W. Thomson explained that investigations were carried on by the Government into the various phenomena in order to bring the best scientific knowledge to bear on naval architecture; while on the Clyde the Messrs. Denny also conducted similar investigations. A ship, he said, could be designed to go at a certain speed, carrying a certain weight, and requiring a certain amount of horse-power of work done by the engine. He next explained by means of clay models and diagrams the nature of the calculations which were made. It was found, he pointed out, that the whole pattern of waves was mainly comprised between two lines drawn from the ship's bow. The law of wave-length was proportional to the square of the velocity, ten knots being equal to 56ft. of wave-length, and twenty-two knots to 272ft. of wave-length. Sir Wm. Thomson, in closing, said that when he was asked by the Council to give the lecture, he laid down the condition that no practical results were to be expected from it. He could not add one jot or one tittle to what others had already discovered. But he wished to make this suggestion—that inasmuch as wave resistance depended almost entirely on surface action, and inasmuch as a fish swimming close to the surface below the water met very little resistance, it seemed to him that by giving a great deal of body below the water-line we might diminish the wave resistance relatively very much, and thus get high speeds of from 18 to 20 knots. By swelling a ship out below the water-line, like the old French ships, there would be a large addition to the displacement, and a large addition to the burden-carrying power, with very little addition to the wave disturbance.

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[*] It is hardly necessary to observe that, as in astronomy, a darkened room and a shaded and rested eye are absolutely requisite for developing the minute star dust which may still be discovered in the field of the crushed mercury by careful manipulation.

[*] Indeed, to my eye, it appears thinner than my finest spider-line, which, with 1,000, represents 𝔪 or 1,000,000, as it does to three assistant observers, as already stated.

[†] This paper was written about eight years ago for the Royal Society, but circumstances prevented its presentation. The next papers will include "Researches on the Structure of Scales of Insects."

The concluding day was occupied entirely by excursions to various places of interest, including a visit to May Island and to Newcastle, where those who are mining as well as mechanical engineers had been invited by the North of England Institute of Mining and Mechanical Engineers to meet them in the exhibition buildings.

MAGNESIUM LIGHT FOR PHOTOGRAPHIC PURPOSES.

As most photographers know, the use of the magnesium light in photographic studios has been found a welcome and useful addition to the appliances at the disposal of the student, so useful, indeed, that Messrs. J. Gaedicke, of Berlin, and A. Miethe, of Potsdam, have thought it worth while to obtain a patent in this country for their improvements. According to them, experience proves that for momentary photographs, or pictures produced in the fraction of a second, the magnesium light is a valuable substitute for either the electric or day light; but for several reasons these advantages could not be turned to practical account. This may be explained by the fact that it has been the practice, hitherto, to burn the magnesium in lamps, in the form of thin ribbon or wire; but it was found to be a most difficult matter to determine the proper "exposure." Another difficulty arose in the burning of the wire itself, as neither the method above mentioned, of burning the wire in lamps, or of burning the same uncovered, proved suitable for employment in the atelier, for several reasons; amongst others, that the latter portion of the wire was not consumed rapidly enough, that the wire was with difficulty ignited; but more especially because the products of combustion were afterwards to be disposed of. The action of the dazzling rays of the magnesium light on the object was, however, a sufficient reason why the same was not employed for photographic purposes. The various improvements invented for the purpose of removing these difficulties have not attained the desired result. According to this invention the magnesium is no longer used in the form of a thin ribbon or wire, but as a fine powder, which is mixed in a certain proportion with materials which readily give off oxygen, and also simultaneously mixed or amalgamated with such bodies as accelerate the combustion of the mixture. Such substances are, for example, chlorate of potash, prussiate of potash, sulphurous or other combustible materials. Whereas prussiate of potash exceedingly accelerates the combustion, the chlorate of potash, on account of its containing a large amount of separable oxygen, performs the very essential function of increasing the temperature to such an extent that the radiating light and the action of the magnesium is greatly intensified. The combustion of the mixture specified lasts from about 1-30th to 1-50th of a second. It must be remarked that although the magnesium light prepared according to this invention possesses several hundred thousand candle-power, yet it is not possible for the effect of a flash to be so powerfully felt that a reaction of the "model" could take place. This is explained by the fact that the time the flash takes to find its way from the sensitive nerves to the central organ, and from thence back to the operative nerves, is much longer than the limit given above for the burning of the powder; and even if the "model" should move, this movement could only have taken place after the photograph or picture was already taken or completed. The improved magnesium powder or mixture is of great value for the purpose in question, because the burning of the same, when ignited, takes place without any explosion whatever. The rapidity of combustion depends upon the fineness of the magnesium powder and other ingredients, and also upon the degree of their mechanical intermixture. The most suitable mixture for this purpose consists of chlorate of potash, 12 parts; magnesium in powder, 6 parts; prussiate of potash, 1 part. Or, chlorate of potash, 24 parts; magnesium in powder, 12 parts; amorphous phosphorus, 1 part. The chlorate of potash is first pulverised in a suitable mortar, and the other substances—namely, the magnesium powder and prussiate of potash—are then added. The best results are attained by mixing the substances together upon a smooth sheet of paper by means of a wooden or horn spoon, or by rolling the substances together until a fine grey powder is produced, which serves thus for the magnesium light. The magnesium powder so prepared can be ignited by means of an electric or other spark, and burns with a short flash. By selecting a suitable method of burning the magnesium powder, a light may be produced which can be employed to great advantage for other purposes, besides those of instantaneous photography. The latest experiments have proved that the introduction of substances or bodies which show certain coloured lines in the spectrum of the Bunsen burner make the magnesium light much more effective for these colours. For these reasons the patentees provide the previously described magnesium mixture with an addition of sodium, strontium, calcium, lithium, barium, or other salts, in order that the magnesium light thereby produced may be made more effective for yellow, red, or green colours. The proportion of these additions of light-colouring bodies can be varied from a minimum quantity upwards, to about 10 per cent. of the mixture; but it is not advisable to take a larger quantity, because that would affect the temperature of the combustion, and also decrease the effect of the light.

ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS.—XV.*

By S. R. Bottone.

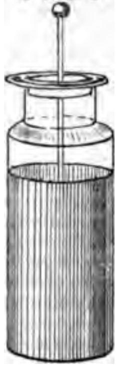
§ 56. CONDENSERS.—These are instruments which owe their peculiar power of retaining charges of electricity to the fact that one conducting surface connected to earth or other large conductors confers, by induction, a greater capacity for charge in a second insulated conducting surface than this latter would have were it not for the presence of the first surface.

Condensers may be conveniently divided into three groups, according to their forms, and the nature of the insulator used between the two conducting surfaces—1st, Bottle formed, or "Leyden jars"; 2nd, Coated glass sheets, also called fulminating panes or Franklin's plates; 3rd, Coated sheets of paraffined paper or other flexible insulator, known as Fizeau's condensers.

§ 57. *The Leyden Jar.*—Every dabbler in electricity has, at one time or other, made a Leyden jar; not every one has made a good one. The first point to be noted is the *shape* of the bottle or jar to be used. It must have a neck sufficiently wide to allow the inner coating to be easily placed in it and smoothly laid. To this end the mouth should certainly not be less than 2in. in diameter for a jar 6in. by 3in., and so on in proportion. The next point that demands attention is that the bottle or jar should be of nearly uniform thickness, and free from flaw or crack. To ascertain this it should be made to "ring." The last, but certainly most essential point, electrically speaking, is that the glass of which it is constructed should be really a good insulator. The white, or rosy white glass (which contains manganese) is very deficient in this regard. The greener-coloured glasses are generally good insulators. To test this point clean and dry the bottle. When quite dry, but cold, rub it briskly on the outside with a warm silk handkerchief. Reject all such jars as do not easily and quickly become charged so as to give a distinct spark. Choose all such as retain the charge (once acquired) longer than the others. The jar or jars chosen should now be fitted with a sound bung. This requires cutting neatly above and below, so as to be quite smooth, the upper surface being afterwards rather thickly coated with good red sealing-wax. (N.B.—The coating of sealing-wax should not be applied until the bung has been pierced centrally and a rod fitted.)

It is essential that the bung should be *new*, or at least *unused*, for if it has served for acid or salts, it will be found to attract moisture, and greatly detract from the efficiency of the jar. The *knob* of the jar should be one of those brass balls which can be procured from most of the metal-shops in Clerkenwell, where they are known under the name of "metal beads." A female screw can be made in the orifice of the brass ball, and a thread put on a short length (say 6in.) of stout brass wire to fit. This wire, or rod, with its accompanying ball is now fitted to the bung. This is effected by making a small central hole in the bung with a bradawl, considerably smaller than the rod. This latter is then forced in until about two-thirds of its length have been pushed through the bung. When this has been done, the upper surface of the bung (that nearer the brass ball) should receive its coating of sealing-wax. Should there be any difficulty in procuring a brass ball, a substitute, quite as efficient, though not so imposing in appearance, will be found in a leaden bullet, cast upon the end of a brass or copper rod of the desired diameter and length. The next step is to coat the jar with tinfoil. It is better to begin with the inside, as when the outside is coated it is not easy to see what is going on inside. A piece of good tinfoil is cut into a circle, a trifle narrower than the outside diameter of the bottom of the jar. One side of this is carefully rubbed over (with the finger) with thin hot glue. It is then allowed to fall in the jar, glue side downwards, and is pressed into its place at the bottom by means of a small mop (similar to those used to clean lamp-glasses). The jar is now measured from the bottom to the bung. Three-quarters of this are marked off as the height to which the tinfoil coating may reach. A strip of tinfoil of this width, and three times the diameter of the jar, is now cut. For convenience of getting in the jar, especially if this latter be narrow, it will be well to divide the strip of tinfoil into two halves, and having glued one half, slip it in the jar, having previously given it a little bend, push it into its place, and smooth it down by means of a tooth brush, then insert the other half in a precisely similar manner. Care must be taken that these side pieces come into actual contact with the bottom circlet. The inside being thus coated, the outside may be proceeded with in precisely similar manner; only the sides may be covered by one entire piece of tinfoil, and this should lap somewhat over the bottom. The coatings should be allowed to dry thoroughly before the jar is used or touched, as otherwise the outer coating will be wrinkled up and spoiled. Very charming effects of a multiplicity of sparks during discharge, may be obtained by coating the inside of the jar with a number of small diamonds of tinfoil, almost, but not quite touching, instead of with one continuous layer. The outside should, in this case, be covered with similar diamond-shaped pieces, and this latter should have a circular hole cut in each, so that each hole should stand ever the corners of the inside diamonds. By this means, not only are the sparks between the outer diamonds seen, but also those between the inside ones. The jar being coated and dry, the bung, with its rod and ball, is fitted to it. It is well to attach a small piece of metal chain to the end of the rod (by soldering), to insure contact between the rod and the inner coating. The *absolute* size of the jar and its parts may be varied at will; but, to obtain the best results, the following *relative* dimensions will be found useful:—Let the height of the jar be three times its diameter; the length of rod and ball four times the diameter. With these proportions, and especially if the coatings do not extend beyond three-fourths of the height to the bung, the jar will be found to hold a good charge for some time. A lesser charge, with longer retention, may be obtained by using less coated surface—say, two-thirds, or even a half, of the total height, instead of three-fourths. Fig. A shows the relative sizes and shapes of the different portions of the jar; B shows the inner and outer diamond-shaped pieces of tinfoil to be used if a "spangle jar" be desired.

FIG. A



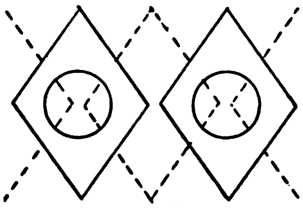


FIG. B

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THE THEORY OF MACHINES.—XV.

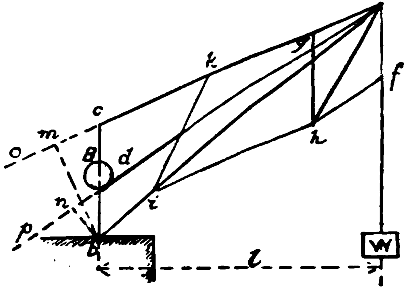
By Francis Campin, C.E.

Cranes.

WE have now to consider the distribution of strains on cranes, derricks, and similar machines, and these require careful examination, because the elements are not all inflexible, as in those combinations of which we have treated in previous articles, the chain or rope bending freely about pulleys, and therefore being under the same strain throughout its working length, regardless of the angle which one part may make with another.

Let Fig. 59 be the diagram of an ordinary wharf, or post crane, of which $a\ b$ is the jib, $a\ c$ the tie, $b\ c$ the post, and B the chain barrel. The chain is shown by $d\ a\ e$ passing round a pulley at a; of course the strain on the part $a\ d$ will be the same as that upon $a\ e$, being equal to the load W. As the chain passes over a pulley at a, the *diagram lines*, $d\ a$, $a\ e$, must be drawn from the centre c of the pulley parallel to the actual chain line, so as to bring all the forces in action at the point a.

Fig. 59



To any convenient scale mark off on $a\ e$ and $a\ d$ respectively the distances $a\ f$ and $a\ g$, each being equal to the load W; complete the parallelogram $a\ f\ h\ g$, then the diagonal $a\ h$ will be the resultant pressure at a due to the tension $a\ f$ and $a\ g$; this resultant pressure is to be supported by the jib $a\ b$ and the tie $a\ c$, the former being in compression and the latter in tension, and their directions must be those of the elements $a\ b$ and $a\ c$.

Complete the parallelogram $a\ h\ i\ k$, then will $a\ i$ represent the intensity of the thrust upon the jib, and $a\ k$ the amount of tension on the tie.

The accuracy of the results thus obtained may be proved by applying the principle of moments as follows.

The overturning moment of the load at the point b will evidently be equal to the load W multiplied by its horizontal distance l from the centre b; this distance l is called the radius of the crane. The moment will also be equal to the sum of the moments of the forces $a\ g$ and $a\ k$ about b, and, of course, if the strains are correctly determined, the two results will agree.

We will illustrate this by an example. Let l = 35ft. and W = 20 tons, then the overturning movement will be 20 × 35 = 700ft.-tons.

The diagram is drawn to a scale of 50 tons per inch for strains and 25ft. per inch for dimensions. This is, of course, too small for practical purposes, and the student should set it out to a much larger scale for his own satisfaction. To the scale we have $a\ f$ and $a\ g$ are marked 20 tons each, then $a\ k$ scales 44 tons, and $a\ i$ 74 tons. The two forces, the moments of which about b are required, are $a\ g$ = 20 tons and $a\ k$ = 44 tons.

Produce the lines $a\ c$ and $a\ d$ to the points o and p respectively, and from C draw perpendicular to them the lines $b\ m$, $b\ n$. These will be the distances at which the two forces act about the point C. The force $a\ i$ passes through the point C, and therefore cannot produce a moment about it.

The distance $m\ b$ scales 13·5ft., and $n\ b$ scales 5·5ft., therefore the moments of the forces in question will be $a\ k \times m\ b = 44 \times 13{\cdot}5 = 594$ft.-tons, and $a\ g \times n\ b = 20 \times 5{\cdot}5 = 110$ft.-tons, the sum of the two being $594 + 110 = 704$ft.-tons. Now we found above that the actual moment from given load and dimensions is 700ft.-tons, and the correspondence is, considering the smallness of the scale, exceedingly close, and a satisfactory proof of the accuracy of our deductions.

The tie will require to be proportioned in sectional area to the tension upon it, and the jib treated by the usual formula for columns, the post being calculated as a cantilever fixed at b.

It will be observed that $a\ g$ and $a f$ being equal, the resultant $a\ h$ must bisect the angle $g\ a f$. If the jib also bisects the angle $g\ a f$, then there will be no strain on the bar $a\ c$. If the resultant falls below the jib, as shown in the figure, then the jib will be in compression, and $a\ c$ in tension; but should it fall between $a\ b$ and $a\ c$, then both those elements will be in compression.

The amount of stress on the different parts of the crane will, of course, vary with the value of the resultant $a\ h$, and that resultant will diminish as the angle $d\ a\ c$ is increased; hence it is obvious that by raising the position of the chain barrel B the strains upon the different parts of the crane are correspondingly reduced, except on the post at the point b, where it remains constant.

Having this example before us, it will be advisable to complete it by determining the sizes proper for the various parts.

The bar $a\ c$ is soonest dealt with, as there is simply a tensile strain upon it. The safe working load in tension per square inch is five tons, and the strain on the tie has been found to be 44 tons; therefore, its sectional area must be $44 \div 5 = 8{\cdot}8$ square inches. The member $a\ c$, however, usually consists of two rods—one on each side of the jib, their distance apart increasing towards the framework carrying the gearing, and so as to steady the jib laterally. This deviation will slightly increase the direct strain on the rods, so that it will be more than 22 tons each; but the increase will be so slight that we may neglect it, the exact proportion being as the length of the diverging rod is to its length, if it were direct from a to c in the same vertical plane with the centre line of the jib and post.

In each rod will be required a sectional area of 4·4, say, 5 square inches; this will also allow for the weight of jib, tie, and chain, which was not added to the load W, and in practice it is necessary to take these—that is, half the weight of the jib, tie, and chain from d to a, and all the chain from a to e. Referring to a table of circular areas, we find that 2½in. diameter will give 4·91 square inches of sectional area, which is near enough for our purpose.

The jib must be treated as a column, and, being in compression, should be made of cast iron. The tie is in the position of a column hinged at its extremities; therefore, if f = its breaking weight in tons per square inch, and r = the ratio of its length to its diameter, then by Gordon's rule $f = 36 \div \left\{1 + \frac{r^2}{100}\right\}$

Taking one-fourth the breaking as safe working strain per square inch of sectional area, it will be $= 9 \div \left\{1 + \frac{r^2}{100}\right\}$.

In the figure, the jib scales 45ft. in length, let it be 18in. in diameter at the centre of its length, then will $r = \frac{45}{1{\cdot}5} = 30$, and the working strain $= 9 \div 1 + \frac{900}{100} = 0{\cdot}9$ tons per square inch. The strain $a\ i$ is equal to 74 tons, therefore the required sectional area will be $74 \div 0{\cdot}9 = 82{\cdot}2$ square inches. The circumference corresponding to 18in. is 56·54in.; therefore, the thickness of metal at the centre must be $82{\cdot}2 \div 56{\cdot}54 = 1{\cdot}45$, say 1½in. This thickness may be reduced towards the extremities.

If r = the radius in inches of the section of a cantilever of circular section, its breaking moment will be in foot-tons $1{\cdot}18 \times r^3$, and the working moment taken at one-fourth of that of rupture $0{\cdot}295\,.\,r^3$. If the cantilever be hollow, and r^1 = the internal radius in inches the working moment will be $= 0{\cdot}295 \left\{\frac{r^4 - r^4}{r}\right\}$.

In our example we have found the maximum bending moment at $b = 700$ft.-tons; hence, at that place, if a solid post is used, as the moment of strain must equal the moment of resistance

$$0{\cdot}295\,.\,r^3 = 700;\ \text{therefore}\ r = \sqrt[3]{\frac{700}{0{\cdot}295}} = 13{\cdot}34$$

and the diameter 26·68, say, 27in. This section may be reduced towards c in accordance with the diminution of the sum of the moments of the forces $a\ g$ and $a\ k$.

Next may be determined the size of the pin carrying the pulley at a, over which the chain passes: the pulley will rest in a fork at the end of the jib, its pin will therefore oppose two sections to the shearing-force $a\ h$, one section on each side of the pulley; the safe resistance of wrought-iron to shearing strain is 4 tons per sectional square inch, and the force $a\ h$ is by scale 35·5 tons, requiring, therefore, $35{\cdot}5 \div 4 = 8{\cdot}83$sq.in., or 4·415sq.in. in each section; this will correspond to a diameter of 2⅜in.

This diameter will not be sufficient for the eye of the tie-rod, for the total strain on the pair is 44 tons, which would require a sectional area of 11in. in the two sections, the diameter, therefore, of the bolt would have to be 2¾in. giving 5·9sq.in. to each section.

On the pins carrying the bottom of the jib there would come a strain of 74 tons, requiring in the two areas $74 \div 4 = 18{\cdot}5$sq.in., corresponding to a diameter of 3½in. nearly, which gives 9·6sq.in. to each section.

The bolts holding the tie-rods at e would require to be the same diameter as that at a, 2¾in.

Care must be taken that the bolts and pins have bearing areas equal in resistance to their sectional shearing areas. The bearing area is measured by the diameter multiplied by length of bearing, and 4 tons per square inch is safe-bearing resistance.

The pulley has a pressure of 35·5 tons upon it, and the pin upon which it runs is to be 2¾in. in diameter; the bearing required is $35{\cdot}5 \div 4 = 8{\cdot}83$sq.in., hence the length of bearing within the pulley must not be less than $8{\cdot}83 \div 2{\cdot}75 = 3{\cdot}2$in.

The lengths of bearing of all the other pins and bolts are to be determined in a precisely similar way; it is, therefore, unnecessary to occupy our space further with this part of the subject; the strain on the barrel shaft must, however, be mentioned.

On the barrel shaft there will be a twisting or torsional strain which will be exhibited as a moment of strain.

Torsional strain is closely analogous to shearing force, the surfaces of rupture sliding off each other as it were as they revolve in opposite directions about a centre, or as one part so revolves the other remaining at rest. The strength of a shaft to resist torsion will evidently vary as its sectional area and its mean distance from the centre. This mean distance will bear a fixed relation to the diameter, and the sectional area will vary as the square of the diameter; hence the resistance to torsion of a solid shaft will vary as the cube of its diameter.

The ultimate resistance of a bar 1in. in diameter to torsion in inch-pounds is for wrought iron 12,000, for cast iron 11,900, and for steel 20,000. Let c = the co-efficient of the material used, d = diameter of shaft in inches, M = moment of force to which the shaft will be subject, and let the working stress be taken as one-fourth the ultimate strength; then the moments being in inch-pounds, $M = \frac{c\,.\,d^3}{4}$ and $d = \sqrt[3]{\frac{4\,.\,M}{c}}$.

In the example, let the diameter of the chain barrel be such that the radius, measured from its centre to the *centre of the chain* coiled upon it, shall be 8in.; then, as the pull on the chain is 20 tons, the moment of torsion on the shaft will be $M = 8 \times 20 \times 2{,}240 = 358{,}000$in.-lb. If all the power is to be applied at one end of the barrel shaft, its diameter must be $d = \sqrt[3]{\frac{4 \times 358000}{12000}} = 4{\cdot}93$in. if of wrought iron. If the shaft is, however, geared at both ends, then the moment at each end will be only $\frac{358000}{2} = 179{,}000$in.-lb, and the corresponding diameter $d = \sqrt{\frac{4 \times 179000}{12000}} = 3{\cdot}91$in.

All the other shafts in the crane gearing can be determined by the same formula. The amount of shearing strain brought directly upon the shafts where they rest upon the bearings will depend upon the relative positions of the driving and driven points, but can never exceed the sum of the driving and resisting forces.

We have yet to consider the stability of the foundations of the crane. If it is fixed in the foundation of a building, the pressure exerted by the bottom of the post in a horizontal direction will be found by dividing the overturning moment at b by the depth from that point to the bottom of the post, and the foundation must be made strong enough to resist this thrust in any direction.

In some situations it has been found necessary to rely upon the stability of the foundation of the crane itself, which must then be made so as to form a solid mass as follows:—At the top and bottom of the foundation brickwork or masonry is a strong iron cross, through the centre of which the crane post passes, and is therein firmly secured; these crosses are connected together by strong tie rods passing from one to the other, and helping to secure the solidity of the foundation.

As the whole value of this foundation mass depends upon its resistance to overturning, it will be seen that it is necessary in forming it to use strong cement instead of mortar, and so bond the bricks or stones together that the whole mass shall act as one piece.

Brickwork weighs 112lb. per cubic foot, and the moment of resistance of a mass, square in plan, to overturning would be, its total weight multiplied by half its width, as it would turn upon one edge, and its centre of gravity is at its geometrical centre; let b = breadth of either side, and d = depth of mass, both in feet, then the overturning moment will be $M = 112 \times b^2 \times d \times \frac{b}{2} = 56\ b^3 d$. In our example M = 700ft.-tons = 1,568,000ft.-lb. Let $d = 15$ft., then $1{,}568{,}000 = 56\ b^3 \times 15$; $b = \sqrt[3]{1868} = 12{\cdot}315$ft.

In steam cranes the engines and boiler being placed behind the crane post will serve as a counterpoise to some extent to the weight to be lifted.

There is a class of cranes in which the jibs are not rigidly maintained at one angle by rods $a\ c$ as shown in Fig. 59, they being caused to rise and fall under the control of chains; the only advantage of this is that the cranes as well as raising a load, say, from a boat, will, by raising the jib, bring it in so that it may be dropped on the wharf without turning the crane round. In designing such a machine the strains must be calculated for that position of the jib in which they are at a maximum, which will be its lowest position.

Travelling cranes used for railway purposes in case of breakdowns, and for unloading or lifting and moving weights from one place to another, are mounted on trucks suited to the gauge of the railway. As a foundation cannot be obtained for cranes of this class, it is necessary to use counterbalances, which are in the form of weighted boxes working on a tail frame behind the post, and so arranged that the distance of the counterbalance from the crane post can be regulated by a screw or chain and ratchet according to the weight of the load to be lifted.

FLOWER FARMING AND PERFUME MANUFACTURE IN SOUTHERN FRANCE.

FOR nearly a century the culture of flowers on a large scale, and the manufacture of perfumes and essences have formed a special and lucrative industry in Southern France. The principal district in which the manufacture is carried on is at Grasse, in the Department of the Alpes Maritimes; but it is also conducted on a more or less extensive scale at Sommières, Nimes, Nyons, and Seillans. The descriptions of flowers principally grown, and their season of harvest, are the violet, jonquil, and mignonette, which are usually gathered in February, March, and April, although, in mild, moist winters, the violets commence as early as December; roses and orange blossoms, with thyme and rosemary in May and June; jasmine and tuberoses in July and August; lavender and spikenard in September, and the acacia in October and November. The flower harvest covers, therefore, about three-fourths of the year; but the season of greatest activity is May and June, when the roses and orange blossoms are gathered. Thyme, rosemary and lavender are among the minor products grown principally by small farmers of the grape and olive, who have at home the simple apparatus for distilling the flowers, and they produce a more or less inferior class of essences, which are used to dilute and adulterate the superior essences produced at the large establishments in towns and villages. Consul Mason, of Marseilles, in a recent report upon flower farming in Southern France, says that the conditions of industrial success in flower growing can be best studied by a specific example, and he quotes the case of a plantation at Seillans in the department of the Var. This farm is about twenty-three acres in extent, and is situated on the southern slope of the hills, about 2,000ft. above the level of the Mediterranean, and at a distance of twenty miles from the coast. The calcareous soil was originally naturally poor and thin, and the olive trees which had occupied the ground for a century or more prior to 1881, yielded but scanty and unnecessary returns. The slope of the surface was so steep that the waters of a spring which flows from the rocks above the track could be but imperfectly utilised for irrigation, and the land was regarded as practically worthless. In 1881 the proprietor caused the olive trees to be removed and the land prepared for flower culture. The ground was dug up to a depth of 4ft., the larger stones removed and built into sustaining walls for the terraces into which the surface was divided and levelled. Along the upper margin of each terrace a shallow ditch was cut, connecting with transverse channels which supply the spring water for irrigation. The abruptness of the slope will be indicated by the fact that, on the tract of eighteen acres, the terrace walls required to produce a series of level or gently sloping surfaces are over 2,000 yards in length. Thus terraced, the tract yielded about seventeen acres of prepared ground for planting. In the autumn of 1881, 45,000 tufts of violets and 140,000 roots of the white jasmine were planted. The following spring the remainder of the ground was planted with roses, geraniums, tuberoses, and jonquils, and a laboratory erected for the manufacture of perfumes. The position proved to have been well chosen, as the flowers grew vigorously and well, and in 1885, the fourth year after planting, this farm, which had previously yielded a rental of £23 a year, produced perfumes valued at £8,630, giving a net profit of £1,553. This is sufficient to illustrate how lucrative flower farming may become in favourable districts, and under good management. From observation at Seillans and in the neighbourhood of Grasse, where perfume flower growing is the leading industry, Consul Mason says that the essential conditions appear to be an altitude of from 500ft. to 2,000ft. Flowers grown on such elevated positions are said to be richer in perfume than similar varieties which bloom in valleys and lowlands; a soil rich in calcareous elements, a situation sheltered from cold northern winds, and not subject to the white frosts which in spring and autumn affect the damp lowlands. In countries like Southern France, where the rainfall is always scanty, and often wanting entirely from May until September, irrigation is essential to the culture of flowers as well as every other crop. It is said the perfume growers and distillers on the Mediterranean coast attribute their success not less to the peculiar climate of Provence than to their knowledge of every detail of the industry—a knowledge acquired by more than a century of experience, and transmitted from generation to generation. One essential principle in perfume culture is that all fancy and "improved" varieties of flowers are discarded, and the natural, simple, old-fashioned kinds are exclusively grown. The roses on the slopes of Seillans are the common pink ones, and the single wild violet is preferred to all the larger artificially-developed varieties. Only the white jasmine is used, the yellow and less fragrant variety appearing to be either discarded or unknown. Jasmine plants are set in rows about 10in. apart, and are closely pruned. Roses are grown on the lower terraces, and are also cut low, and the ground between the plants heavily manured. After the roses have been gathered, the stem is cut to within a few inches of the ground to preserve for the next season the entire vigour of the plant. During the harvest season traders or "middle men" go through the country every day with waggons collecting flowers from the farms, for which they pay prices varying according to the extent of the crop and the demands of the market; their loads are hurried to the nearest manufacturer, and delivered while the flowers are still fresh and crisp. The flowers are usually gathered in the morning, as soon as possible after the dews of the preceding night have disappeared. The manufacture of perfumes includes the making of pomades and oils by the process of absorption, and of essences and essential oils by distillation. Every complete establishment is provided with apparatus for all these processes. Pomades are the commercial vehicles for absorbing and transporting the perfumes of the jonquil, tuberose, jasmine, and other species of flowers. A square frame or *chassis* of white wood, about 20in. by 30in. in size, is set with a pane of strong plate glass. On either side of the glass is spread a thin, even layer of grease—two parts lard to one of tallow—which has been purified and refined by previous boiling and straining, Thus prepared, the frames are piled up in ranks, six or seven feet high, to await the season of each special flower. When the blossoms arrive, the petals are picked from the stem, and laid so as to cover the grease in each frame. These being again piled so as to rest upon their wooden edges, which fit closely together, there is formed a species of tight chambers, the floors and ceilings of which are of grease, exposed to the perfume of the flower leaves within; the grease absorbs the perfume, the spent flowers are removed daily, and fresh ones supplied, and this process goes on from two to four, or five months, according to the desired strength of the pomade, which, when sufficiently charged with perfume, is taken from the glass with a wide thin spatula, and packed in tin cans or *stagnons* for export. By these methods the delicate odours of flowers are extracted, and retained for transport to distant markets, where the grease, being treated with alcohol, yields the perfume to that stronger vehicle, and produces the floral waters and extracts of commerce. Coarse pomades are made by boiling the flowers in the grease, and subjecting the residue to pressure. The spent pomades are used for toilet purposes, and in the manufacture of fine soaps. The process of preparing perfumed oils involves the same principle, except that instead of solid grease, superfine olive oil is used. With this oil, pieces of coarse cotton fabric are saturated, which are then spread upon wire netting framed in wooden *chassis* about 3ft. by 4ft. in size. The flowers are spread upon the saturated cloths, and the frames piled one upon another, so that the perfume of the flowers is absorbed, as in the previous process. Essences and scents are produced by ordinary distillation, in which the flowers are boiled with water in large alembics; the vapour carries off the perfume, and is condensed in adjoining copper tanks. Some of the retorts used for this purpose are of sufficient size to receive at once half a ton of fresh flowers, with the requisite water for their distillation. When scents are to be produced, alcohol is used in the distilling tank to receive the perfumes. By skilful combinations of the perfumes of the different flowers, sometimes with the addition of chemicals, a large variety of scents, such as "patchouli," "jockey club," &c., are produced at the original laboratory. The work of the manufactories is largely done by women, who earn from tenpence to one shilling for a day's labour of ten hours, and during the busy season of roses and orange flowers they earn half as much more by working until midnight, or even later.—*Journal of the Society of Arts.*

FASHION v. SCIENCE AND HUMANITY.

FROM a very remote, we may even say a prehistoric, period it has been the custom of human beings to provide themselves with garments at the expense of the lower creation. From a time almost, if not quite, as early animals have been slain to furnish food for man. In our own days, also, both practices exist in operation side by side. While, however, the necessity for flesh as an article of diet is generally admitted, provided that it be used in moderation and combined with vegetable food, the need for taking the life of animals in order to clothe the body, it must be allowed, has been to a great extent obviated by the progress of textile industry, which gives us as woollen fabrics most of what we require for daily wear without depriving a living creature of one drop of blood. Fancy, taste, luxury, utility—one or all of these—it is true, still order the destruction of countless fur-bearing and feathered beings of a lower grade than ourselves; and we are not prepared to say that, in obeying the mandate, at all events of the last-named authority, man exceeds the privilege of his lordly position. When, however, we find him, at the bidding of a mere fashion, persecuting the life of some harmless and to him otherwise useless race of animals, and this even to the extent of extermination, we blush for the cruel heart of our so-called civilisation. When, for instance, little birds, whose only fault is their beauty, are sacrificed by thousands in a year, in order that their feathers or their bodies should adorn the "softer sex" of our species in hours of enjoyment, we are bound in creature kindness to those helpless members of the world's great family, to condemn the barbaric fancy which is so heedless in its self-esteem. Artificial substitutes can be found for ornaments of this kind, and the counterfeit is not by any means a despicable imitation. The desire for their more general adoption is not, we are sure, limited to ourselves, nor is the hope that other Governments will copy the recent practice of our own by restricting the indiscriminate slaughter which has already lost to the world not a few interesting and beautiful forms of animal life.—*Lancet.*

TECHNICAL TRAINING CONSIDERED AS A PART OF A "COMPLETE AND GENEROUS EDUCATION."*

By R. H. THURSTON, M.A., Doc. Eng., Director of Sibley College, Cornell University, Ithaca, N.Y.

THE development of the individual has a natural history which accords with the rational history of the complete education of the citizen the more perfectly as that education the more perfectly approaches the ideal to which our study of the best education leads us. It requires no argument to convince the thoughtful mind that the building up of an intellect and the training of a mind must have some natural and most efficient method and scheme, or that this natural order of procedure must correspond thoroughly with the plan of development of the faculties, and of their application to the purposes for which they were designed. We may, therefore, give a moment's thought, with profit, to the consideration of this individual history and to this natural process of development of the faculties and powers of man. I am inclined to divide the life of the individual into five distinct periods or sections: 1. The stage of perception; 2. The period of absorption; 3. The time of action and accomplishment; 4. The period of direction and counsel; 5. The time of meditation and culmination of wisdom. A child has its perceptive faculties in highest efficiency at the very start; its mind is engaged constantly in the survey and examination of all that constitutes its environment; it thinks but little; it perceives much and accurately; it acts only by intuition and impulse; it is perpetually engaged in receiving impressions through the senses and in seeking new experiences; its mind is mainly employed in the perception of these new experiences, and its memory is stored only with such as it distinctly appreciates. All its mental operations are like those of the lower creatures; it sees, feels, hears, enjoys the operation of the senses, remembers all that is pleasing and all that is unpleasing or painful, and seeks to repeat the former and to avoid the latter; just as the birds see, as the insects feel, as the animals of whatever kind seek to repeat pleasing and to avoid the repetition of painful experiences. The young child does not distinctly reason, and has no consciousness of the processes by which it is becoming a man.

The youth retains something of this first characteristic of humanity; but his most striking attribute is the facility with which he avails himself of the perceptive faculties, and of his memory, to acquire all that kind of knowledge which can be transmitted from one individual to another; his is the period of absorption of information and experiences from others, either through the study of books or the conversation of his elders and companions. His perceptives are less acute than before; but his memory for impressions conveyed from others and his understanding of lines of reasoning and of argument originated by his elders have become sufficient to make them the means of his education in the next higher stage to which he has now attained. He is passing from the period in which the kindergarten and the Froebelian method are his only proper means of education into the next higher condition, in which, while the child's school may still contribute much in matter and method, the use of books and of oral communication of ideas, facts, and reasoning may be made an important, if not the principal means, of instruction. Object teaching is supplemented properly by abstract thought. It is by the combination of the two methods of gaining knowledge that the school education of the individual is completed; the brain, like the body, is thus matured and made ready for life's work, for action.

The young man or the young woman, mature in body and developed as to faculties and all natural powers, instinctively seeks to apply those powers, and enters upon the period of action and of accomplishment. The perceptive faculties have stored the memory with all the familiar impressions received by the senses during the ordinary operations of life; the mind has been enriched with useful knowledge and prepared by study and carefully directed thought to meet successfully the opportunities and the tasks that life is about to present to the now active and ambitious, earnest and energetic novice, in a world full of work to be to try this upon anything more valuable than a piece of firewood, at least not until he knows he can do it well. It is often a hard job to turn a very long object, and a "steady rest" must be employed to do the least in this direction. If an extra "stock" is available, a casting may be made to go into the stock like the shank of a rest, the upper end of this casting to be flat, and pierced for receiving a bolt. A notch is cut in a bit of hard wood board, which is bolted to the casting. The worst of this job is to get an inch or two of smooth surface turned in the middle of the long piece of work. To do it, a very sharp gouge must be used, and an extremely thin chip taken off. The bevel of the gouge must bear upon the work, and the gouge must rest as light as a feather upon both work and the rest.

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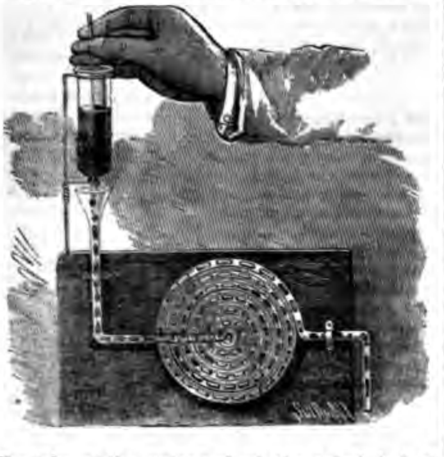
* Extracted from an address delivered at the seventeenth annual commencement of the Worcester Polytechnic Institute.

Smoothing up must be done with a very sharp chisel, and a delicate touch is required in applying the chisel to the work. If the least chatter be perceptible stop at once, begin over again, and try until an extremely true and smooth spot is turned large enough to receive the notched board in the extra rest stock. Adjust this bit of board or "back rest," as it has now become. Place it so it barely touches the work, then drive the wedge under the lathe, and set up the rest with a hammer. The edges of the notch in the rest should be nicely rounded, and a drop of oil rubbed on them (not on the work). If many pieces of the same size are to be turned a hole may be bored in the back rest, then half of the bigness of the hole cut away. This gives more bearing and reduces the tendency to heat, burn, and grind away the work. For little split patterns all manner of fancy dogs and centres have been used for holding two pieces of wood together when they are to be turned, but the best way of all is to glue the two pieces together with a piece of manilla paper between them.

NOVEL LANTERN SLIDE.

THE engraving shows an inexpensive and very simple and effective device for exhibiting the action of the circulating fountain upon a screen. It consists of a glass tube of small diameter bent into the form of a volute, with the inner end of the tube extended laterally, and then bent vertically and provided with a funnel at the upper extremity.



The tube at the outer end of the spiral is bent outward radially, then downward at right angles. The tube thus bent is mounted on a board having a circular aperture a little larger than the spiral, so that the entire spiral may be strongly illuminated while the ends of the tube leading to and from the spiral are concealed by the board. Above the funnel is supported a reservoir with a fine ajutage, the reservoir being provided with a pointed wooden rod which extends down into tube at the lower end and forms a valve for regulating the flow of liquid. The liquid employed is water to which as been added some colouring matter, such as aniline blue, red, or green. A few drops of aniline red ink answers for this purpose.

The flow of the liquid is started by loosening the valve, so that the water drops regularly into the funnel of the tube below. The drops should fall so as to include air spaces between them. The liquid, as it issues from the downwardly turned end of the spiral, is received in a cup, by which it may be returned to the reservoir to be used again. When it is desired to accelerate the motion of the liquid in the tube, a short rubber pipe is connected with the downwardly turned end of the glass tube. The glass tube is about one-sixteenth inch internal diameter, and the spiral is three and one-half inches in diameter. When the fountain is in operation, the material of the spiral appears to revolve, but each convolution at a different rate of speed, owing to its increasing diameter. When projected with a good lantern and a strong light, it becomes a very interesting object.—G. M. H., *in Scientific American.*

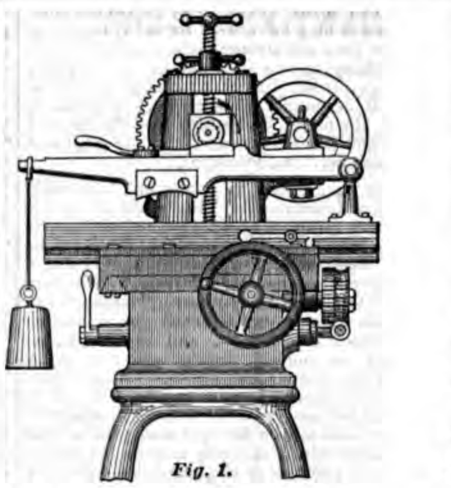


Fig. 1.

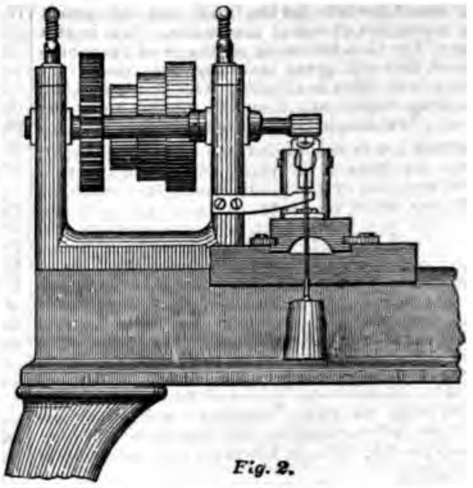


Fig. 2.

THE MILLING MACHINE—ITS CONSTRUCTION AND USES.*

I WILL endeavour to show some of the possibilities of producing curved or irregular surfaces with the common straight cutter. Milling of this class is termed bridge, profile, or cam milling, according to the machine or fixture used. The different kinds of milling mentioned above can only be done where the radius of the curves to be milled is greater than that of the milling cutter itself. The appliances necessary for bridge milling are, the ordinary plain milling machine with a fixture made especially for it. Profile milling is of the same class, but is generally done on a regular profiling machine. Cam milling is done on a machine called a cam cutter; in this machine the cutter spindles and the spindle holding the work to be milled, revolve in opposite directions.

Bridge milling is generally resorted to where the pieces to be milled have a greater radius than it is practicable to mill in the regular cam cutter, or, again, should the pieces be of greater length than it is possible to mill crosswise in the regular milling machine. I am not thoroughly familiar with the manner of finishing the link motion of the locomotive, but can see where a properly constructed machine of this class would do such work with exactness, and at a very slight cost as compared with the planer.

It is, of course, not necessarily confined to large work, small pieces being done very profitably. For instance, the shuttle of the modern sewing machine, having a circular shuttle race, where it is absolutely necessary to have the shuttle of the same radius as the race. This is a good example of this class of milling, and the one I will take as an illustration. Fig. 1 represents the front elevation of a part of a milling machine having a fixture on its platen. Fig. 2 is an end elevation, showing the position of the cutter, the piece in position to be milled, and the former resting on the bridge. It will be seen by reference to Fig. 1 that the fixture for holding the work is hinged at the back end of the platen, the front end resting on a bridge, or a piece fastened to either the head or bed of the machine, as may be most convenient. This bridge has a surface on top of hardened steel, rounded, or sometimes a roll, so that it presents at all times only a line bearing to the former. The hinged fixture has a former fastened to the bottom, adjustable by screws, and resting on the top of the bridge during the operation of milling. The outer end of the fixture is generally held down by either springs or a weight; this, however, is not always necessary, as the feed of the carriage is from the joint of the fixture, and the motion of the cutter as indicated by the arrow, thereby causing a downward pressure on the work and preventing the fixture from lifting.

Where it is possible to put the bridge directly under the centre of the cutter the former will be of precisely the same profile as the piece to be milled; but in case it is necessary to put the former forward of the cutter, the former will be changed in shape, as the fulcrum of the lever is constantly changing with the forward movement of the feed. It may be seen that a piece clamped in the fixture and fed under the cutter will assume the shape of the former, or rather the shape of the model from which the former was produced. These are various methods of laying out formers for bridge milling; but the quickest and most practical is to put into the cutter spindle a blank cutter or arbor of about the same diameter as the cutter to be used; exact diameters is not essential, so that it is smaller than the smallest radius to be cut. Fasten to the seat of the fixture intended for the former a blank piece of steel coated with blue vitriol. In place of the bridge fasten a scriber, place the model of the piece to be milled in the fixture, hold the outer end of the fixture up against the blank cutter in the spindle, and either by power or hand feed the carriage the length necessary to produce a line on the blank former the entire length of the model; work the former to the line and harden. This arrangement for milling irregular forms has not received the attention from mechanics that it deserves. The advantages it possesses over the profiling machine are many, among which are cost of machinery and less cost for attendance, as the profiling machine requires the constant attention of the operator, while in bridge milling one man can run four or more machines. This of itself is enough, in these days of close competition, to give it a place in the front rank of milling attachments. Another feature is the perfection of the shape produced and the small cost for cutters, as compared with those that reproduce their own profile, the cutters used in bridge milling being small, straight, and often of the kind known as shank cutters.

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* By JOHN J. GRANT, in the *American Machinist.*

MAKING GALVANOMETER MIRRORS.

THE following directions for making the mirrors of reflecting galvanometers will be useful, as the process can be adapted to other purposes. The details are by Dr. J. B. Williams in the *Electrical World*, of New York. He says: The making of these little mirrors is a tedious operation to many, but a method practised by myself, and which has given very good results, is the following: Take five or six thin glass circles, such as are used in mounting microscopic objects, and clean them thoroughly by rubbing them with a small piece of cotton tied to a stick, which cotton has been dipped in nitric acid. Then wash them in a solution of caustic potash, or strong ammonia water, and finally rinse them first in clean and then in distilled water. Dry them thoroughly with a piece of soft linen rag, and fasten them on a piece of cardboard with mucilage, by placing small drops of mucilage near the edge of a card and allowing the circles to fall upon them. Next, take a piece of good looking-glass and cut out circles of the alloy upon the back of it near the edge, by laying a coin a little larger than the glass circles upon the alloy, and draw a sharp-pointed instrument around the edge of the coin. Remove all of the alloy between the circles and the edge of the looking-glass so that the circles of alloy can be slid over the surface of the looking-glass and on to the thin glass circles gummed on the card. The circles of alloy are loosened from the looking-glass by placing a globule of mercury upon them and spreading it over them with the finger; after which they can be gently pushed on to the glass circles, the edge of the card being held against the edge of the looking-glass. After placing the circles of alloy upon the thin glasses, press them gently with the fingers upon all portions. Next cut discs from a piece of heavy tinfoil, a little larger than the circles of alloy, lay them gently upon the latter, and press them firmly upon the alloy. By so doing all of the superfluous mercury is then removed from the alloy and unites with the tinfoil. The outer alloy, formed by the union of the mercury and tinfoil, is then removed by scraping it gently with the edge of a sharp knife blade. A coating of shellac dissolved in alcohol is then painted over the backs of the mirrors, and after it has become dry the mirrors are removed from the card by moistening the latter with water. I have used mirrors made according to the above-described process in my galvanometers and electrometer, and find they will, when used with a biconvex lens, give an excellent definition crosses the Conemaugh river at Johnstown, Pennsylvania, is 250ft. long, and was moved 75ft. down the river. Trestles were erected on each bank, and rails laid on the top; the bridge was then lifted on to the trestles, and moved slowly to its new site.

It is said that there is a steam omnibus running in Dresden. The motive power is applied to the rear wheels, and is supplied by a vertical boiler and compound engine. In the United States, there are several inventions in the shape of steam tricycles, in one of which, at least, the kerosene or petroleum for fuel is carried in the hollow steel framework. Fifteen miles an hour is stated to be the speed of the steam tricycles. Perhaps, like the earlier attempts, these steam road vehicles will not survive long.

As many inquiries continue to be received about the so-called "Eclipse" battery, we may mention that the company has been registered, and that the patents are Nos. 8288 of 1884 and 4744 of 1887.

Amongst recent inventions in connection with batteries, we hear of porous cells made with cork. The cork is first reduced to powder, and is then made into a stiff paste with naphthaline "diluted with water!" The paste is put into moulds and dried, when a certain portion of the naphthaline is driven off and preserved for further use.

Electrical Tramcars.—Comparing the cost of electrical traffic with that of horses, Herr Huber states that to operate the usual one-horse car, which, including driver and conductor, carries 26 persons, seven horses are required on the same line for one day of 100 kilomètres run. So that, as the electric car carries 31 persons, $8\frac{35}{100}$ horses would be necessary. The cost of maintenance for one horse during the last year, according to a Hamburg paper, amounted to 1·96 marks—two shillings—per day per horse; so that the cost per car kilomètre amounts to 16·04 pfennigs per car per mile. It follows, therefore, that even to-day electricity is more economical than horse flesh, and the cost of the former can be considerably reduced by improvements. The New York *Electrical Review* thinks many will be surprised by the statement that more than 3,500,000 passengers are carried annually in the United States in street cars moved by electric motors. In Montgomery, Ala., electricity is used on eleven miles of road, and the cost is reported by the general manager to be only one-half the cost of horse-power. Roads on which electricity takes the place of horses are found in Baltimore, Los Angeles, Port Huron, Detroit, Scranton, Appleton (Wis.), and Denver. Electric railways are either in course of construction or under contract in twelve other cities, and in 37 companies have been formed or other steps taken for the building of such roads. Upon none of the roads now in operation, however, is force supplied by storage batteries attached to the cars. In most cases power is communicated by an overhead conductor.

A 28-Knot Herreshoff Yacht.—The *Now Then* is the name of a new steam yacht built by the Herreshoff Company for Mr. Norman L. Munro, of New York. She was designed by the famous blind designer, Herreshoff, at Bristol, R. I. She started from Newport the other day, and made the run from Newport to New York. Coming through Hell Gate, according to the estimate of her designer, she flew along at the marvellous speed of 28 miles an hour. All the Sound steamers going East were passed. The *Now Then* is 81ft. long on the water-line, 85ft. over all, 10ft. beam, and draws 3ft. 3in. of water. She has a flush deck of red cedar, with trimmings of red cherry. She has two masts, fore and aft, schooner rigged, a low pilot house, and a brass smokestack. Her bow is extremely long, sharp as a knife, and terminates in a long clipper overhang. Her stern is her most peculiar feature. It runs outward aft from the deck just like the bow of a ram, and the propeller is under the projecting part. This projection is designed to prevent a deep immersion of the stern in running at a high rate of speed, and it works like a charm. The engines are of the triple expansion type, and the boilers can bear a pressure of 250lb. There is a comfortable cabin aft, and the yacht is fitted for extended cruising. Mr. Munro says the name occurred to him when she was building, and he casually remarked, "Now then we shall do something." He is ready to race any steam yacht in America, including the *Stiletto*, from Newport to Larchmont, and will will give any of them 10 miles. He believes that his boat will beat the *Stiletto* because she can maintain her great speed for a longer distance. Mr. Herreshoff, her designer, and also the designer of the *Stiletto*, coincides with Mr. Munro in this view.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions our correspondents. The editor respectfully requests that communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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THE LATEST "LITTLE BILL" FROM BROMPTON—MEDAL NOT WITH HIM THAT FLATTERETH—LIMITING PARALLELS FOR OCCULTATIONS—A TELESCOPE NULLI SECUNDUS—BORING CLEAN HOLES IN CARD—THE DETERMINATION OF STELLAR PARALLAX—LINEAR DIAMETERS OF THE PLANETS—SPIRITUALISM—"PETITIO PRINCIPII" WITH A VENGEANCE.—FLOODS.

[27705.]—THE thanks of every independent man of science—nay, even of every ratepayer—in the United Kingdom are due to you, Sir, for the *résumé* of the Technical Instruction Bill which you print on p. 504. Surely this fresh shameful South Kensington job will not be permitted to pass unchallenged through the House of Commons. This is a question utterly outside of mere party politics, and one on which the staunchest Conservative may well refuse to follow the Government into the lobby. The fact is that having jobbed the City and Guilds of London Institute up to South Kensington, the Ring there who batten on National ignorance have not found it quite so profitable as they hoped and anticipated, and hence, utterly ignoring its existence, they have persuaded the Ministry that a fresh gigantic scheme to provide themselves with additional billets, and to pour some more of the hardly-earned money of the taxpayer into their own pockets, is the panacea for trade depression, and the one thing needful to restore national prosperity. For some time past the wire-pullers in this scheme have been instant in season and out of season in assuring the British public that the check which national manufacturing industry has received, or perhaps it would be more correct to say the increasingly appreciable stress of foreign competition, is referable to the superior technical instruction imparted to the Continental workman; and that we have only to improve the training of the English artificer to regain our pre-eminence as purveyors to the civilised world. Now, assertions of this sort may commend themselves to the Mundella type of intellect; but the average thoughtful educated man will see at once that, even admitting for the sake of argument that England has fallen behind in the industrial race, it by no means follows that it is on account of inferior workmanship. No; the primary reason is much nearer the surface than this. It is that everything nowadays is sacrificed to *cheapness*; and as the result of the Trade Unions has been to bring workmen to a dead level, to discourage individual enterprise in the shape of piecework, working overtime, and the like—in short, to obtain for the competent and incompetent alike the maximum of wages for the minimum of work, the frugal German, Austrian, Italian, or Frenchman, with his long hours of work and simple and cheap mode of life, is able to undersell the British workman hopelessly. Mind, I am not saying that this is a good or a desirable state of things. For a man to become a mere pitiful drudge is to degrade our common humanity. I am simply predicating its existence, and fearlessly assert that if every artificer in England were put through a South Kensington course to-morrow, we should be no nearer to the recovery of our commercial pre-eminence than we are now, unless at the same time he was prepared to work during Continental hours for Continental wages. But waiving this obvious fact for the time being, and assuming that the one thing needful for the industrial salvation of the English workman is that he should be handed over to the gang at Brompton to be taught, let us see what is the nature of the education with which Sir William Hart Dyke's Bill proposes to provide him. Now in the outset, technical education is to be practically defined by the South Kensington Ring, and is to include those "branches of science and art with respect to which grants are for the
time being made by that department." If th
unhappy turner or fitter who proposes to he
towards the regeneration of British manufacturi
supremacy is to be dosed with some of the Sout
Kensington "science" (falsely so-called), God hel
him! "Ne sutor ultra crepidam," and therefo
confining myself to that branch of physics
which the larger part of my life has been devote
astronomy, I would humbly venture to inqui
whether my hypothetical fitter is to be taug
that the stars which pass overhead in London ri
and set!—that the dial is before the clock wh
the sun is in perihelion, and after it when he is
aphelion! &c., both of which statements are—
were—to be found in textbooks compiled by th
Brompton light who has been so well described
"a chemist among astronomers, and an astr
nomer among chemists," and who is paid 50 p
cent. more for promulgating this ridiculous tra
than so eminent a mathematician as Mr. Turn
receives as First Assistant at the Royal Observ
tory! Should this meet the eye of any Member
Parliament, he might do the State some service
inquiring whether astronomy is to form part of t
"technical" curriculum, and, if so, whether it
to be the astronomy of Bessel, Herschel, Ai
Struve, and Newcomb, or such ignorant paste-an
scissors rubbish as I have quoted. But suppos
that the preposterous Bill upon which I am co
menting should be forced or smuggled through
House too much occupied to seriously discuss su
a trifle as a prospective heavy addition to o
already plethoric rates and taxes, what the
What may be done in London I do not know; b
I venture to assert that in agricultural distri
such an Act would become virtually a dead lett
A nice little army of inspectors would *in lim*
be created to work this precious scheme, were
adoption in the least degree likely to beco
general, and the wretched farmer must contrib
his quota towards their support by an increase
his Imperial taxation; while, as though lo
rating were not sufficiently high already, he wo
have to dip his hand deeper still in his misera
lined pocket to provide the necessary teachi
staff in his own locality. I neither can
will believe that he is such a fool as to
voluntarily plundered openly in this way mer
to fill the pockets of the gang who trade u
public apathy at Brompton. Most unhapp
for the honour and credit of England, occ
support is afforded to this Ring by Royal
Rendered daring by former successful jobs, t
sigh for fresh worlds to conquer, and secure in
patronage at which I have hinted, they seem
have Parliament so thoroughly under their thu
that it is only at rare intervals that a bold
fearless member, like Sir George Balfour, da
lift his voice to inquire into their doings. If e
flunkeyism and sycophancy die out in England,
a Ministry is in power which can afford to de
Court influence, it strikes me that South K
sington and the Ring who trade on it will have
a short shrift indeed.

If Mr. Ranyard should need a fresh argum
against the bestowal of medals as a recognition
service rendered to science, he may, I think, f
it in the announcement of a person who sty
himself "Premier Chronologist of the Chro
logical and Astronomical (?) Association of Lond
and *Transit Medalist*"! What is a "Tran
Medalist"? and, to borrow a form of expressi
from the Catechism, who gave him this med
Two learned societies, and two only, are, as far
I know, in the habit of giving medals for ast
nomical work. They are the Royal, and the Ro
Astronomical Societies, and it is certainly wit
my own knowledge that neither of them
bestowed this form of reward upon the "Prem
Chronologist." Moreover, with a tolerably w
and extensive acquaintance with transit literatu
I do not seem to remember the name of
"Premier Chronologist" in connection with it
any shape or way. Nor, perusing the ridicul
little magazine in which I find his style and ti
set forth, do I much wonder at this. It is rea
much funnier reading for a scientific man th
Punch itself. "Some persons," says the P. C.
one place, "think that the Astronomer Royal is
highest authority concerning time. But the er
of this will be seen in a moment," and so on; wh
in another we are gravely told that some of
fixed stars "are so immense in size that th
cannot be central suns. A planet would never
round them"! Most appropriately on the 1st
April, the paper whence I am quoting seems
have given a diagram showing that the Millenni
is imminent. If I understand Messrs. Prem
Chronologist and Co. (Limited), it will begin
1897¼, and the Restoration of the Jews is to happ
in 1927. Another gentleman, on the same page
the Millenarian author, tells us that "the s
moon, and stars" are "on one and the same altit
above the earth—viz., 3,200 odd miles," in whi
last words lies a glimmering of sense, inasmuch
they must be very "odd miles" indeed. I fan
though, that the writer of this stuff is onl
correspondent. But my apology for quoting s

Measurement of E.M.F., Wheatstone's Method.—Let the battery whose E.M.F. is required be connected up with the galvanometer G, and the resistance box R (see Fig. 26). The four mercury cups serve as a commutator by connecting *a* to *c*, *b* to *d*; the current flows in one direction connecting *a* to *d*, *c* to *b*, and it flows in the other. Use one or more coils of the galvanometer so as to get a deflection abous 55° or so without having much resistance out in the box. Read the deflection (both ends of the index), reverse, and read again and take the mean, say, α_1.

Now pull out some of the plugs so that the deflection is diminished 10° or 15°; read again as before; let α_2 be this deflection, and R_1 the resistance added.

Now put in the standard Daniell cell afterwards described, and put in resistance until the deflection is α_1 as before. Now add resistance R_2 until the deflection comes down to α_2. Then—

$$\frac{E_1}{E_2} = \frac{R_1}{R_2}$$

where E_1 is the E.M.F. of the first battery, and E_2 that of the second.

Or, supposing E_2 is the electromotive force of one of the standard cells, then—

$$E_1 = \frac{R_1}{R_2} \, 1{\cdot}07 \text{ volts.}$$

Standard Daniell Cell.—This cell is a simple pattern of any ordinary cell. Inside a porous pot 6 × 2 a cylinder of thin sheet copper is placed, with a terminal soldered to the top. The pot is placed inside a battery-jar 6 × 4; in this is also placed the zinc plate about 6 × 6, and bent round so as to fit inside the jar.

Before charging, soak about 1in. of the top of porous-pot in melted paraffin for some time.

Fill up the pot to within 1in. of the top with a saturated solution of copper sulphate; pour in the outer jar a saturated solution of zinc sulphate to about the same height, and put in a few scraps of zinc.

This cell should only be used as a standard with which to measure the E.M.F. of other cells, and before being used should be short-circuited for a short time, about ten minutes.

After testing, pour out the solutions into their respective bottles and fill up the cell with water; by these means the E.M.F. will remain fairly constant, and may be taken as 1·07 volts.

Method of Sum and Difference.—Connect up the cells in series with the galvanometer (Fig. 27 a) and take the deflection α_1, then

$$K \tan \alpha_1 = \frac{E_1 + E_2}{\rho}$$ where ρ is the total resistance in circuit. Without altering the resistance connect up the cells in opposition (Fig. 27 b), and again read the deflection, then

$$K \tan \alpha_2 = \frac{E_1 - E_2}{\rho}$$ the resistance being the same in both cases. From these two equations we get

$$\frac{E_1}{E_2} = \frac{\tan \alpha_1 + \tan \alpha_2}{\tan \alpha_1 - \tan \alpha_2};$$

or, if $E_2 = 1{\cdot}07$ volts,

$$E_1 = 1{\cdot}07 \, \frac{\tan \alpha_1 + \tan \alpha_2}{\tan \alpha_1 - \tan \alpha_2} \text{ volts.}$$

There are other methods of comparing E.M.F.; but as they require a knowledge of the internal resistance of the cells, they will not be discussed till later.

Galvanometer Resistance.—There are several ways in which the resistances of the various galvanometer coils may be measured:

(i.) Ordinary Wheatstone's bridge.
(ii.) Thomson's method.
(iii.) Calculation from length and size of wire.

The most satisfactory way is the first, but it requires the use of another galvanometer. The needle is dismounted, and each coil measured in the ordinary way (see Fig. 22).

For the two thick coils of the galvanometer (iii.) will do very well. Thus total length of coils $= 2 \pi n r$ + connecting wire, where $\pi = 3{\cdot}1416$, n = No. of coils, and r = radius. For the first coil we have $n = 10$, and r = 4in., and allowing 1ft. of wire for connection, total length = 22ft. The resistance of No. 18 wire per yard is ·0136 ohm; ∴ resistance of the coil = ·1 ohm. The resistance of the other coils can be found in the same way, taking care to give r the *mean* value of the radius.

Measurement of Battery Resistance.—Connect up the battery whose resistance is to be measured with the box of coils and the galvanometer (with commutator).

Arrange the resistance in the box so that a deflection of about 55° is obtained, then carefully read; reverse, and read again. Put more resistance into the circuit, so as to bring down the deflection 10° or so, and again read.

Measure the length of the connecting wires (*which should be about No. 18*), and find their resistance by multiplying its length in yards by ·0136.

Let G be the resistance of galvanometer connecting wires, &c.; when the first deflection α is obtained, let r be the resistance which diminishes the deflection to α_2, then

$$B \text{ (resistance of battery)} = \frac{r \tan. \alpha_2}{\tan. \alpha_1 - \tan. \alpha_2} - G$$

This method of measuring internal resistance is a very good one, and with care will give good results; but the test should be made as quickly as possible, so that the battery may not polarise. The constants of the instrument can now be determined. Carefully set up the instrument, and connect up each coil (with commutator attached) to one or two of the standard cells attached and a resistance box. Put in sufficient resistance to bring down the deflection to about 45°, and carefully read; reverse and read again.

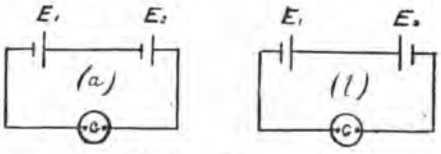


Fig. 27

Now determine the internal resistance of the cells, as just described. Then—

$$K \tan. \alpha = \frac{n\,(1{\cdot}07)}{B + G + R}$$

$$\therefore K = \frac{n\,(1{\cdot}07)}{(B + G + R) \tan. \alpha}$$

where n = number of cells used; B = battery resistance; G = resistance of wires and galvanometer; R = the resistance inserted in the box. In this way the constant of each coil can be determined.

Another Method of Determining E.M.F.—Connect up each cell in turn (the standard and the one to be tested) with the galvanometer and resistance box; obtain a deflection about 60°, bring this down to 40° or so, carefully reading each. From these observations determine the internal resistance B_1, proceeding in the same way with the other cell, and determine its resistance B_2; then taking one set from each we have—

$$K \tan. \alpha_1 = \frac{E_1}{B_1 + G + R_1} \text{ for 1st cell.}$$

$$K \tan. \alpha_2 = \frac{E_2}{B_2 + G + R_2} \text{ for 2nd cell.}$$

$$\therefore \frac{E_1}{E_2} = \frac{(B_1 + G + R_1) \tan. \alpha_1}{(B_2 + G + R_2) \tan. \alpha_2}$$

If R_1 and R_2 be so adjusted so that the two deflections are equal $\alpha_1 = \alpha_2$, then—

$$\frac{E_1}{E_2} = \frac{(B_1 + G + R_1)}{(B_2 + G + R_2)}$$

In conclusion, those who wish to become well acquainted with electrical measurement cannot do better than carefully study "Elementary Lessons in Practical Physics," Part II., by Stewart and Gee, also "Absolute Measurement in Electricity and Magnetism," by Gray—both published by Macmillan.

J. S.

AMATEUR METAL FOUNDRY.

[27711.]—Mr. Seyd, in recommending (p. 525) ordinary founder's green sand, is evidently unaware of the fact that a very much superior kind of sand for fine moulding is prepared specially for the use of dentists, and can be obtained from any of the dealers in dentist's appliances. This sand gives a much finer and more perfect face than any ordinary moulder's sand, and, being very much more cohesive, is very easy to manage in deep drawing and difficult patterns. So great is the difference in working that anyone accustomed to work with dentist's casting sand would fail to obtain good results with any other without a considerable amount of practice and extra care.

Thos. Fletcher.

PROPULSION OF VESSELS—PADDLE BOATS.

[27712.]—Will Mr. Roberts (see p. 535) explain the action of this novel arrangement more fully? By what means are the paddle-boards made to keep in a vertical position? as by the sketch it would imply that their own weight would be sufficient, which would not be found to be the case in reality. It would seem that the effective propelling power is represented by one of these "boards" on each side constantly in the water. This leads to the consideration, "What is its superficial area as compared to an ordinary set of paddle-boards? Also, what size are the cranks to be, in order that with the same engine-power an equal velocity of the boards, not to mention a greater, is to be obtained?" The slip "must" be just as much as in any feathering arrangement as at present used. Are not both the high and the low-pressure cylinders in connection with the crank-shaft, as would be the case were ordinary paddle-wheels on the vessel? And supposing this to be the fact, would there not be far more area of boards, as well as much greater speed of their movement, than it is possible to attain by means of these cranks, as there is no practical reason why the engines should be allowed to revolve quicker in the one case or the other? The paddle-box, if not so high, would be more than twice as broad as an ordinary one.

A., Liverpool.

[27713.]—Further to my letter in reference to above, I have just come across letter 27608, from "A., Liverpool," in which is stated an objection against Mr. Marshall's method of propulsion, that the sudden withdrawal of the pistons has a tendency to back the vessel, so retarding it. This fact cannot be controverted, the water being heavier than the vessel, and at the first look it would seem to apply equally to the method of propulsion suggested by me; but I find it is possible to provide against this, and cause at same time an acceleration in speed of ships, by simply arranging that when piston is ascending to open the forward pipe, closing the after one, so that the water *is drawn into the cylinder through the forward pipe*, the effect being to *pull* the ship onward.

In the description given under diagram, a word has been misprinted. Instead of "pouring" it should be "pressing," which more correctly describes the action.

Nomoplast.

ELECTRICAL THERAPEUTICS.

[27714.]—I send you from a large collection of cuttings from the *Lancet* a few on the above subject:—

"Investigations undertaken to prove that the Electric Condition of Mineral Waters is the Principal Cause of their Activity.—M. Scoutetten has of late worked very hard to prove the above proposition, and has published several accounts of his researches in the French medical papers. To give these researches some authenticity, M. Scoutetten repeated his experiments, a short time ago, at Mont Dore, a watering-place in Auvergne, under the eye of a distinguished medical committee, whose report is inserted in *L'Union Médicale* of the 25th of July. The author states, in his introduction, that 'his researches throw a new light on the question; they prove that the waters, when emerging from the soil, are in an exceptionally active condition, that a chemical action productive of electrical phenomena is going on; and that to this cause the general effects of mineral waters are to be attributed.' The experiments undertaken before the committee alluded to above, have proved—1. That the platinum electrodes, placed in ordinary water contained in a glass or china vessel, are not affected by even a trace of dynamic electricity; and that the needle of Nobili's galvanometer remained motionless. 2. That the same experiment, performed with mineral water, immediately caused a considerable deviation of the needle. 3. That the same mineral water was examined in a like manner at various periods after collecting the water at the spring, and at different degress of temperature, it being found that the elevation of the temperature sensibly increases the electrical manifestation; that the latter become weaker, on the contrary, the later the water is examined after emerging from the spring, which peculiarity is easily explained by the diminution and subsequent cessation of chemical action. Another experiment has shown that the immersion of only a portion of the human frame in mineral water is sufficient instantly to give rise to electrical phenomena, which are rendered manifest by the deviation of the needle. This important fact explains the exciting qualities of mineral waters, which qualities may be so powerful as to induce a feverish state in the individual acted upon. This property exists in all mineral waters, but in different degrees, regulated by the activity of the chemical combinations. This electrical action cures disease by strengthening weakened organisms, which diseases are apparently widely different, but are nevertheless merely local manifestations of a general morbid state. It should be added that several experiments were undertaken with gold leaves, so as to prove that statical electricity does not exist in mineral waters. The latter have also been tried mixed with milk or syrup, and it was found that this mixture sensibly lessens the active properties of the waters."

"Galvanism in Lock-jaw.—Sir,—I have observed in your impression of February 6th a paragraph, stating that M. Matteucci tried the effect of galvanism in a case of lock-jaw; but only temporary relief was afforded, and that from thirty to sixty pairs of plates were used. Having succeeded a manner as not to require a senior wrangler's mathematical knowledge to apply it, I shall be as glad as Mr. Brokenshire to learn of it. In the meantime, he cannot do better than set to work with stage micrometer and camera lucida and make his own measurements, being careful *always* to have the distance from eye-lens to paper *exactly* the same as from back of objective to eye-lens, whatever that distance may be.

Mr. Brokenshire asks to be "let down" gently. For my own part, I do not see that any letting down is necessary. When information is honestly sought, it should be honestly and kindly given by those who possess it, without any thought of letting down the querist; for I apprehend that the most learned amongst us is a long way short of possessing all knowledge, and must at some period of his career have been *very* dependent upon others for help in solving problems that then puzzled him.

Chorley, Lanc. **F. Jas. George.**

TEA AND COFFEE AS SANITARY BEVERAGES.

[27719.]—NEARLY every article of human consumption, *taken in excess*, has a deleterious effect on the system, more or less, according to the climate and constitution of the consumer—notably the above two vegetable products in daily domestic use.

Analytical investigation has long ago discovered two active principles, *theine* and *caffeine*, both of which proved fatal to cats in some laboratory experiments. The fresh leaves of the tea-plant are powerfully emetic, a property only removed by the bruising, squeezing, and rubbing they undergo on coarse bamboo mats in the first stage of manufacture. When the rolling tables are annually cleaned, this poisonous juice is found inspissated, or in dry masses. Some specimens were forwarded to Europe for examination; but I have never heard the result.

The infusion of high-class properly roasted leaf, generally diluted with milk, on the moderate scale of a cup or two with a hearty meal, is highly beneficial to the digestive organs, being a very mild stimulant of a soothing character. Its value was recognised during a great epidemic of Asiatic cholera in France, for use of convalescents, who had a particular longing for this liquid food. It is also much praised in that country as a pleasant drink for sufferers from colds and coughs. Only chemists keep tea in stock there, and no tea-dealers or grocer vendors (or were not at the time I mention), for our Gallic neighbours call it a *medicine*. In my own case of "Insomnia," produced by over-study, very strong green tea, prescribed by an amateur homœopathist, on the usual *similia similibus* formulary, proved very effective. I was reading hard at three Oriental languages (often till midnight), and was brain-racked by hard-worded phantasms—this, too, in spite of daily rides and many out-door recreations. The counter excitant proved the stronger to the nervous system, and I soon slept well and naturally. Of course, there must be no milk in the infusion, and I have eschewed that animal fluid from boyhood, having a dislike to it—like the Chinese, with whom I have occasionally enjoyed a cup of pure, aromatic Bohea, tasting only of itself.

Newly manufactured teas are stored in bulk for a year or more, with the object of ridding them of the acrid volatile principle adherent to the fresh leaf, besides adding aroma to the same. The Celestial opium-eater long ago discovered this "pick-me-up" preparation, without which aid he would have succumbed to sleep and sloth; still, he is short-lived.

No doubt the all day long tea-drinking habit of a few individuals in this country induces premature decay by impairing the functions of the stomach, and then the nervous system. I know a town practitioner who has been preaching widely to domestic servants on this addiction to "too much of a good thing"; but how much worse and more general is the abuse of alcohol, the gluttony in fat-producing aliments, and many other self-indulgences of modern life! For many years after I arrived in tropical climates I could not swallow the usual early morn cup of tea without the attendant emetic effect of ipecacuanha; hence I took a disgust to the beverage, and substituted iced water, or the coldest I could obtain, with much benefit to my stomach—a natural tonic of invigorating character, if the element be chemically pure.

The preparation and consumption of tea-leaves doubtless originated in China; hence the traveller in N.E. India comes across what is locally termed "Indigenous tea," scattered in occasional belts and patches over the great wilderness of Upper Assam, and in the forests of the Shan frontiers, where man without written language hunts the abundant fauna. He is fond of the native leaf; having collected a supply of the young shoots and buds, he pounds them between stones, kneads them, and mixes with salt. When dry, he gets a hollow joint of the large bamboo and rams this queer mess into the cavity. He slings this crude tea-caddy by a fibrous string over his shoulders, and when in want of the cheering cup, he picks out some of the ugly, dirty compound with the point of his trade knife. I never saw his teapot or kettle, but having used a joint of bamboo as cooking-pot for rice myself in Savageland, I suppose the wild man can boil his tea equally well. In Kashmir and Central Asia "brick tea" is in popular use. This is merely any good sort of tea reduced to dust and kneaded with sheep's blood into small oblong slabs (for the sake of portability, I imagine). A large iron pot is placed on the fire; when the water boils, a large piece of the brick is thrown into it; then soda, bitter aromatic drugs, salt, sugar, butter, &c. —a most awful brew, which for politeness sake I have accepted, and secretly emptied on the ground, while I used to mutter, "Deliver me from *such* an afternoon tea." The colour of said decoction resembles that of a mountain torrent in first flood, ruddy and turbid! There are many agreeable substitutes to my thinking: fresh mint leaves with a slice of lemon and a bit of sugar-candy, or balm leaves, similarly used, as an infusion; or of lemon grass slightly acidulated with citric acid. All these are sudorifics, if taken hot, and great quenchers of thirst, too; they are of immense value in the febrile disorders of hot climates, where they act as "diuretics." I recommend them all as dog-day drinks in Great Britain; their cost, too, is within the reach of a beggar! As a milk hater, they are doubly valuable to me.

Now let us turn to the more potent and valuable stimulant, coffee. As taken by the majority of English consumers, the very large proportions of water and milk employed in its concoction deprive its daily use of all noxious probabilities. Then, again, it is so frequently adulterated with harmless ingredients to swell the weight and bulk of the ready-ground article, that the effects of any caffeine must amount to nil. I dread the so-called coffee of refreshment rooms, entertainments, and British matrons. Politeness forces me to sip it, and drives me to my tobacco pipe as soon as possible, to eradicate the sickly flavour of the spoiled beans. I have grown them, roasted them, swallowed the decoction (strong and black) in moderation, and have administered them in dangerous malarious fevers with success. There is no better counterpoise to the narcotic effects of opium or tobacco, with which view, I take it, the beverage is so largely consumed by the Turks. A gang of French miners have been known to outwork two or three reliefs of Englishmen, the former only consuming occasional draughts of black coffee, the latter using alcohol or malt liquor. I have had this corroborated by the losing party. I believe all Europeans of sedentary life and indoor occupations may be injured, and slowly killed, by addiction to strong black coffee. Not so the Dutch settlers and Boers of South Africa, who have the coffee-pot ever on their hearth, and imbibe the pure extract by boiling infusion at all hours; when they "off-saddle" after a long journey, or stop their waggons, they all shout for coffee, and it comes. Within a small radius during my travels there were five patriarchs over 100 years, and plenty of octogenarians—all Dutch colonials. I attended the golden wedding of a stalwart specimen, who helped to keep up his grand festive hospitality for a fortnight. There were 120 guests, of whom more than half drank largely of black coffee in the daytime, and naught else. I have met with foreign doctors who insisted that addiction to strong coffee produced "heart disease," and advocated a large percentage of admixture with roasted chicory roots as a preventive. Moreover, as this drug has diuretic and hepatic virtues, it may possibly act in protecting the kidneys. Alcohol—especially the noxious gin tribe—is far more likely to kill in that way than the strongly-suspected coffee. Those who like the aromatic flavour of the beverage without risk, can well imitate it by slowly-roasted horse-beans or any large garden peas—carefully browned—rice of whole grain, bread gradually burnt brown over charcoal, adding a percentage of the best newly-ground coffee. I abhor the taste of chicory, and so do many persons. For a great many years I have swallowed one small cup of pure black coffee daily at an early hour; again, one large cup of same at breakfast. I consider the possible effects of the same are balanced by my pipes of tobacco, and active outdoor life. Were I a town dweller, neither luxuries might suit my bilious constitution, to which butter and eggs are peculiarly obnoxious and distasteful. There are very few persons, except the travelled Englishman or Englishwoman, who really understand the preparation of this beverage. Water at boiling point, beans roasted and ground just previously, a proper fireproof ware pot admitting of bottom heating while percolation is proceeding, enough ground coffee in the said pot. Baron Liebig put all these rules in print years ago —yet how few persons seem to act on them! Every French soldier and sailor can do this properly; the workman has it done for him at the street stalls, the odour of the beans as they revolve in the little iron cylinder over the bright charcoal fire being very enticing. Be it known that the vapour arising from burning coffee-berries is a deodoriser and purifier. In the slavers, when any mortality occurred between decks, a shovel heated red hot was filled with coffee-beans and carried below, supplying a cheap and ready mode of fumigation; thence the discovery was carried to India, and brought to the notice of the English Government. I discovered this property accidentally. The smallest, and at the same time most potent in medicinal virtues, is *Coffea Bengalensis* —an indigenous shrub, covering low hills in Assam. The fragrance yielded from this species, on burning the beans, surpassed that of the best Mocha, while the flavour, equally fine, was rendered nauseous by an intense bitter, clinging to the palate like quinine. As the latter febrifuge was not to be had, I tried the necessary experiment of administering small and frequent doses of a black infusion to one of my boatmen, a native, whose skin had turned to saffron hue by a severe attack of jungle fever, and I had the satisfaction of eventually seeing him shake off the dangerous malady. I brought the curative power of this new remedy to public notice in Calcutta. Coffee has long ago been found a palliative in acute asthma; it arrests the paroxysms very rapidly, and is often used in Europe in preference to many dangerous drugs.

All those who wish to ward off sleep can do so effectually by taking a cup of pure, black coffee, if unused to do so. In my own case it rarely succeeds, as I am a regular consumer. I believe the after-dinner cup of genuine black coffee (I am speaking of public and private feasts, not the every-day homely meal) to be a good prescription for an over-loaded stomach and heated brain. I have found it so. Kidney disease is so very dependent on conditions of climate and bodily infirmity, inducing that form of abnormal symptoms —the state of the liver especially—that I must hesitate to accuse coffee of being an agent, any more than tea or tobacco. **Boa.**

"ABOUT A HAT."

[27720.]—YOUR correspondent (letter 2768[illegible], p. 536) has succeeded in writing as funny a letter as if he had intended it for *Punch* instead of your practical columns. To take it seriously is very difficult; but if we must be in earnest, it would be quite safe to suggest that he may as well leave it alone, or, say, to the law that permits only the "survival of the fittest." The hideous stove pipe has been attacked by all sorts and conditions of men, villified from every point of view, but it holds the field, and will do so apparently for many a generation yet.

Why? Because it suits our 19th-century taste; because it adds more than anything else yet discovered (at all practicable) to the dignity of the human figure and the comeliness of the ordinary run of faces.

To put it on the table is an unfair way of looking at it, as much as it would be in estimating the artistic value of a pair of breeches. The effect on the wearer is the proper standard of judgment. The truth is we don't quite understand the stove pipe; we have not the secret of its charm, and till we find it out we shall only be foolish to rail at its popularity.

Perhaps it is the lines of ever varying flexure—its flowing brim, its balance of parts. It may be its respectability, or even perchance its rare durability; but Mr. Richards may be sure that no helmet-shaped, flapped mushroom cowl ventilated arrangement in drab will, in our day at any rate, "knock it out of time."

I question very much whether ear flaps are desirable on any grounds. They may be useful occasionally, say once a year; but the blue and swollen ears of 'bus and cab drivers will not be remedied by such things, no more than would their sometimes just as blue and swollen noses.

M. C. W.

CORRECTIONS: HOWORTH'S FLOOD.

[27721.]—IN p. 538, line 8, my first word was "writing." Four lines lower, "'F.R.A.S.' must know well that, with more reason could," &c. Further down, the clause "[according to Darwin, however, destroyed animals, large and small, from Patagonia to Behring Straits]" should have been bracketed thus, it being not Howorth's, but my remark on his passage; which then recommences with the words, "and which forms a great dividing line," &c. The points I meant to emphasise are that while one author, Darwin, ignores Genesis, and the other, Howorth, sneers at it as Babylonian legend, by their mutual corrections, each finds the other to err exactly where, and only where, the said other differs from Genesis.

In the last but one of same letter, "it" does not mean (as, perhaps, in strict grammar it ought), "the earth," but the previous mentioned "seven-

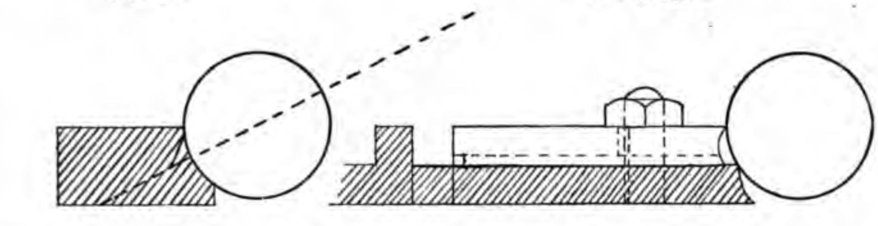


FIG. 1

FIG. 2

and should be tapped into the bottom bar and riveted over to allow the bottom bar to slide smoothly on the face of rest. A nut must then be fitted on top as shown, and a piece of iron placed in the recess at back so as to prevent the top bar springing back when pressed against the hob. The top bar presses against a piece of square rubber, placed in a notch, forming a powerful spring, thrusting the top bar forward, and tending to keep the bottom cutter out of action. When, however, pressure is applied to the bottom bar to cut a screw, this spring holds the top bar up to its work, whilst still allowing sufficient play to the bottom bar. Of course, it is essential that in forming the thread on chases the top and bottom bars should be cut at once. The bolt prevents the top bar lifting, and the overlapping prevents side play, which, of course, would be fatal. I have not now got a lathe, so I cannot test this myself; but if thought of any use, perhaps some correspondent will kindly test and report. The chaser plates might, perhaps, with advantage be notched at the top cutting edge to give more back clearances. The sketch is roughly to full size, and is, perhaps, rather flimsy; but its use being only to start the thread, perhaps it is heavy enough.

Govan. **G. T. Pardoe.**

THE EDMUNDS MANDREL.

[27730.]—*Thread-rate.*—In studying the thread of our lathe nose one point has been overlooked. What length of working thread-face do we get from a particular length of threaded cylinder?

If a square thread be examined it will be seen that the shortest element of working thread-face requires the thickness of two threads—i.e., one thickness of thread behind each of the faces. If one complete turn of working thread-face be examined it will be seen that, in addition to the pitch-distance which it makes along the cylinder, there is also the thickness of one thread on each side to support the end of the working face. Therefore, the shortest portion of working thread-face has outside it on each side the substance of a whole thread. One whole turn requires the length of the one thread *plus* that of two others. Two, three, or more full working turns of thread-face, therefore, all alike require, along the cylinder, the pitch-distance of their own number of turns *plus two.* This may be expressed algebraically of all screw threads by putting n for the number of turns of working thread-face, and then the length of cylinder required, in terms of the traverse made by each turn of the thread, will be

$$n + 2.$$

If now we examine a truncated thread, such as our buttress thread truncated one-fourth top and bottom, we see that there is a flat outside the substance of each extreme thread which, though part of the pitch distance, is formed by the surface of the stem at the bottom of the groove and constitutes no part of the thread. Now, in truncated threads these two flats have to be deducted from the length of cylinder required, and if we put f for the flat, the expression becomes

$$n + 2 - 2f.$$

In a long screw-bolt this additional length of cylinder required for a given number of working threads is not important. But in utilising a short-screw-nose the amount of cylinder thus taken up before we get any length of working thread-face is a matter of great importance. And as the ratio of this addition increases with the increase of pitch, it follows that we waste more of our nose by having a coarse thread than by having a fine one. To get the maximum amount of strength in the thread upon our short lathe-nose we must, therefore, make it no coarser than is necessary. Our thread must not be so fine as to cause the chucks to jam, nor so fine as to put undue axial tension upon the nose. But I think it must not be so coarse as ·2in. The thread-rate then should be either 6, 7, or 8 turns per inch, and the finer the thread the less waste do we get in the length of our nose.

Diameter of Nose.—Our model mandrel being tubulated throughout, we have to treat its nose, not as a *screw bolt*, but *as a tube.* And the substance of the nose is better disposed of in the direction of width than of length. But, taking a finer thread, our nose will be less deeply incised, and, therefore, something may come off its diameter. If we keep the total projection of our nose at one inch, how far may we reduce its diameter below the $1\frac{1}{16}$, which in my last letter was suggested with the five-turn thread?

The bore of the mandrel shaft is $\frac{5}{8}$th (·625in.), and, if the interior of its nose is to serve as a chuck-hole for miniature chucks, we turn out the first $\frac{1}{4}$in. to a diameter of $\frac{3}{4}$in., while the next $\frac{3}{8}$ths will be threaded out at the rate of 16 turns per inch, and will incise the nose inside $\frac{1}{32}$nd all round. Our mandrel-shaft is to have an outside diameter of 1·125 ($1\frac{1}{8}$), 1·1875 ($1\frac{3}{16}$), 1·2, or 1·25in. ($1\frac{1}{4}$), between the gear-wheel and the mandrel-head. In this long stretch of shaft we have to provide not only for strength but also for *stiffness.* But in our nose we have to provide only for strength. And we want to make our nose-screw at its junction with the cylinder-base nearly equal in strength to the shaft. The internal hollowing for the chuck-hole would terminate at $\frac{5}{8}$in. from the end of the nose, and would not reduce the substance of the nose internally at its base. Now, if we reduce our nose to 1·25in. in diameter, and screw it with a thread of seven turns, i.e., ·0714 in depth, we leave a nose-stem 1·107in. in its diameter at the bottom of the thread, and, if we add to this, as the strength arising from the thread upon the stem, the depth of one thread (·0714), we get a virtual diameter of 1·18 in the nose-screw, but only as against torsional stress and not as against tensional.

Taking the six-turn thread, we incise the nose all round $\frac{1}{12}$th of an inch, and reduce the stem to an unincised diameter of $\frac{15}{12}$th minus $\frac{2}{12}$th inch ($1·25 - ·1\dot{6} = 1·08\dot{3}$) which leaves $\frac{13}{12}$th inch. If, instead of making the inside of the nose a chuck-hole, we cone it out for interchangeable centres, we do not reduce the strength of our nose-stem to the same extent as for internal chucks. Then, upon a $\frac{3}{4}$in. bore, with our six-turn thread, we should have $\frac{13}{12}$th of an inch, minus $\frac{9}{12}$th, which leaves us $\frac{4}{12}$th of an inch; this divded by two gives a tubular stem one-sixth of an inch thick. But the coning out for centres would leave the substance of our tube stronger than this, and also with its substance increasing uniformly towards the base of the nose, which is its best possible disposition. Considering the availability of adapter chucks for old ornamental apparatus, it will be our most usual course to adopt coned interchangeable centres for the head-stocks, and use our adapter chuck to carry miniature and repetition noses. To this tube of cast steel a sixth of an inch thick we may add something towards its stiffness and torsional resistance, on account of the screw-thread. Therefore, a nose of 1·25in. in diameter, screwed with a six-turn buttress thread truncated $\frac{1}{4}$in. at top and bottom, gives us a tubular screw-nose of great strength.

The point at which our nose-screw passes into our nose-base is one of great importance. After making a good many models, I have come to the conclusion that this point should be turned completely out by an annular groove exactly to the same depth and shape as the thread-groove, but with the obtuse angle of the point of the tool smoothed off so as to make a parabolised sweep through which the nose-base shall flow into the screw-stem. The stress which may occasionally be inflicted upon the mandrel at this point, by unduly heavy work or by carelessness or accident, will by this parabolised sweep be distributed, instead of being all converged upon a circular line. Then, in order to produce cylindrical work of the highest character, the flexibility of the mandrel-shaft must be alike in every diameter. A square mandrel-shaft will be found, when under considerable stress in turning, to produce work whose cross section is a square with its angles greatly rounded. The reason is that elasticity is an element which cannot be altogether eliminated, and a square mandrel-shaft, when under stress on its diagonal or long diameter, will bend much less than at every alternate quadrant of its revolution when there is only the side of its square in diametral resistance to flexural stress. Hence our model mandrel should have no point at which thickening or thinning occurs to vary its flexural elasticity on different diameters. Now the root of our nose-screw, if not turned out to a complete annulus, will obviously constitute a buttress which would stiffen unduly its own diameter of the mandrel-nose. In order to get uniform elasticity at all points of its revolution, we therefore turn this out; and, in order to distribute any exceptional stress which may be inflicted on the mandrel-nose at this point, we parabolise the obtuse angle at the point of the tool with which we have cut our screw-thread. This annular screw-thread groove must be turned out with great nicety, and it must not incise the stem more deeply than the screw groove. And, in designing our nose, we must provide ample substance for the annulus.

Cylinder-base.—It is necessary to keep the length of our cylinder-base to one quarter of the length of our 1in. screw-nose. With refined workmanship, *and a proper grinding machine*, the ·25in. can be ground up within a quarter-thousandth, and when produced, this $\frac{1}{4}$in. will be more than we need for strength and endurance. A workman, unprovided with a proper grinding machine, would want $\frac{1}{2}$in., and would spoil that. The $\frac{1}{4}$in. is all that is needed if the mandrel-face be entered axially by a broad groove on its inner half, and if the same groove also enters radially into the cylinder-base, so as just to show light between the bottom of the cylinder-base and the plane of the mandrel-face when viewed in projection. The polishing down of the cylinder-base to gauge must be done by a V-faced lap wheel, revolving at 45° from the mandrel-axis. The rounded shallow groove may incise the bottom of the nose-base as deeply as may be necessary. As to the additional diameter to be given for our cylinder-base, the amount on which I settled in my former model was ·05in., which allowed $\frac{1}{40}$th rise all round upon the radius. But with our buttress-thread and the circular annulus at the root of the screw-thread, we have a cylinder-base descending into the nose-stem at an angle of 45°. Therefore, the more we give to the diameter of our nose-base, the shorter we make its working-face. Now, $\frac{1}{100}$in. would suffice for this increase in diameter, as all we really need is to protect the chuck-recess from being injured by contact with the nose thread. I find in my models that an allowance of $\frac{1}{80}$th would do very well, but, on the whole, I prefer $\frac{1}{50}$. Two-fiftieths add $\frac{1}{25}$th for the diameter of the nose-base. This makes our nose-base $1·25 + ·04 = 1·29$in.

This will make a sound and artistic construction. Those who require a stronger nose will simply lengthen the nose, and thus add more thread while increasing the distance between the nose-base and the internal reduction of substance for the chuck-recess or coning-out.

Those who go for very light running at high velocities may keep down the front bearing to $1\frac{1}{8}$ and make the bore anything between a full $\frac{1}{2}$in. and a full $\frac{5}{8}$, according to the strength they require in the mandrel-shaft, while the nose will be kept down in total projection to 1in. In this way the screw-thread, nose-diameter, and nose-base will remain invariable, while all other points may vary to suit special objects.

I cannot leave this topic without stating that on some points I have as yet failed to carry manufacturing instincts with me. Mr. Birch is well known for the beauty and accurate working of his medallion and other fine lathes, and his tools in the present Manchester Exhibition excel in design and in execution. His feeling as to manufacturers' requirements must, therefore, be taken seriously into account. He is perfectly convinced as to the value of the principles which are involved in our standard mandrel-head; but he thinks that the nose should be made of a length equal to its diameter, and that the 1·25 nose-screw is needlessly large. On both these points I have listened with great interest to Mr. Birch's sturdy criticisms, and have thought them all very carefully over. His fixed rule of making the nose at least as long as it is broad is, no doubt, a sound one *for a solid nose*: but *for our tubular mandrel* I cannot convince myself that he is right. I believe that he has not yet realised that we are designing *a screwed tube* and not a screwed bolt. I therefore simply believe that he will ultimately adopt our view as to the advantages secured by disposing of the mass of our nose rather in the direction of width than of length. On the second point I think Mr. Birch may be right, and at any rate I think we shall be safely guided by the conclusions at which he may ultimately arrive. If we throw over the scope reserved for internal chuck fitting, and only cone out our mandrel-nose, we get everything we can want, and perhaps more simply and cheaply, by means of adapter chucks for miniature and repetition noses. Of course it may be said that this renders it less necessary to reduce the size of our main mandrel-head to its narrowest limits. But I think we must be guided here by Mr. Birch. If, then, we reduce the diameter of our nose still further, to what extent shall we go?

Now I stand upon reserving the possibility of having, throughout our mandrel-shaft, a $\frac{5}{8}$ths bore, always free from obstruction. The annulus at the root of the nose-screw is our weakest point, and this will be $\frac{5}{8}$in. from the end of our inch nose. If we cone out the bore for 2in. from the end of our nose at the rate of $\frac{1}{20}$, which, by the table of tangents, gives us twice the tangent of 1° 26', we get a hollow cone of 2° 52'. This reduces the substance conical and those with the cylindrical bore. Up to the year 1847, all flutes were made with the conical bore, except the fife, which has now gone out of use. The military flutes are still made conical, and so are the ordinary flutes, with from one to eight keys. In the conical flutes the head or top joint into which the performer blows has a cylindrical bore, and in the body and foot joints the bore becomes gradually smaller towards the end of the instrument. In the cylinder flutes, on the contrary, the body and foot on which are the keys, are cylindrical, and the head joint tapers towards the top. The cone in this case is not a straight taper, but is slightly curved, forming a section of a parabolic curve. In the conical flutes there are many different bores employed, some large, some small, and varying in numerous particulars. The conical flute has several serious defects—for instance, the six holes covered by the first, second, and third fingers of each hand have to be placed where they can be conveniently reached, and in consequence their correct size and position have to be sacrificed with the necessary results of incorrect tuning and inequality in the tone of the several notes. In the modern cylindrical flute, the holes are of equal size, and placed in their correct positions. The fingers are not used to cover the holes, but to depress the padded keys which perform that operation. In Carte's 1867 patent flute, the size of the bore is nearly ¾in.; embouchure, ½in. by ⅝in.; total length, 25½in. If you are bent upon making a conical flute, your only method is to borrow one and copy it. A verbal description would be of but slight value.—SM.

[62665.]—**Shutt End Ry.**—"Nun. Dor." would much oblige by giving those "further particulars" he is kind enough to offer.—LOCO.

[62669.]—**Smelting.**—The details of the process employed in making malleable cast iron are of so little interest to the majority of your readers that I think the querist should be referred to Dr. Percy's classical work, or to Bauerman's "Metallurgy of Iron" (Lockwood and Co.) At the same time, the querist may be told that he will find a great deal of practical information on the subject in back volumes, and that if it is worth while to search for it he will find it. See p. 470, Vol. XLIII., and the indices generally.—SELIM.

[62671.—**Cleaning Castings.**—Scrub with coker-nut husks and sand, and then pickle in the acid dip.—NUN. DOR.

[62672.]—**Dry Cleaning.**—This process is, I believe, simply cleaning with benzine, and has been fully described in back volumes. It is so good a process that in one work, which is supposed to give tried receipts, it is actually repeated three times on adjoining pages—camphine being the hydrocarbon used. Any further information on application. There is no "patent" in it, or anything else.—SAML. RAY.

[62678.]—**Cracks on Stained and Polished Work.**—Should have used an oil varnish—carriage varnish for such work, or if black is required coachmaker's japan. Spirit varnishes are always liable to crack, and do so particularly over black, which absorbs heat.—NUN. DOR.

[62682.]—**Jew's Pitch.**—Bitumen of Judæa, or asphalte, adheres firmly enough to glass when the latter is properly cleaned. Use nitric acid after cleaning well with potash.—NUN. DOR.

[62686.]—**Heating Bath.**—Try the plan illustrated by "Eos" in No. 1,154, p. 225, or procure Mr. Fletcher's catalogue of gas appliances. Don't understand what is meant by a cess pot.—COLD BATH.

[62689.]—**Telescoping of Carriages.**—This querist might possibly find what he wants in the *Engineer* or *Engineering*. I fancy I have seen illustrations of telescoped trains in those publications. It is a peculiar request—not of much use to English Mechanics, one would think.—K. R. P.

[62694.] — **Distilling Whisky — Sulphuric Acid.**—The records of our great London hospitals, one and all, but especially those of the University Hospital, contain cases of lead-poisoning sufficient for my present purpose. In these said records "Nun. Dor." will find the apparently marvellous statement that the daily dose continued many months of gin and of beer containing lead (PbO,CO_2) in so minute and attenuated a form as 1/15,000th part of one grain dissolved in one gallon (70,000 grains) of the said liquors, has resulted in a most profound disorder in the health of the individual or subject. That a pernicious result of a continued, almost immeasurably, small dose of an elementary substance can and often does happen, all of us will, I conclude, henceforth tacitly admit. That sulphuric acid dilute B.P. has a beneficent chemically preventive action in favour of those obliged to work with and amongst lead and its salts, I have not denied; but I maintain that the quantity of each dose of HSO_4 actually necessary chemically for the said end is often very much exceeded, in consequence of which, and not from the lead only, the health of those using it is often much below the usual standard. One of the leading symptoms in lead-poisoning being *bound bowels*, when a person presents himself as an out-patient at the Great Ormond-street Hospital suffering from most obstinate constipation, plumbum is *the* medicine successfully prescribed, provided the whole or totality of the symptoms (not caused by lead-poisoning, though) point to or indicate lead as the remedy. On the other hand, in a case of acidity of stomach, HSO_4 dilute is the marvellous antidote. So much for the theory of *similia similibus curantur*—the guiding star in modern medicine. A perusal of some of the items in "Drugs and Doctors" in the "E.M." of last year, and of some of the excellent League tracts issued at 1d. and 2d. each by the secretary of the Society, E. H. Laurie, Esq., 16, Blandford-square, N.W., or by the printers, Messrs. Bate and Son, 87, Titchfield-street, W., being *tres apropos* to this subject. As to the symptoms of disordered health caused by sulphuric acid dilute Dr. Ringer, in his enormously-popular book on therapeutics (the art of healing), and who is the great authority at the said University Hospital, says, "That although HSO_4 dilute does in a small dose benefit diarrhœa, yet a full dose, by increasing the acidity of the digestive canal, aggravates the said diarrhœa." Christison says that the use of sulphuric acid dilute often "causes eruptions to break out all over the body." (N.B. Consult an elaborate work on the materia medica of homœopathy, under the heading of the elementary body, sulphur—dear "Nun. Dor.") Drs. Royle and Headland speak of HSO_4 dilute as a powerful astringent. Pereira says "that all the mineral acids act both locally and constitutionally; that if long-continued, then the tongue becomes white, appetite and digestion impaired, griping and diarrhœa, with febrile disorder, occur. If their use be still persevered in, the assimilative process becomes injured, and a kind of scorbutic cachexy is established. Dr. Dewar, of Kirkcaldy, has written a pamphlet on sulphuric acid; while an article on the same subject appears in the *Homœopathic World* (12, Warwick-lane, E.C.), Vol. III., page 5. Still the medicinal action of this important chemical and curative has not been studied exhaustively, and it offers a large field yet for observation and experiment. In my own person I experience the most valuable medicinal action from HSO_4 so dilute as to be just perceptible to the taste in teaspoon doses ten minutes before meals when certain sensations in the stomach, and a semi-intoxicated state of brain, caused probably by acidity, indicate this remedy. HSO_4 has also a remarkable action on the female economy, i.e., when the menstrual flow appears every 14th instead of every 28th day. Causative in health and curative in disease.—THE LYDNEY DISPENSER.

[62699.]—**Locomotives.**—To "V. J. B."—I cannot at present compare your list with my own; but I believe you will find that some of the ancient goods locos., "Montrose" class, have been replaced by the modern type, built by Neilson. 161, 412, 413, and 330 are saddle tanks, by Beyer, Peacock, and Co. I should be extremely obliged if you could give me the chief dimensions of the old 4-coupled passenger engines, such as Briton, Eclipse, Queen, Princess, or Sussex (No. 1). Also of the corresponding tanks (250 class), and of the modern tanks by Adams, 415 (Beyer, Peacock, and Co.), or 516 (Dübs).—REYMOND.

[62741.]—**Cameras without Lenses.**—Before our friend, "Gamma Sigma," says anything further about "merest tiros," will he look at the process block of the Invalides, reproduced from a photograph taken with a "pinhole stop" having a hole 1/50in. in diameter, and an exposure of 20 seconds? He will find it on p. 160 of the "Year-Book of Photography" for 1887. Making due allowance for the degradation of the picture by the process of transferring it to zinc, I think he must allow that the "merest tiro" is not quite a fool if he regards pinhole photography as a useful addition to the resources of the traveller.—E. G.

[62731.]—**The English Language.**—To MR. R. A. R. BENNETT.—With regard to the pronunciation of the *ch*, I think it can be represented by *tsh* (not *sh*, as I had carelessly written)—e.g., "Fren*tsh*." I am not so sure about initial *ch*. Do you think that "tshart" exactly represents the pronunciation of "chart"? There seems to me some difference in the sound of the final and initial *ch*. Has this ever struck you? "Churtsh" seems all right, but how about "tshurtsh"? The difference of opinion about "chasm" illustrates the pressing need for some authority in English, similar to the Dictionary of the Academy in France, to preserve this "rapidly rotting" language from further decay.—REYMOND.

[62731.]—**English Language.**—As "E. S. H." persists, on page 541, in identifying χ and our *ch* when representing χ and the German and Scotch *ch*, I ought to say just how I believe this disproved. The same MSS. (all English ones before printing that I have seen) which use the letter I call "guttural" wherever we have *gh*, and to begin a few words, as *you*, *yet*, *young*, and *if*, never use it where we have *ch*. Old English as well as modern used *ch* in numerous words, but always for what had in Greek been either Kappa or Chi, and in Latin either C or Ch, which two in Classic times were never confounded; but wherever we now give *ch* the *k* sound, as in *mechanic*, it can be proved to stand for Chi. On the contrary, wherever we give *ch* the compound sound, as in *church*, I undertake to show it stands for Kappa, or for the C of a word, Latin or other, that Greeks represent by K. In page 541, besides the preposition *with*, I should have mentioned *booth* and *smooth* as having the final *th* grave.—E. L. G.

[62758.]—**Deafness.**—Some months ago I mentioned "Guide to Medical Batteries," illustrated by plates of the best instruments, full descriptions of their use and application, and numerous anatomical diagrams, by Dr. H. C. Garratt, M.D., of Philadelphia (publishers, Lindsay and Blakiston), price 6s. or 7s.; Harry Lobb, of London, several illustrated books on "Curative Treatment by Galvanism" (publishers, Baillière, London, America, and Paris); Dr. Julius Althaus, M.D., on "Paralysis, &c., Treated by Galvanisation"; on "Localised Electrisation," by Dr. G. B. Duchenne, translated by Dr. J. N. Radcliffe, of London. Dr. D. has been justly designated "the father of electro-therapeutics." A large and rather expensive book might be found second-hand. Althaus, in treating a case of deafness, discovered that salivation can be produced by galvanisation, and that the organ of hearing is intimately connected with the organs of taste and smell. He gives cases. Publishers, Trübner and Co., London.—EOS.

[62773.] — **Sundial.** — Really our friend "E. L. G." (p. 542) might just look into the matter before rushing in with a correction of my humble effort to assist an inquirer. In attempting to set me right in one imaginary blunder, he falls plump into two real ones himself. In stating that the arm of the cross sundial requires to be three times the depth I gave, he surely must overlook the fact that if the shadow of any part of the stile falls on any part of the arm it will do. Thus, in summer, the upper part of the stile is shadowing the lower part of the arm; while in winter, on the contrary, the lower part of the stile shadows the upper part of the arm. That being the case, the depth of the arm must not be less than the length *a e* (Fig. 1, p. 518) × tan. 23° 27′—i.e., ·433. In practice, of course it should be somewhat more than this, that the dial may not be shadowless at the solstices. The proportion I gave was ·531. In a 10in. arm there would therefore be ½in. of shadow on the scale at June 21 and Dec. 21, and more at all other times. The other mistake "E. L. G." makes is in supposing that the dimension *a f* has anything to do with the matter, or that the 3 and 9 o'clock requirements as regards depth of arm are different to those of any other hour. The sun's apparent diurnal motion must be always parallel to the earth's equator, and our dial was to be placed in a similar plane. How can a shadow, therefore, that falls on the arm at, say, one o'clock, escape from it at three or any other hour? The only thing that can affect the position of the shadow vertically is the change in the sun's declination, and that has been duly provided for. There is, of course, no particular necessity to keep precisely to the proportions given. The depth ought not to be less, which was what I meant to convey; there is no harm in it being more if the constructor fancies. The only limit in that direction is whether he considers it workmanlike to make things much larger than really necessary. Like Mr. Doyle, I am burning with curiosity to see the mean time dial "E. L. G." promised. In my ignorance, I should have said such a dial was not possible; but perhaps it will be better to reserve criticism until the dial is before us. One thing, however, one may perhaps be permitted to say in advance, and that is to hope it will be more correct than "E. L. G.'s" corrections. Before leaving the subject of sundials, I should like to enter a mild protest against Mr. Doyle's method of "dodging" the work of setting out hour lines. It sounds very ingenious, but it would be found in practice more troublesome and uncertain than the usual method of calculation. Apart from this, however, there is always the task of getting the stile parallel with the earth's axis. In some cases this is no easy matter, without calculation and workmanship into the bargain. For instance, how would "a watch set to show the solar time" assist anyone who had to erect a vertical dial on a southerly wall declining, say, 13° to the west? It strikes me that anyone who thinks to perform with a watch, and shirk his trigonometry, would want a little helping over that stile. —W. J. R.

[62810.]—**Iron Washing Boiler.**—The following cured an iron washing boiler of rust: After washing is over, draw the fire, empty out all water, and thoroughly dry all over; and then, whilst still warm, get a piece of bees-wax and rub the boiler all over—the inside. The boiler need only be just open. The depolarising body can during the time of rest take up the oxygen which it has lost during the time of action. Its action is unlimited on condition it is not overworked, and that the zinc and sal-ammoniac are replaced from time to time. It is used for electric bells and house telegraphy, but from its enormous internal resistance it is but a feeble source of electricity. The above is taken from page 27 Hospitalier's "Modern Applications of Electricity," translated by Maier. It is an expensive book (and being published in 1882 is probably out of print), so I have copied it at length. An engraving of Niaudet's cell will be found on page 31, where the method of fastening the zinc referred to is clearly shown.—AN A. S. T. E.

[62887.]—**Triple Expansion.**—I think if querist will refer back to number published July 1 he will there find an article explaining what he wishes to know more fully than can be done in a reply.—T. C., Bristol.

[62898.]—**Deafness.**—Nothing but the very best electrical treatment by an expert can possibly cure a case of such long standing. The ears, nasal organ, and throat are all intimately connected, and it is quite possible that a galvanic current may produce the normal secretions, which appear to be abstracted. You have lost much time.—EOS.

[62900.]—**Blistered Feet.**—Some years ago I was troubled much by blistered feet, caused by perspiration of the feet, and many is the time that my feet have bled when I have done plenty of walking in the warm weather. But I found a cure by bathing my feet in salt and water once a day, which I made by putting a good double handful of salt into a bucket of warm water, and then let it cool down. The next and greatest consideration is that people with feet in this state should wear worsted or woollen stockings instead of cotton.—R. B. H., Birmingham.

[62901.]—**Rolled W. I. Joists.**—By far the simplest method is to write to such people as Measures Brothers or other merchants for their illustrated lists of joists, where you will find the safe load in tons for each girder at different spans. The load being calculated as distributed must be halved if load is all at centre. Joists are supposed to be resting on supports simply at each end. All other ways are ignored in practice, except in the case of cantilevers. One does not trouble to calculate these joists; but refers to the list.—T. C., Bristol.

[62902.]—**Test for Platinum.**—It will probably be sufficient for your purpose to know that platinum is not acted upon by any simple acid, but only by a mixture of strong nitric and hydrochloric acids. A drop of nitric acid will corrode German silver.—SM.

[62902.]—**Test for Platinum.**—Platinum is not acted on by nitric acid, while German silver is dissolved, forming a deep green liquid; platinum is whiter than German silver. Dip a glass rod in nitric acid, touch your metal; if it turns green and effervesces it is brass or German silver; if it turns black, it is silver; if no action, it is platinum.—PRINCIPIA.

[62902.]—**Test for Platinum.**—Platinum is absolutely insoluble in nitric acid, while German silver and other alloys of that ilk (including silver) are readily dissolved in this acid. Basing yourself on this fact, you might extemporise a rough-and-ready test by rubbing a piece of the suspected metal on a clean surface of freshly-broken flint or limestone until you produce a bright streak on the stone. If this streak be touched with a drop of aquafortis it will remain unaltered if platinum, but will bubble up green and be dissolved away if German silver.—S. BOTTONE.

[62904.]—**Dry Rot.**—This is usually caused by deficient ventilation. Hence we expect to find it in floors covered with oil-cloth, and in roofs in which the felt is laid directly on the boarding. Remedies: 1st, abundant ventilation; 2nd, serving the wood with creasote or tar; 3rd, soaking the wood in solutions of corrosive sublimate, or of sulphate of copper, and allowing to dry thoroughly before placing *in situ*.—S. BOTTONE.

[62905.]—**Legal.**—The receipts you possess—viz., for Lady-day and Christmas—are held to be *primâ facie* evidence that no rent is due for previous quarters; but this presumption may be rebutted by the landlord. See "Taylor on Evidence," p. 746; Archbold's "Landlord and Tenant," second edition, p. 151.—B.SC., Plymouth.

[62909.]—**German Yeast**—Is obtained chiefly from the great Continental breweries, and consists of surface yeast or under yeast, collected, placed on a cloth to drain, and then pressed until nearly dry. The surface yeast (ober-hefe) is propagated by buds from the yeast plant, *Torula cerevisiæ*, and under yeast (unter-hefe) is propagated from spores. The fermentation of the former is quick and irregular; of the latter, slow and quiet.—B.SC., Plymouth.

[62911.]—***Circular Cutters.***—I think the general mistake is putting in too many teeth; $\frac{3}{16}$in. pitch for 2in. diameter and face of tooth upright should suit. Drive half as fast again as you would for turning iron of same diameter, and lubricate well. I expect the teeth break when they first strike the work, or there may be some tremble; still, six dozen slots represents a lot of work.—T. C., Bristol.

[62912.]—**Dissolved Bones.**—I know that many agriculturists have made their own; but you must be in a position to secure an unlimited supply of bones, otherwise it will not pay to manufacture this manure. The sole apparatus is a large cistern of stout sheet lead, placed in an outhouse far away from human habitations, as the stench given out by the phosphoric acid is appalling. Officinal sulphuric acid, at about a farthing a pound, is used to decompose the bones, which should be previously broken into convenient fragments, so that the material may be rapidly softened. In India and other countries where wood ashes are abundant, the bones are put in layers with that simple substance, and left to be crumbled by the crude potash it contains. As to "breaking the bones," manual labour is rather slow and expensive; but a neat little instrument has just been brought out. A friend of mine describes it as a sort of spiked hammer and hollow anvil, and that he gave 3s. 6d. for the implement, and finds it work well on a small scale. The bone mill of the trade crushes several hundredweight daily, and is worked by a horse. These bone manures are of great value on exhausted land, and their effects are of some duration. I have lately tested them on garden crops. Bones are far from being very plentiful. One of the large manure firms in the North showed me samples of cattle bones sent him from Bengal, a rather dangerous cargo, like horns and hides, which have been known to depopulate a ship.—EOS.

[62913.]—**Petroleum and Hot-Air Engines.**—The latter are not yet very satisfactory. The best petroleum engine is perhaps the "Spiel," twice described in "Ours" last year. The cost of this, according to Dr. Hopkinson, is about 1½d. an hour per horse-power.—S. BOTTONE.

[62914.]—**Coil.**—The secondary never is connected with the primary. Probably the maker, not having thick enough wire at his disposal for the primary, wound on two pieces of thinner wire connected in parallel.—W. PERREN-MAYCOCK.

[62914.]—**Coil.**—You say that the primary was not attached to secondary. It is not usual to attach primary to secondary. You say also that the primary had four ends, two of the ends were attached to one of the battery terminals, and the other to hammer, as per usual. That makes only three. Where did the other end go to? Perhaps I can help you if you tell me this.—S. BOTTONE.

[62916.]—**Assay of Tobacco for Nicotine.**—Mix 25grm. powdered leaves with five of slaked lime, and exhaust with hot water in a Soxhlett tube and inverted condenser. The resulting solution should be mixed with ether and well agitated. Separate the ether and add enough normal sulphuric acid to render it acid. Shake as before and titrate back with normal alkali; 1grm. H_2SO_4 combines with ·162grm. nicotine. For glycerol you might try this:—The aqueous extract which has been separated from the ether is evaporated to a small bulk, made alkaline, if necessary, with a little soda. A previously fused borax bead is dipped in the residue and held in the Bunsen flame. A green flame (boric ether, examine it by spectroscope) is indicative of glycerol. I have never examined tobacco for this substance, but should think the above method would answer.—SM.

[62918.]—**E.M.F. of Batteries.**—Chromic acid cell, 2·2 volts; bichromate of potash cell, 1·90; Grove, 1·95; Bunsen, 1·90; Niaudet, 1·65; Skrivanow, 1·5; Lalande-Chaperon, 0·8; Schanschieff, 1·5; Mariè Davy, 1·54; chloride of zinc double cell, 1·5; accumulators (Planté's), 2·02; Leclanché, 1·48; Smee, 1·24; Latimer Clark, 1·457; Walker graphite, 0·66; Daniell 1·079; chloride of silver, 1·03; Cruikshank, Wollaston, Volta, 0·81.—S. BOTTONE.

[62918.]—**E.M.F. of Batteries.**—These are as follows:—Bichromate, 1·90 volt; Smee, 1·10; Grove, 1·95; Bunsen, 1·90; Daniell, 1·079; double fluid bichromate, 1·30; zinc chloride, 1·50; iron sulphate, 1·70; mercury sulphate, 1·54; copper oxide, 0·98; Leclanché, 1·60; agglomerate Leclanché, 1·55; Latimer Clark, 1·457; lead sulphate, 0·55; silver chloride, 1·19. I believe Sprague gives a list of E.M.F. The way I get mine is to hunt up price lists and books, and get some from one and some from another.—PRINCIPIA.

[62919.]—**Lift for Well.**—Don't you want to come up again? If it is merely a matter of lowering yourself, a $\frac{3}{16}$in. chain is amply strong, and an ordinary double-purchase crab will be suitable "clockwork"; but replace one of the handles with an arm carrying a square board at each end, say 18in. square, to act as a fan to govern descent. But why not have a simple "rubbish wheel," and a weight within half a dozen pounds of yourself at other end of the chain? You could then, by means of a fixed rope, either lower or raise yourself with very little exertion. Mind foul air at bottom of well.—T. C., Bristol.

[62920.]—**Tomatoes.**—Even in the humid climate of Lower Bengal, where jams and chutnees are difficult to preserve, I found no difficulty in keeping my "Tomato Extract" till the fresh gathering came round again. Strain the pulp through a hair sieve, so as to remove all skins, seeds, and cones, boil in a block tin vessel over a very clear fire (an enamelled iron deep pan is better), the extract should become very dark and thick, then remove it to prevent burning, and put it away all night; should it seem soft and will not congeal into a firm mass, boil very slowly again, and evaporate the moisture; it must not be covered or the moisture will be retained. I used to add some salt and cayenne pepper, which may have helped to make it keep; but the extract was very dark, and firm like some of the apothecary's vegetable preparations, a teaspoonful sufficient for a made dish, and gave it a fine colour. Never keep it in large jars, but in small sealed two ounce bottles, as the air will spoil any large quantity before you can use it. As to the "tomato sauces," and such liquid preparations, they always ferment, unless very highly seasoned—bad for the flavour, and worse for the digestion. Such is a showy bottle of American manufacture I have just bought on trial, and dislike for said reasons. My dry extract could be turned into a "sauce" on very short notice, by any intelligent cook, enough for two or three days' consumption, and no more, by adding gravy or lime juice, for fish, flesh, or fowl, hot or cold. Try my extract in a curry, which to me is imperfect without it. This has been a good tomato year, under glass, with me.—EOS.

[62920.]—**Tomatoes**—In Italy, where these are so common, three modes are adopted for preservation for winter use:—1st. The best and soundest ripe tomatoes are chosen, cut up, and placed in good, stout, wide-mouthed bottles (previously washed perfectly clean), and these bottles stood in a large boiler, filled with water up to the shoulders of the bottles. Salt is added to the water in the boiler to heighten the boiling point. The water is then gradually heated till it boils, and the tomatoes break down to a pulp. As soon as this happens, the fire is drawn, a layer of olive oil poured on the top of each bottle, each of which is then carefully corked and sealed, and allowed to cool gradually in the water. 2nd. The tomatoes are cut up, placed in a preserving pan (previously well tinned), and allowed to simmer in their own liquor until disintegrated. While still hot, the pulp is rubbed through a tammy sieve, then again boiled until it no longer runs on cooling. It is then poured into bottles or jars, previously heated to the boiling point, a little oil poured over the top, and the bottles then corked and sealed down. Though both these methods will give a product which keeps indefinitely as long as the bottles are kept shut, yet once opened they must be used within a week. 3rd. The pulp is boiled down as in the last operation, and, as before, rubbed through a sieve; then the boiling is continued, until the pulp becomes almost as stiff as putty and as dark in colour as damson jam. It is then spread out in thin layers on japanned trays, and exposed to the sun until quite hard and dry. It is kept in bags in any dry, airy place, and soaked in warm water when required for use. Probably the English sun would not be hot enough, nor the air dry enough, to insure success with this latter process here.—S. BOTTONE.

[62922.]—**Ground Rents.**—Yes, Smith can pay his ground rent to Green, the over-proprietor, if Bennet, the original lessee, is agreeable, and it will save trouble. If Smith pays to Bennet he will require (in order to keep himself safe) to see Bennet's receipts from Green, because, should Bennet fail to pay, Green can come down upon Smith, even although he has already paid Bennet.—B.SC., Plymouth.

[62924.]—**Steam.**—Regnault's formula for total heat of steam = 1,082° + ·305 T, T being degrees of heat of steam by Fahrenheit's thermometer. Therefore, steam at 300° contains 1,082 + (300 × ·305) = 1,082 + 91·5 = 1,173·5°, and as feed is at 60° each lb. of steam receives 1,113·5°. As 10lb. are used, this equals 11,135° thermal units. Each thermal unit = 772lb. raised 1ft. high. Consequently, the steam receives power equivalent to 11,135 × 772 = 8,596,220ft.lb. per minute. The theoretical efficiency of the engine, however, is $\frac{300 - 104}{300 + 461} = \frac{196}{761} = 0{\cdot}26$, neglecting friction and other loses, so above must be multiplied by 0·26 and divided by 33,000 to find horse-power if a perfect engine = about 69H.P., quite double the efficiency of most engines. 2. Rather a wide question, and depends entirely on initial pressure and number of expansions; but if taken as an elementary question, with no expansion, and boiler pressure at 50lb. above atmo. h.p. is 100 × (P = 50) × 144 ÷ 33,000 = 22, nearly. If a higher pressure is used and expanded, the n use i place of P the pressure found as follows: $P \times \left(\frac{1 + \text{hyp. log. } N}{N}\right)$ where N = number of expansions and P = total pressure on gauge + 15lb.; deduct 17lb. if non-condensing, and 2lb. if condensing. 3. A perfect gas varies in pressure inversely as the volume, so that if it occupies double the space, it has half the volume from which the curve (hyperbolic) may be set out. Steam, if treated as a perfect gas, would be the same; but the adiabatic curve is really lower, and is found by the use of logarithms usually. Thus, if it occupies double the space, expansion is twice, and pressure = $p \div 2\ (\frac{10}{9})$, and if three times $\div\ 3\ (\frac{10}{9})$, and so on.—T. C., Bristol.

[62925.]—**Harmonium Swell.**—It is a very easy matter to put a swell to a one-row harmonium, providing there is sufficient space allowed between pallets and under-side of keyboard. All that is required is a framework round the pallets; over this framework a shutter should be hinged, which should be allowed to rise and fall; the shutter should be actuated by a small knee-lever. It is also quite practical to add an expression-stop to any ordinary harmonium. It is simply a valve which closes and shuts off the air from the reservoir. I will send him a drawing if he really thinks it necessary.—G. FRYER.

[62926.]—**Mechanical Die-sinking.**—There is no machine that is of any use in die-sinking. There is a machine used in brass stamp cutting called a "routing" machine, but it is only applicable to cutting metal to a uniform depth, and only works well in brass or wood. The dies, however, at the Mint are reproduced in a certain sense by striking steel "hubs" from the original die, these being after hardening forced into dies, which are ultimately used for coining. Both the hubs and the coining dies, however, require to be touched up a good deal, so that the reproduction merely saves the rough part of the sinking. It, however, secures more uniformity in the general appearance of the coins than if independent dies had been sunk. If the querist means a machine for cutting a sunk die from a relief model, then the only "machine" that exists, or is likely to exist for that purpose, consists of the following parts: A heavy "dish" for holding the die capable of being easily rotated, a hammer, half a dozen chisels, as many gravers, a few riffles, and finally a man who possesses some artistic sense, coupled with high skill, not to be obtained without years of patient industry.—W. J. R.

[62927.]—**Tank Locomotives.**—G.N.R., 116 to 132, 510 to 517, 528 to 533, have cylinders 17in. by 24in., four coupled 5ft. driving-wheels; 241 to 250, 621 to 628, diameter of wheels, 5ft.; four coupled cylinders, 17½in. by 24in.; 270 to 279, four coupled 5ft. 6in. wheels, cylinders, 17in. by 24in.; 694 to 698, 682, 683, and 761 to 765, have four coupled 5ft. 2in. wheels; cylinders, 17½in. by 24in. G.W.R., 1, 3 to 6, 202 to 208, 455 to 470, 967 to 986, 613 to 632, 1,154 to 1,165, 1,465 to 1,476, have four coupled 5ft. wheels; cylinders, 16in. by 24in.; 1,401 to 1,464, 1,813 to 1,832, 1,834 to 1,853, six coupled 5ft. cylinders, 17in. by 24in.; 215 to 224, 517 to 576, cylinder, 15in. by 24in., four coupled 5ft. wheels; 826 to 845 have 5ft. 3in. four coupled wheels; cylinders, 16in. by 24in. If "V. J. B." would like a complete list, please write to 48, Kyverdale-road, London, N.—E. INNES.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Sm" has replied to 62641.

62513. Telephonic, p. 329.
62517. Reflecting Galvanometer, 329.
62520. Problem for "Vladimir," 329.

62668. Boring, p. 423.
62670. Organ, 423.
62673. Jupiter's Satellite, 423.
62691. Compass for Navigation, 424.
62695. Keying Eccentric Sheaves on Crank Shaft, 424.
62696. Density of Solutions, 424.
62705. Drilling Bicycle Hubs, 424.
62706. Stains in Plane Planks, 424.
62708. Tokens, &c., 424.
62709. Hot-Air Engine, 424.
62713. Reducing Cyanide of Gold, 424.
62714. Electro-Metallurgy, 424.

AT a shipyard in Newburg there is being constructed the first vessel to be propelled by electricity ever built in the United States. It is a yacht 37ft. long, 7ft. wide, and 5ft. deep. It is to be run by stored electricity. It is building for a Newark, N.J., electric company, and will be run between that city and New York.

QUERIES.

[62929.]—**Galvanometers.**—Would Mr. Bottone or some one of "ours" kindly say of what size wire the coils are wound for intensity and quantity?—ONE IN A FIX.

[62930.]—**Literature.**—Can any reader give me any particulars about Timm's "Abbeys and Castles"?—H.J.W.

[62931.]—**Caistor Castle.**—Can any correspondent give me any information concerning the date of building, &c.? It is near Yarmouth, Norfolk.—H. J. W.

[62932.]—**Problem Engine, L. and N.W.R.**—Can any engine driver kindly give me the dimensions of the engine Problem, L. and N.W.R., which I saw at Crewe a few weeks ago?—INQUIRENS.

[62933.]—**Acoustic.**—Can any reader inform me how best to fix wires across schoolroom to improve the acoustic properties? We do not want to improve the sound at one particular part only, but in every part of the room. It is about 22yds. long, and 14yds. wide. What kind of wire and what thickness? Will the wires need to be placed across as well as lengthways, and how many?—ACOUSTICS.

[62934.]—**Photographic.**—Can any of "ours" tell me of a clear varnish that will not work up when collodion is poured on it?—FRED GEORGE.

[62935.]—**Thermopile.**—TO MR. BOTTONE.—Is your small thermopile, described p. 429, No. 1163, suitable for amateur electro-plating? Could I arrange it with paraffin lamps to equal two or three pint Smees to deposit 1oz. or 2oz. of metal daily when required?—C. HARLEY.

[62936.]—**Organ.**—Will some musical reader inform me if it is possible for an organ to be blown by a constant hydraulic pressure? It is now blown by a man pumping water. I want to play at times when he is not at work. My water supply is plentiful. I thought he could pump the tank full, and then I could play during his absence. I might want more pressure than the tank would give. What kind of accumulator is most suitable for an organ, and if there is any such arrangement?—W. T. C. B.

[62937.]—**Faulty Electric Bell.**—I have a 3in. bell that has been in use for three years, and it has suddenly stopped ringing. Will some of our electrical friends please to suggest the cause of it stopping, so that I can remedy it? I know that it is the bell that is faulty, as I have fixed another one in its place and it rings all right. W. T. C. B.

[62938.]—**Tangent Galvanometer.**—Will "J. S." kindly explain the apparent mistake respecting the number of turns in the third and fourth coils in his otherwise very clear instructions for making the above instrument? By so doing he will doubtless oblige others besides—J. RICHARDSON.

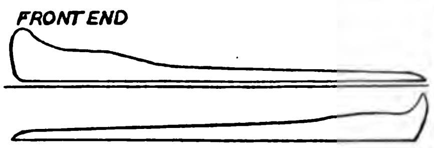
[62939.]—**N.E. and G.E. Compound Engines.**—I am much obliged to "A. W. B." for his reply to my query respecting the N.E. compound engine, and should be glad if he will send the sketch of the patent starting gear, as it is one of the essential features of the compound system employed by Mr. Worsdell. I have travelled behind one or two of the compound engines on the G.E.Ry., and have noticed that whilst they will take a moderate or somewhat heavy load at a fair speed on a rising gradient, they do not attain any great rate on a falling incline; but in spite of this drawback (due no doubt to the back pressure from the exhaust not being able to get freely away) I believe they are tolerably good timekeepers.—EAST COAST.

[62940.]—**Chemical.**—Can a pap made of wheaten bread be made to undergo vinous fermentation, and how?—TEMPERANCE.

[62941.]—**Screw.**—The screw of my tincture press has worn very shaky. How can I tighten it without having a new brass nut? The screw is in good condition.—TEMPERANCE.

[62942.]—**Glass.**—What acid or solution will remove from glass the effects of sulphur fumes arising from an open smith's hearth?—case of long standing. Windows are directly over the hearth, and very little light is obtained.—WALTER F. SCHOFIELD.

[62943.]—**Engine Query.**—I inclose a set of diagrams of our engine. I want to know the H.P., and how to reduce the consumption of coal. We think it is far too large a consumption—3 tons 10 cwt. per 57 hours run. Dimensions are as follows: h.p. cyl. 9in. diam., 12in. stroke, speed 120 per minute, scale 1-20, boiler pressure 30lb., plain slide valve, ordinary throttle valve. Will some of "ours" kindly give advice on the above?—E. D. H. P.



[62944.]—**Carbolate of Lime.**—Would one of your chemical readers kindly answer the following questions? What quantity (say gallons) of carbolic acid of 95 per cent. should I have to put to a ton of lime to make a powder which would test 15 per cent. of acid. What is it that makes some of the powder such a bright red or pink—it is certainly not the acid? I should be glad of any information as to the manufacture of this powder.—J. WILLSON.

[62945.]—**Lacquer or Varnish for Copper.**—Will some fellow-reader tell me a varnish that will keep hot copper from tarnishing if properly applied after a good cleaning? I wish to keep bright some large (10in.) copper pipes that are difficult to clean continually, and think it would be very possible to do so with the right stuff applied, [illegible] after a good scouring, having been partially successful. But the difficulty seems to be in the varnish [illegible] off, and discolouring by the continued heat in the pipes. Of course, the varnish was applied when [illegible], or only warm.—CYGNET.

[62946.]—**Ortho-Chromatic Gelatine Plates.**—I wish to make some of the above to take portraits by paraffin light, but do not wish to make them sensitive to red light or deep orange, as I want to develop with this colour. Will someone please say how to treat ordinary gelatine plates to make them sensitive to paraffin oil light so that the exposure would be about equal to an ordinary plate by daylight?—W.

[62947.]—**Stereo-Metal.**—I understand that stereo-metal is made in the following manner: 80 per cent. of lead, 20 per cent. of antimony and 1 per cent. of tin. Will any of "ours" kindly tell me how to go about it, so that I can make my own, and also answer me the following queries? 1. Why is antimony and tin mixed with lead, and what will the effect upon the compound be if too much of either is put in? 2. What is the natural flux for lead, antimony, and tin? 3. When the metal is worked for some time and begins to lose in quality, what is the nature of its deterioration by the constant working? 4. I also understand that if zinc should get in amongst it, that it will be of no use. Is there not some way whereby the zinc can be extracted without the whole being spoiled? 5. If, from circumstances, the metal should be soft, or hard, and no means be at hand whereby it can be made right, what is the best way to go about, so as to make the most of what you have and get plates that will print. 6. In the case of new metal, is there any reason why the first plate from a new mould should be streaked and have one or two hollows in, and yet from the same mould and the same metal the plates that follow are all good?—W. R. GIRLINGTON.

[62948.]—**Hydraulics.**—In the subjoined sketches, Problem I., A is a reservoir full of water, B C and D E are both pipes 6in. diam., the former is 10ft. long and the latter 20ft., the length of column in both cases being measured from the surface of water to the lower extremity of each pipe. Required to know the quantity of water discharged by each pipe in cubic feet per minute. Problem II., A is also a reservoir full of water, B C and D E are pipes 6in. diam., laid in a parallel plane to an inclination 1 in 20. B C is 20ft. long and D E 40ft. long, the head of water over the orifices of the pipes at B and D being the same. Required to know the quantity of water discharged by each pipe in cubic feet per minute. In Fig. 2 the pipes should be parallel with each other; but for engraver's convenience they are shown one above the other. Suppose in the latter problem the pipes were laid to an inclination of 1 in 5, what would be the ratio between the discharge through the longer and shorter pipes?—BONA-FIDE.

FIG. 1

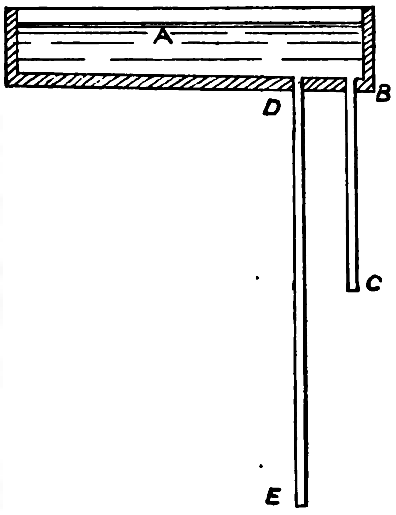
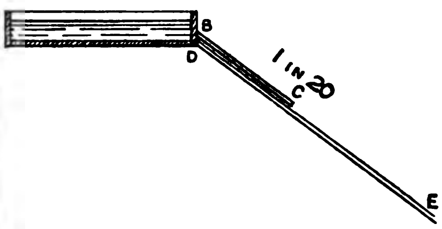


FIG. 2.



[62949.]—**Boiler.**—Would "Glatton" or "T. C., Bristol," kindly assist? I have a model horizontal cylinder 2½in. by 1½in., steam ports 5-16 by ⅛, exhaust 5-16 by 3-16, steam inlet 3-16, for which I want a boiler. What size and shape would be suitable, dimensions of tubes (if any), material of boiler and tubes? Also how should I fire it? How must it be put together to stand 20lb. pressure, and what would it develop, size and weight (also of fly-wheel? A sketch of boiler would greatly oblige—INQUIRER.

[62950.]—**Watch Repairing.**—I have a [illegible] watch (small) out of order, which I would [illegible] repair. Being an amateur, as far as I can see the [illegible] balance wheel and the hair spring are lost and one of spaces is broken off the small wheel underneath that catches in the cylinder (which is also gone). I took it to a watchmaker, but he wanted 14s. for repairing it. I think if I could get the parts lost I could mend it myself. Can I get them separately? I have tried and cannot get any information where I can purchase them in Dublin or otherwise.—DUNDRUM.

[62951.]—**Painting.**—Will anyone tell me how to paint creasoted poles black or white?—DUNDRUM.

[62952.]—**Lens of Camera Obscura.**—I have lately constructed a camera obscura, using the object glass of a very good opera glass in the lens? Everything is reversed right to left, and left to right, but is otherwise correct. Why is this?—DUNDRUM.

[62953.]—**Lathe.**—I have an ornamental turning lathe by Williams, 3, Long Acre, London, but some of the parts are missing, viz., slide-rest holder, chucks, and overhead motion standards. As the lathe must have been purchased over 30 years ago, I cannot now trace the maker. Will anyone kindly give sketch of how this lathe was originally set up? It has a beech frame and mahogany shears.—AM. MEC.

[62954.]—**Astronomical.**—1. Would anyone who was examining the sun within ten minutes of 6.44p.m. on Wednesday, August 3rd (the evening of the eclipse), kindly state if he observed anything out of the common? 2. Did any one with proper apparatus for correct measurements make any about that date of the larger sunspots of the series that have been on the disc during the last fortnight?—INQUIRER.

[62955.]—**Photographic Developing Troubles.**—I develop Ilford plates, also Fry's German, with pyro., citric acid, and ammonium bromide; the other bottle is potash, or sometimes I use ammonia. If I develop the above plates with Beach's formula, I get clear negatives free from any markings, but not dense enough; but if I use any other developer I get a greenish scum on surface of plate, which nothing will remove except rubbing with the finger. What can it be?—H. W.

[62956.]—**Pure Carbonate of Potash.**—How can I make ordinary carbonate of potash (salts of tartar) chemically pure?—H. W.

[62957.]—**Flying Cutter.**—Can any reader give me a description of a flying cutter with slide so as to be attached to lathe? The slide so as it can be adjusted to the cutter to shave to any small thickness. A good description with drawings, if possible, of the machine, showing how to attach it to the lathe, will greatly oblige.—B. H. G.

[62958.]—**Una Boat.**—Being anxious to build a small Una boat 6ft. by 3ft. 6in., will someone give me lines with full dimensions, from a good model, and any hints as to length of spars, choice of woods, thickness of planks, &c.? Must the planks be steamed (I have no means of doing so? and have heard boiling will do as well), or can they be simply bent on to the ribs? Is carvel more difficult for an amateur than clincher build?—F. E. A.

[62959.]—**Expansion of Rails.**—How much does a 30ft. steel rail expand in a hot day, and how much space should be left at the end of each?—LOCO.

[61960.]—**Railway Distance.**—What is the distance from Nottingham to Manchester as run by the new Midland express, via Butterley?—LOCO.

[62961.]—**Propagator.**—I am desirous of making a propagator for the purpose of striking cuttings and raising plants, &c. Any information on the subject will be gladly received by—SEEDLING.

[62962.]—**Phloroglucol-Hydroxyquinol.**—Will some chemist tell me how to prepare phloroglucol and hydroxyquinol?—R. J. H.

[62963.]—**Mensuration of Cones.**—Will a reader of the "E. M." kindly tell me how I can find the number of cubic inches in a round cone, measuring on the top 93in. diam., bottom 163in., and 102in. high. Not knowing algebra, a simple example will be much esteemed by—NU.

[62964.]—**Tricycles.**—Is the Quadrant really unspillable, or has any machine yet been made that is?—A. F. SHAKESPEAR.

[62965.]—**Cycle Lamps.**—What is the best oil to burn in these lamps? Mine, the "Pilot," is always going out. I have tried whale oil and petroleum mixed, and also separately, but they won't stand the jolting, and I am in darkness before I have covered a dozen yards.—A. F. SHAKESPEAR.

[62966.]—**Dynamo.**—TO MR. BOTTONE.—I have an Otto gas-engine indicating about 2H.P., and wish to know what would be the largest dynamo it would drive. I would prefer a ring armature and horseshoe field magnets. I would be obliged to Mr. Bottone if he would give the size of both, the number of coils and turns on the armature and size of wire on armature and F.M. I wish the machine to be shunt-wound. The lamps I have are 10c.p. and about 35 to 40 volts. As this sized Otto is a good domestic engine, the information might be useful to others besides—EGROEG.

[62967.]—**Thermopile.**—I am greatly obliged to Mr. Bottone for his assistance, but on looking over my query I find a mistake which may have misled him. The query reads, "I want to light a 10c.p. 6 or 8 volt battery lamp (Shippey's) in parallel," whereas it should have read, "I want to light four 10c.p. 6 or 8 volt battery lamps (Shippey's) in parallel." All the rest of the query is correct. I shall be glad of a little further information. In your answer to me you advise me to use 150 elements. How am I to get the odd six elements in? Could I build five circles of 30 elements in each instead of 36? That would take the 150 if I can do that. What current will it give with 6ft. of gas per hour? Should the tinned iron strips be soldered together just at the lips, or should there be a surface contact? Will you kindly describe how to connect the elements in parallel?—THERMOPILE.

[62968.]—**Bracing Climate.**—Will any reader of the "E. M." give me the following information? I have been in a Tropical country for nearly 30 years, and an eminent medical man once told me that a bracing climate is absolutely necessary for anyone who has been for so long a time in or about the Tropics. I should be deeply indebted to anyone who would give me a list of six of the *most bracing places* he knows in England, south of a line *running through Warwick* and excluding any of the suburbs of London. It must not be within eight miles of the sea, as none of my family can stand the sea air. There must be good schools for girls. The town must not have less than 10 000 nor more than 30,000 inhabitants, and it must not be a smoky manufacturing town, as I want the purest air I can get for my girls.—UBIQUE.

[62969.]—**Electrical Pendulum Indicator.**—Would some one kindly answer this query? I have fixed one of the above to 15 rooms, and sometimes when the button is pressed in one room two indicators will commence to move instead of one. There is contact between the wires. Is it possible for the current from the room that is pressed to induce a current in another wire, or is it the fault of induction in the indicator?—SALOPIAN.

[62970.]—**Iron and Steel Test.**—Can you inform me of a way of testing iron and steel, and how to tell the one from the other in a manufactured state? We have heard that nitric acid is a proof, but do not know the effect it has on either.—C. E. L.

[62971.]—**Electrical.**—I wish to run a bell wire underground for about half a mile. What is the best way of doing this? I wish also to have a bell at each end so that each can ring to the other. Must I have two wires? I can use water main as return.—ROSICRUCIAN.

[62972.]—**Astronomical.**—Can anyone give me the duration of the total phase of the solar eclipse of January 1st, 1889, on the west coast of the United States?—ROSICRUCIAN.

[62973.]—**Pit Saw.**—Having purchased a second-hand pit saw, and after trying it I find it keeps turning to the left hand cut after cut. I should feel thankful for a little help to try to get it to go straight, and if it's on the teeth, which is the best way to get them set?—JOE CARPENTER.

[62974.]—**Wasp's Nest.**—A large nest is being built in the roof of my house, and as I wish to secure it, shall be glad to know when the whole of the grubs will be hatched out. The wasps are no trouble, scarcely ever coming in at the windows, so it can remain until the most suitable time for taking.—J. S.

[62975.]—**Hydraulic Propulsion.**—As I believe the Portland Rotary pump, which was illustrated some years ago in *Engineering*, was tried for this purpose, could any reader tell me where and how I could obtain a full illustration of the same and the smallest sizes made?—A. SCEPTIC.

[62976.]—**Porous Carbons.**—In what way can ordinary flat battery plates, $\frac{1}{4}$in. thick, be made sufficiently porous to allow water to filter slowly through them, and could a plate be made so as to filter much slower than the present porous carbon blocks in filters? Is it merely a case of coarser-grained carbon powder before pressing or a chemical in the mixing? Could I make one myself? A SCEPTIC.

[62977]—**Piano Repetition.**—TO MR. W.H. DAVIES.—I have a cottage piano with what is called a repetition check action; but I have great difficulty in playing such pieces as "Rosellen's Reverie" in G, where the notes are repeated in quick succession. I shall be glad if you will inform me how this may be remedied. The house is not damp, and the hammers appear to work freely.—J. W.

[62978.]—**Winged Ants.**—On a certain day every year—generally in August—a large number of winged ants are to be seen. They drop in the streets and appear unwilling or unable to fly, although provided with large wings. On Saturday hundreds of them were crawling about in the streets of Colchester. What becomes of them?—THOS. M. BEAR.

[62979.]—**Plante Storage Battery.**—I want to make the above on the principle suggested in an article in the "E. M." of July 15th. Will some of your readers kindly inform me what would be the E.M.F. of each cell and what should be the area of surface to supply six or eight 10c.p. lamps? Also the thickness of lead most suitable, the strength of acid, and how long it takes to form the cell by charging and discharging?—SOUTH.

[62980.]—**Engine Conversion.**—Will "T.C., Bristol," or any other reader answer the following? I have a small vertical engine, 4in. stroke, 2in. bore, steam ports $\frac{5}{8}$ by $\frac{1}{4}$, exhaust $\frac{5}{8}$ by $\frac{3}{8}$, 50lb. pressure, 300rev., I think is about $\frac{1}{2}$H.P. Should I get any more power by altering it into a tandem compound condensing, and how much, or is the speed too great? What size circulation pump, cooling surface, and best sort of metal for condenser?—AMATEUR.

[62981.]—**Distance of the Sun.**—Would "Tria" be pleased to show the method of finding the distance of the sun from the earth, with the horizontal parallax given on p. 1 of the *Nautical Almanac*? I have never been able to find the logarithms of such small quantities.—G. YOUNG.

[62982.]—**Whalebone.**—What are the chief uses of whalebone nowadays? I read that the other day in Dundee two lots were sold at £1,700 and £1,725 per ton respectively—the highest prices given for a long time.—E. S. T.

[62983.]—**Induction Coil.**—TO "SIGMA."—I am constructing a coil to sizes, &c., given in your valuable book "Electricity," p 250. Would you kindly say how many pounds of No. 36 s.c. wire would be required for the secondary?—W. P.

STATISTICS show that fifty-three thousand wells have been drilled in Pennsylvania and New York since the discovery of petroleum, at a cost of 200,000,000dols. These wells have produced 310,000,000 barrels of oil, which were sold at the wells for 500,000,000dols. This represented a profit to the producer of 300,000,000dols. The amount of oil exported is placed at 6,231,102,924 gallons. In the pool in Washington County alone 3,200,009dols. has been expended in machinery and drilling. This does not include the many millions that are represented there in the natural gas industry. Independent of the oil business there is about 50,000,000dols. invested in natural gas plants in Pennsylvania.

ANSWERS TO CORRESPONDENTS.

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⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 10, and unacknowledged elsewhere:—

J. D.—J. Seal.—W. H. Bailey and Co.—A Country Cabinetmaker.—One Anxious to Proceed.—W. H. P.—F. B. Fowler.—Dr. Royston Pigott.—G. A. Au'sley.—D. B.—G. Beaven.—The Lydney Dispenser.—Cast-Iron.—W. P. Maycock.—F. W. H.—Old China.—B. Hodgson.

GEO. JOHNSON. (We have frequently stated that Pitman's system is considered to be the best by a large majority of those competent to judge, and it is used by 90 per cent. at least of those who use shorthand. To speak of Pitman's system as being "difficult" is simply to discount the abilities of the judge. You will find opinions on this matter by consulting the indices of back volumes.)—SUBSCRIBER. (Tricycles driven by electricity or compressed air are to be found only in the columns of the daily papers. Prof. Ayrton had an electrically-driven tricycle some years ago, particulars of which you will find in No. 913, and of Sir T. Parkyn's steam tricycle in No. 917. The laws regulating the traffic on highways effectually prevent the adoption of any motive power for tricycles, as the speed is then limited to about two or four miles an hour. There is no other difficulty in the matter.)—E. W. (See p. 461. Any battery which is capable of yielding the required E.M.F., and of lasting for a few hours will do, if expense and trouble are not considered.)—J. W., Leeds. (Why do you want a "sketch"? Surely it is simple enough. When current is passed through a magnet, the armature carrying the hammer is attracted and retained as long as the circuit remains unbroken. See indices. 2. Against the rules, but a little inquiry amongst those likely to deal in such articles would no doubt elicit the desired information.)—J. H. (For cleaning engravings, see pp. 44, 169, Vol. XXXVI. A weak solution of chloride of lime is usually effective; but it should be removed thoroughly by means of boiled water and blotting paper.)—FANSHAWE. (Yes, if it can be made to drive an hydraulic ram which will pump water up to a sufficiently high reservoir; or it might be made to drive a turbine or water-wheel, which could drive pumps.)—HINTON BATEMAN. (See many replies in back volumes—even in recent numbers.)—CHAPMAN. (Do you mean a receiver or a transmitter? You will find a variety of telephones in back volumes. Bell's original telephone, the pattern which is free from patent rights, was described in No. 594.)—NIMBUS. (Certainly, by means of a double convex lens. The average height of clouds varies with the season of the year and the kind of clouds—say, from 1,500 to 4,000 yards. 2. Fat and soda—the latter replaced by potash makes a soft soap.)—IRON. (You can try by heating to a red and dipping into water; but we do not think you will succeed, and suggest trying because we do not know what you may mean by "malleable.")—ENGINE ATTENDANT. (They are simply examination questions which are answered in any of the cheap textbooks, as they have been answered many times in our back volumes.)—ARTHUR MEE. (A note addressed to the Assistant Secretary, Royal Astronomical Society, Burlington House, would no doubt produce an answer that would be satisfactory, because he has access to the records of the society. It was formed in 1820, and incorporated by Royal Charter in 1831. The assistant secretary could also give you the exact dates of the decease of the astronomers named.)—CRANHAMS. (You will find a diagram of an hydraulic ram in No. 1072, showing the snift valve in position. There is a section of the valve in No. 813. It is placed on the lower part of the air vessel, as a rule, and its purpose is to admit air.)—THERMOPILE. (See Hints No. 4 above. Such questions should appear as advertisements in the "Addresses Wanted" column.)—SLOPER. (Kindly read up what has already been said on the subject, and make the machine according to the inventor's directions.)—A SUBSCRIBER, Bracknell. (Answered on p. 522, as soon as possible after it was received.)—G. M., Dublin. (That will work right enough if you scrape the parts clean and wet them with soldering fluid before dipping into the well. Soldering fluid is made by dissolving zinc in spirits of salts, as much as it will take.)—Q. (The metal at that part always gets hot in any lamp. In the design mentioned, that is not a defect.)—C. S. M. B. E. (Many methods described in back volumes. There is the tedious process of allowing the parts to soften by soaking in rain-water; but some use boiling water. They are bleached by means of a solution of chloride of lime.)—AMATEUR BOSSER. (How can any one tell you how to repair your garden pump unless you give some notion of what is the matter with it?)—E. T. (Yes, if the camera is of the size mention-

The English Mechanic
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FRIDAY, AUGUST 19, 1887.

NOTES ON THE CONCERT-ROOM ORGAN.—II.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

BEFORE going into details, scientific and practical, connected with the Concert-room Organ, it is, perhaps, desirable to briefly define the nature of such an instrument when it can be pronounced properly appointed. It is quite certain that no other class of Organ is called upon to meet so many demands upon its resources as that designed for the concert-room. A chamber Organ has, at the most, to meet very reasonable calls both in solo and accompanimental playing, while a church Organ has, in its legitimate office, only to accompany the voices of the choir and congregation, and to lend itself to a limited range of dignified solo music. On the other hand, a Concert-room Organ has a threefold office to fulfil, and it must be able to meet any demand the musician may think proper to make. It must be capable of taking part, in conjunction with a full orchestra, in the accompaniment of the most complicated choral works; it should be equally capable, alone, of furnishing a substitute for the entire orchestra, in the accompaniment of the same choral works, when an orchestra is not forthcoming; and, lastly, it must furnish the musician (I do not mean the ordinary organist, for his demands are limited) with proper materials for the effective interpretation of the thoughts of his own or other minds; and for the rendition of the most complex compositions written either for the Organ or the orchestra. In short, the Concert-room instrument should be a perfect Organ and a full orchestra combined.

It must be obvious that, to fulfil all the purposes above outlined, and be able to respond to the most exacting demands of the true musician, the Concert-room Organ cannot but be an extremely complicated machine. Truly, it must ever be complex in its nature and construction; yet there ought to be so perfect a system observed throughout both its tonal and mechanical structures that simplicity will appear to characterise all matters relating to its control. It may seem paradoxical when I say that no Concert-room Organ yet constructed is complicated enough in its structure, or simple enough to readily respond to the ever-varying demands of the musician; but there is really nothing paradoxical in the statement. Let me explain myself. Firstly, all the speaking stops should be grouped in the different departments of the instrument on a definite and easily-recognised system; and when this is done, their number, however great, ceases to present the slightest element of confusion. Secondly, the means provided for the manipulation, singly or in any form of combination, of the complete series of stops should be so perfect and so easily mastered that no exercise of memory, and but a very slight acquaintance with the instrument, are necessary on the part of the organist. Thirdly, every department of the Organ should be wholly or partly expressive, and the means of controlling the several swells should be as simple as they are complete. Fourthly, the claviers should be so placed with reference to the Organ proper, that the player may hear perfectly the effects he is producing. All these conditions seem pretty simple, reasonable, and necessary; yet there is not a Concert-room Organ in existence which comprises them, or even any one of them. Not a solitary English instrument presents any one of them in perfection. Do not these facts show how much has to be done before the perfect Organ makes its appearance?

Position of the Organ and its Claviers.

The position of the Organ in a concert-room is probably a matter on which there is scarcely any diversity of opinion; but its proper treatment in the accepted position does not appear to have received the attention it deserves on the part of the architect and others interested in the building and its Organ. As in the church, so in the concert-room, one finds, as a rule, far too little space provided for the accommodation of the instrument ultimately placed therein. The architect, from his very superficial knowledge of the nature and requirements of the Concert-room Organ, or in carrying out instructions not sufficiently considered by his clients, does either not provide space enough, or provides it of a disadvantageous kind, which practically amounts to the same thing. One noteworthy instance of blundering on the part of everyone concerned is afforded by the well-known concert-room belonging to the Liverpool Philharmonic Society. This room, allowed to be the finest, acoustically considered, in England, and one of the best in the world, has an atrociously bad Organ equally badly placed. Its situation with reference to the orchestra seats is the usual one; but the architect constructed a deep and narrow chamber for its reception, and, I may add, for its annihilation. The instrument placed therein is so bad in every way that one almost forgives the blunder which prevents its being heard; but however fine the organ might be, its fate would be the same. It is quite safe to say that nothing in the shape of a chamber or deep recess should be constructed for the Organ; on the contrary, it should stand as uninclosed as possible, so that its every sound may have perfectly free egress, and reach the ear at its true value. It would be just as absurd to cram a full orchestra into a chamber, and compel it to play behind a heavy screen of woodwork and pipes, as it is to cram all the pipe-work of an Organ into a similarly objectionable place. The Organ in the Liverpool Philharmonic Hall certainly presents the most objectionable treatment known to me in an instance of any importance.

In providing for the accommodation of an Organ, in its usual locality, behind and above the tiers of seats for the chorus singers and the orchestra, the architect should contrive to give as great a width as possible combined with moderate depth, rather than to form anything like a recess in a central position, with the view of concentrating the instrument into a deep mass with a comparatively narrow frontage. Two conditions are necessary to a successful result, and these the architect and organ builder should never lose sight of; namely, ample room within the limits of the Organ for all its sound-producing portions, so that every pipe may have absolute freedom of speech, and an ample frontage, practically uninclosed, to enable the sounds from every department to have perfectly free egress. These brief remarks anent the position of the Organ proper and its treatment in that position must suffice for the present. I have now to say a few words on the position of the claviers—a matter, in a Concert-room Organ, only secondary to the position of Organ itself.

I have, I regret to say, not one favourable word to say with reference to the positions of the claviers belonging to Concert-room Organs at present erected in this country; and until the matter is taken out of organ builders' hands, or, at least, until they have no control over it, we need not expect to see a better state of things in this important direction. Glancing once more at the representative Concert-room Organs I have previously spoken of, what do we see? In every instance, a most objectionable arrangement. Ask Mr. W. T. Best what he thinks of the position he has had to occupy, for the last quarter of a century and more, while playing the organ in St. George's Hall. Ask him if it is possible to form any correct idea of the effect the Organ is producing in the locality the performer is compelled to place himself. I know very well what his answers to both these questions would be. The position of the claviers and, of course, the organist also, are quite as bad in the case of the Organ in the Albert Hall, South Kensington. They are all but as bad in regard to the Organ in the Public Hall, Glasgow, and only one decided degree better in the case of the Organ built by M. Cavaillé-Coll, in the Albert Hall, Sheffield. I only mention these Organs so as not to weary the reader; but I may add that every other Concert-room Organ in England displays the same unsatisfactory state of affairs. It is not difficult to understand why English builders have adhered to what may be called, for sake of distinction, the *close direct position*, or what may quite as appropriately be designated the hole-in-the-case position; but it is difficult to understand why they have been allowed to adopt it in instruments of so much importance. In this position the claviers are contiguous to the sound-producing portions of the instrument; and all the mechanism connected with both them and the draw-stop system is direct and comparatively simple. Much trouble, uncertainty, and expense is thereby saved to *the builder*. It is only right to remark that the peculiar formation of the end of St. George's Hall, in which the Organ is located, left Mr. Willis no choice as regards the position of the claviers. The regret here is that the architect did not understand matters connected with the Organ sufficiently to provide for a more satisfactory arrangement. Besides this, St. George's Hall was not originally intended for the concert-room it has since become. The Albert Hall, at South Kensington, and the Public Hall, at Glasgow, were both designed as concert-rooms, and permanently fitted up as such: how comes it, then, that their Organs are almost as inconvenient, in the matter of their clavier positions, as the earlier instrument at Liverpool? In all these Organs the organist has to sit above the highest tier of seats appropriated to the instrumentalists of the orchestra, with his back to the conductor; and, in addition to the multifarious calls upon his attention, has to watch the conductor's baton in a mirror placed above the music desk.

M. Cavaillé-Coll endeavoured to remedy this state of affairs somewhat in his Organ in the Albert Hall, at Sheffield. He reversed the claviers, placing them in an advanced console. The treatment is not quite satisfactory, for two reasons. Firstly, the console is not sufficiently advanced to enable the organist to perfectly realise the effect he is producing to the ears of his audience in the hall; and, secondly, he is so seated, behind a high and deep console, that he cannot see the conductor save in a mirror placed obliquely on the top of the console. For ordinary solo playing, however, this arrangement has some advantages over those in the Organs previously noticed, for the organist at least faces his audience.

I now come to the consideration of the best position for the claviers in the orchestra; and, as it happens, the two most important conditions affecting the organist, and the result of his labours help materially the solution of the question. It is essential that he should be so far removed from the sound-producing portions of his instrument as to be at all times able to realise exactly the effects he produces in solo playing, or when he alone accompanies the choir, or in *ensemble* playing with the orchestra. In the two latter cases it is important that he should be as near as possible to and in full view of the conductor. Such being the case, it is obvious that the best position is immediately in front of the conductor's desk, and, for the convenience of the front ranks of the orchestra, somewhat lower than they are. Some ingenuity is necessary to arrange the console and all its accessories in a perfectly seemly fashion, so that the organist assumes a subordinate place while aiding the full orchestra, and a sufficiently prominent position when he is the solo artist. This is not the place to go into any matters relating to the design and construction of the orchestra platform, the conductor's desk, &c.; but I may assure the reader that there is no great difficulty in arranging all that is required for the comfort of the organist.

It is quite probable that organ builders may have realised the advantage of this comparatively distant position, but have felt constrained to abandon or suppress its advocacy on account of the imperfect, unreliable, and cumbersome nature of the mechanism at their disposal. There can be no doubt that the old-fashioned tracker and the later pneumatic-lever actions would prove insufficient for the distance and depressed console arrangement. Now, however, all difficulty has been swept away by the introduction of the more perfect forms of the tubular-pneumatic and electro-pneumatic actions, invented by English and American builders.

Number and Compass of Claviers.

No Concert-room Organ should have fewer than five independent departments, commanded by one pedal and four manual claviers. Instruments of the first class should have six independent departments, commanded by one pedal and five manual claviers. When circumstances are unfavourable to the introduction of a fifth manual clavier, two minor departments can be commanded by one clavier. This will be fully explained later on in these Notes.

I feel somewhat reluctant to upset the old-established nomenclature of the departments and their claviers; but I hardly see how they can be retained under the new methods of stop appointment and the multiplication of expressive departments which I have to propose. In the first place, in an instrument comprising three or four expressive departments, the term Swell organ has no definite significance when applied to any one of them. It is open, therefore, to serious question whether this name should be retained. There is one name I would sweep away entirely—namely, that of Echo organ. This is a meaningless and most undignified appellation in connection with any part of a Concert-room instrument: it smacks of trickery and of fanciful ear-tickling effects, altogether unworthy of the office such an Organ fulfils. If the effect of an echo is at any time required, it can readily be obtained from the ordinary expressive departments; but such an effect is very rarely necessary in dignified music, and should certainly not give its name to an entire department.

Probably the simplest solution of this difficulty is to abandon the terms Great, Swell, Choir, &c., and use the sufficiently distinctive names First organ, Second organ, Third organ, &c.: or, in the most musical of languages, *Organo Primo*, *Organo Secondo*, *Organo Terzo*, &c. More of this anon.

I now come to the question of the compass desirable for the manual and pedal claviers of the true Concert-room Organ, and it can be disposed of with a very few remarks here. There can be no doubt that the greater the compass the manual claviers have the greater are the resources for grand and varied effects at the disposal of the organist. The extreme limits may be fixed at G G G, 10⅔ft. downwards, and c^4 upwards. The Organ in St. George's Hall, Liverpool, has all its four manual departments complete, from G G G to a^3 = 63 notes. Much of the truly remarkable grandeur of this majestic instrument is due to the unusual resources, in the Bass, which it possesses. It only requires the performer to know how to utilise them in a manner distinct from the Pedal basses. It is, however, unlikely that the great expense entailed by the addition of so many large pipes, and the space they demand for their proper accommodation, especially in swell-boxes, will ever again be contemplated; more especially as the CC, 8ft. downward range, is now considered ample for all manual claviers. It is quite beyond question that all the manual claviers of the Concert-room Organ should extend upwards to c^4. The Organs in the Albert Hall, South Kensington; the Public Hall, Glasgow; the Albert Hall, Sheffield; and the Music Hall, Cincinnati, have all their manual claviers extending from CC to c^4 = 5 octaves. Besides giving additional facilities to the organist, this high range is most convenient for octave coupling.

The usual modern compass for the pedal clavier is from CCC to F = 30 notes; but this is certainly the minimum compass for the Concert-room Organ, and I strongly advise that adopted by Mr. Henry Willis, in the Albert Hall Organ, namely, from CCC to G = 32 notes. There are other instances of this compass in English Organs; and it was used as early as 1850, by Jackson, in the Organ in the Liverpool College. The two additional notes at the top are very useful, especially when melodic passages are taken on the Pedal organ, while they do not entail any great expense. In scheming a Concert-room Organ, every possible call on its resources should be anticipated; and it may be accepted as a fact that every fresh addition to the capabilities of the instrument, although it may be in advance of the times, will tend to the improvement of organ music, and will speedily be utilised by the progressive organist. In the following Notes, the compass of the manual claviers will be understood to be from CC to c^4, and that of the pedal clavier from CCC to G.

(*To be continued.*)

THE THEORY OF MACHINES.—XVI.

By Francis Campin, C.E.

Machines Working by Impact—Buffers.

A CONSIDERABLE number of machines are in use, in which the force of impact is employed to bring about the desired results. Among such are punching-machines, power hammers, pile-drivers, fly-presses, and the like; and in order to understand their mode of action we must examine the characteristics of impulsive force as compared with simple pressure.

There can be no such thing as instantaneous action. Action involves motion of some sort, and any motion must occupy space and time, although in so small a quantity as to be absolutely inappreciable by our unaided senses, so we cannot say that motion is absolutely *instantaneously arrested*. Impact, then, in this light, simply indicates the expenditure in a comparatively short time of work accumulated in some longer period.

This is illustrated by an ordinary pile-driver. The work done will, according to the principles already laid down, be equal to that accumulated in the falling weight, known in this machine as the "monkey." Assuming that the piles are being driven through some softer soil to a harder substratum, it may be taken that the resistance is uniform for each blow. If W = weight of "monkey" in pounds, h = height of lift in feet, R = resistance of pile to driving in pounds, and d = descent of pile at one blow of the monkey in feet; then by the equality of work $W h = R d$. Let the weight of monkey be 960lb.; lift 15ft., and the distance the pile descends under one blow equal 2in.; then $960 \times 15 = R \times \frac{1}{6}$; R = 86,400lb. mean pressure on the head of the pile.

From the mean pressure on the pile thus determined, we can judge what load may be safely placed upon it, and thus for any given foundation specify up to what resistance the driving of the piles is to be carried before commencing to build upon them; thus, in the above case, if only one-sixth the disturbing weight is to be placed upon the foundations; each pile driven until it only moves 2in. per blow, will carry safely 6 tons 8 cwt. In this case, the pile being supposed to be pointed, will be sustained by the friction of the earth against its sides.

We will next take, as an example of another kind of impact machine, the fly-press used for stamping and coining. In this case the work is accumulated in revolving weights on the arms of the fly by pushing them round by hand-power until sufficient velocity is acquired, the work being given off at the bottom end of the fly-shaft, which works in a screw-thread, so as to descend upon the die or stamping block to be actuated, the block being so arranged mechanically as not to turn with the shaft. Given the weight of the balls of the fly, and their linear velocity at the moment of impact, also the travel of the die after impact upon the material operated upon, the mean pressure on the die and work can be ascertained directly, regardless of length of fly-arms and pitch of screw-thread; let the weight of the balls be 50lb. each, their velocity at moment of impact 10ft. per second, and the travel of the die $\frac{1}{30}$th inch. We have shown that the accumulated work in a body is $\frac{Wv^2}{64\cdot4}$; therefore, in this instance, if P = average pressure in pounds on the die; and d = the travel in inches; $P \times \frac{d}{12} = \frac{Wv^2}{64\cdot4}$ $P = \frac{Wv^2}{5\cdot38\dot{3}\,.\,d} = \frac{100 \times 100}{5\cdot38\dot{3} \times \frac{1}{30}} = 95{,}458$lb. This being the mean pressure, the maximum may be twice as much, as it would, if the compression of the material commencing at zero offers a uniformly increasing resistance up to its completion, and to this maximum force the strength of the parts of the machine must be adapted.

In punching and shearing machines, the work is accumulated in flywheels, the punch or working end making one stroke for a given number of revolutions of the flywheel; but these machines keep on ahead, and do not have to be turned back after each stroke as do the fly-presses.

In direct-impact machines, such as pile-drivers and steam-hammers, we are not, however, limited to the energy due to the weight of the falling mass only: this can be subsidised by applying steam or air-pressure. The additional effect thus obtained may also be easily determined.

It has been experimentally proved by a very precise apparatus (Atwood's machine) that the acceleration of velocity in one second caused in a given mass of matter will vary directly as the force applied to it. If, for instance, we have a mass weighing 5lb., that 5lb. is the force pulling it towards the earth, and giving an acceleration of 32·2ft. per second; if, on the *same* mass, a pulling force of 10lb. can be applied, the acceleration per second will be doubled, and in all cases the momenta (that is, the weights multiplied by the velocities in a given time) will vary directly as the forces by which they are generated.

Let us now apply these considerations to an ordinary direct-acting steam-hammer so fitted that steam can be admitted above the piston to drive it as well as below to lift it.

Let the effective dead weight of the hammer-head, piston, &c., be 10 tons, and the working pressure of steam upon the piston 130lb. per square inch. The diameter of piston being 24in., its area will be 452·4sq.in.; this would correspond to a total steam-pressure of 452·4 × 120 = 54,288, so with the weight of the hammer itself, the total impelling force will be 76,688lb.; the acceleration due to this pressure will be $f = (76{,}688 \times 32\cdot2) \div 22{,}400 = 110\cdot24$ft. per second. The velocity of the hammer at the end of the stroke, this being made of exactly the same bore. Costly instruments are only required by the few. Any burette, or piece of glass tubing, with an opening at one end just large enough to allow the passage of accidental pieces of dirt which are occasionally present in oils, will answer all ordinary purposes. The size of the viscosimeter will depend on the quantity of oil usually available for examination. Two marks are made on the tube—one near the large, the other about 2in. from the narrow end; and the number of seconds required for equal bulks—represented by the capacity of the tube between the two marks—of different kinds of oils to flow through the small orifice is a measure of the relative viscosities of the oils. About 50c.c. is a convenient volume.

The viscosity test enables us to determine whether an oil is suited for machinery of a particular weight or not. For very light machinery, watches, clocks, &c., the viscosity should be low, and vice-versâ; and, for this reason, low viscosity means little friction, high viscosity indicates the existence of a strong cohesive force, which enables the oil to a greater or less extent to separate the metallic rubbing surfaces, and so change the nature of the friction from *solid* to *fluid*. In heavy machinery the increased friction due to the high viscosity of the oil is of slight consequence.

The viscosity varies with the specific gravity in the same kind of oil. Mineral oils from the same source afford the best instances of this. As the more volatile portions, which are of lower densities, are removed by distillation, the viscosity increases, until it exceeds that of castor-oil at ordinary temperatures. Different oils of the same density may have very different viscosities.

The viscosity varies, too, with the temperature, but not regularly, for some oils diminish in viscosity with increase of temperature much more rapidly than others. This may be taken advantage of in determining the nature of a sample. For practical purposes the viscosity is measured at ordinary temperatures, say 65° F., and should also be measured at a temperature near that at which the oil is likely to be used. Cylinder oils, for instance, should have their viscosities measured at about 200° F., ordinary machine oils at from 120° to 150° or 180°. Some mineral oils of remarkably high viscosity at ordinary temperatures are wholly unsuited for cylinder oils by reason of the great diminution in viscosity at increased temperatures. This question of viscosity is, therefore, often of the greatest importance, and should not be overlooked. An oil which varies but slightly with increase or decrease of temperature proves more generally useful. Sperm oil, which has long been a favourite lubricant, has at ordinary temperatures a low viscosity, which varies less with increase of temperature than that of any other oil.

(305.) Other points of great importance in lubricating oils are the amounts of free acid present, and of the tendency to corrosive action on metals. These are determined as described in Arts. 230 (*d*) and 246. Sheets of iron and brass should be tried as well as copper, for it has been found that different oils attack some metals more than others. Those specially interested in this subject will find a very curious and instructive table in the *Journal* of the Society of Chemical Industry, Vol. V. p. 363.

(306.) The presence of volatile oils in mineral lubricating oils is objectionable, because they lower the flashing point and the lubricating value of the latter. The loss on heating over boiling water should be determined.

(307.) The flashing point when above 212° F. is usually taken by heating gradually a small portion of the oil in an open beaker on a sand-bath or piece of asbestos cardboard, stirring with a thermometer and noting the temperature at which the vapour flashes when a lighted taper is held (at intervals) *near* the surface of the oil. Oils of low flashing point are dangerous, those flashing below 300° F. are unsafe. When the flashing point is below 212°, Abel's apparatus should be used.

(308.) The temperature at which fat begins to deposit, or at which the oil becomes so thick that the thermometer can with difficulty be moved about in it, should be noted. A low solidifying temperature is important, especially in the case of oils for watches and clocks and *similar delicate* machinery.

(309.) The amount of ash should also be determined, for in some prepared lubricants this is occasionally present in such quantity as to injure delicate machinery. There is, however, a certain class of lubricants generally described as

Solid Lubricants,

which usually contain an appreciable amount of ash. They are used for the heaviest kinds of machinery.

(310.) *Railway or Waggon Grease* is a well-known member of this class. A most important point in connection with solid lubricants is that they shall not readily run off the axles or bearings. Indeed, this is the principal reason for adopting them. A high melting point is, therefore, desirable. The bulk of the grease should not melt below 150° F., and the melting point of a part may rise as high as 240° F. or above. The ash should be as low as is consistent with a high melting point. Sometimes these greases contain upwards of 30 per cent. of sulphate of baryta, chalk, and soda; and this quantity left on the axles must be injurious to them. The best greases are mixtures of fatty substances with soda and lime soaps. The ash should not exceed 5 per cent., and a fair limit for water would be from 25 to 30 per cent. The latter sometimes approaches 60 per cent.

(311.) *Tallow* is also much used as a lubricant. There are two good kinds sold under the names of "Russian and "clarified." The former has a melting point three or four degrees higher than the latter. In tallows for lubricating, the melting point and the percentages of water and ash present are important. The melting point of best clarified tallow is about 115° F.; that of Russian about 120°. The less ash and water the better. Usually there is none; but 0·1 per cent. of ash, and 0·2 per cent. of water are occasionally met with. Russian tallow is almost invariably free from even traces of either.

(312.) *Plumbago* is another solid lubricant in much favour, and largely sold under the name of "anti-friction powder." Its value as a lubricant, or indeed, for any other purpose, depends on the percentage of pure graphite it contains; and this is best determined as described in Art. 201. First quality contains from 99 to 100 per cent. of graphite; second quality from 95 to 98, and inferior qualities contain a smaller percentage.

Plumbago can also be purified cheaply in the same way.

(313.) *Gumming* is a serious defect in a lubricant. It is indicated in several ways. If, in the Bailey testing-machine, the saddles are, as it were, "gummed" to the axle next morning, it is due to this defect. If, on spreading an oil in thin layers on glass, it dries in a day or two, or if, on heating on the water-bath, it gains instead of loses weight, this defect is thereby indicated. A lubricant which possesses this defect should invariably be rejected.

Before leaving the subject of oils, it may be advisable to include a few tests for an oil which is now largely used for burning in the "Lucigen" light. The oil sells for 1d. a gallon; but large users think it worth while to have it tested.

(314.) *Creasote Oil* has a sp.gr. of about ·970. On distillation it yields at 450°F. a total of 18 per cent. by volume; and at 600°F. a total of 82 per cent. by volume. Of these 82 parts, 32 are soluble in soda, and may, therefore, be called tar acids; the remaining 50 parts are tar oils. On ignition it should leave only a very little ash—the less the better; it should leave no mechanical impurities when passed through a coarse filter; and it should not deposit napthalene or any other solid when cooled down to 40° Fahr., and allowed to stand at that temperature for a considerable time.

Besides the tests described in these papers, there are others more delicate, and consequently more difficult of manipulation; but they are of use only to the expert, and would be out of place in these pages. It is hoped that those which have been given here, taken in connection with the results which are for the first time published, will serve as guides to those who have not had much experience in this branch of analysis, and who have to depend for their information on textbooks, which, so far as results are concerned, are usually misleading to a slight extent, in as much as the figures are taken from *special* or *laboratory* instead of from *commercial* samples.

In searching for an adulterant, more expensive oils may be excluded from the list; and it is therefore advisable to know the current prices of the various oils.

(To be continued.)

SACCHARINE AND ITS USES.

NOT much has been heard of saccharine since its discovery was announced; but as we continue to receive queries asking about it and where it can be obtained, the following particulars may be useful:—

Saccharine is the body discovered in 1879 by Dr. Constantine Fahlberg when experimenting with the toluol sulphamides; its scientific name is anhydro-ortho-sulphamine-benzoic acid, and the formula is—

$$C_6H_4 < {CO \atop SO_2} > NH$$

It is stated by the inventor to be 300 times as sweet as sugar, and the only body known of such marked sweetness. The manufacture of this substance has been commenced on a large scale by the inventor and his partners, trading under the name of Fahlberg, List, and Co., at Salhke, Westerhüsen, near Magdeburg. They have now commenced active operations, and will be able to supply saccharine in bulk. Whether this substance is destined to become common in those manufactures specially adapted to food-stuffs is a question which time only can answer; but it is advertised as being of great service to brewers, chocolate and cake manufacturers, and many other purposes. Its absolute harmlessness on the animal system has been proved by the highest medical authorities and its importance for use in medicine and pharmacy sufficiently demonstrated.

It is a preparation of toluene, the substance found in the light distillate of coal-tar, and forming the principal portion of the rectified product known as 50 per cent. benzene. Saccharine is but little soluble in water. Pure water does not dissolve more than about three-tenths of 1 per centum of saccharine. It is more soluble in hot water, and may easily be obtained from such a solution in the crystalline form. Alcohol dissolves it more readily, and saccharine becomes more soluble as the strength of the alcohol is increased; 10 per cent. alcohol dissolves ½ per cent., while absolute alcohol dissolves just above 3 per cent. The maximum solubility, however, is when 70 per cent. alcohol is employed, in which about 3·1 per cent. dissolves. Ether dissolves it readily, and its solubility can be increased at pleasure by the addition of any carbonate of an alkali or alkaline earth. The inventor states that there are many uses to which saccharine may be applied. Grape or starch-sugar dissolves saccharine with facility, and may be sweetened by this means to almost any degree. One or two parts of saccharine mixed with 2,000 parts of starch-sugar forms an excellent substitute for cane-sugar where body and sweetness are required. When it is desirable to produce a high degree of sweetness in a comparatively small quantity of substance, saccharine may be used with advantage, and it may also be employed in aqueous and alcoholic solutions, as in the manufacture of lemonade, champagne, &c.

The chemical nature of saccharine is fully set out in the specification of the letters patent No. 6626, 1885, but the patentees, Fahlberg and List, have also protected the invention, in one of its most useful applications, by a subsequent patent, in which they say: the object of our invention is to render less disagreeable the taste of various organic alkaloids used as medicines such as quinine, cinchonine, strychnine, morphine, and others, and the invention consists in combining those alkaloids with saccharine. For this purpose saccharine is dissolved in water or alcohol, and the solution is neutralised by the alkaloid to be subjected to the treatment. A compound alkaloid with the saccharine is thus formed, which may be separated out from the solution in amorphous or in crystalline state, and in which the particular state of the alkaloid is far less prominent than in the sulphate or the hydrochlorate of the same. If saccharine is added in excess to the solution of the alkaloid prepared as described, an acid salt is formed, which may also be easily obtained in crystalline state, and which possesses still less than the neutral salt the taste of the pure alkaloid.

become inconceivably greater and more magnificent when the missing parts are built into it.

Emerson says of books in his address on the American scholar:

"What is the right use? What is the one end which all means go to effect? They are for nothing but to inspire. I had better never see a book than to be warped by its abstraction clean out of my orbit, and made a satellite instead of a system. The one thing in the world of value is the active soul. This every man is entitled to; this every man contains within him; although in almost all men obstructed and as yet unborn. The book, the college, the school of art, the institution of any kind, stops with some past utterance of genius. 'This is good,' say they; 'let us hold by this.' They pin me down; they look backward, not forward. But the eyes of man are in his forehead, not in his hindhead; man hopes: genius looks forward; genius creates."

The book is like the mechanic's tool; it is a means to an end; it gives us the wisdom and the thought of the good and the great, the wise and the far-seeing; but it must be properly used, or all our time and labour, our patience and our expended energy, go for naught. Rightly used, complementing the study of life, of men, of nature, of art, and of the flowing currents of industry and commerce, as in actual existence all about us; read with thought and clear apprehension, marking each sentiment and each fact with attention; digesting every proposition thoroughly, and giving the author a carefully balanced judgment at every step, the book becomes the means of the highest culture and of the noblest training.

Richter, the prophet of education, in his "Levana," his beautiful treatise on education, concludes by saying, "Give natural philosophy and natural history, astronomy and geometry, and abundant supplies of 'bread studies' in the school rooms and lecture rooms of your gymnasiums; and in so doing, you will give your boys ten times more pleasure than they will receive from the unfolding of the mummy bandages of the ancient graces; thus too you will impart the common nourishment needed by both the future divisions of your pupils into sons of the muses and sons of labour."

With Emerson we would say: Give us no books, if books be all. With Richter we would say, as say all our witnesses against the weakness of the older ways: Give us knowledge of the works of the Creator, before we learn the smaller ways of humanity; teach us through the book of nature before we learn from the printed volume, rich as it may be in the thought of man. It is thus that we would amend the older system of education; it is thus that we would better prepare the youth of our country for the work and the life into which they are to enter so soon and with such diffident steps. Teach them to study the world as it appears to their senses, and to glean the rich harvest of facts and the wealth of knowledge which the investigation of the laws and processes of nature gives. What philosopher, however keen of intellect, and however greyed with the wisdom that meditation brings, knowing nothing of nature, could give to the young mind just growing into form in this world such wisdom and such thought as nature gives?

Draper, speaking of science, says: "For her the volume of inspiration is the book of nature, of which the open scoll is ever before the eyes of every man. Confronting all, it needs no societies for its dissemination. Infinite in extent, eternal in duration, human ambition and human fanaticism have never been able to tamper with it. On the earth it is illustrated by all that is magnificent and beautiful; on the heavens its letters are the suns and worlds." And thus it is the grandest means of promotion of the growth of the human soul, as well as of giving the world the means of securing that leisure which is indispensable to the opportunity of growth. It is to pure science that we are beginning to look for the greatest stimulus of the mind that the race has yet discovered; and it is to applied science that we must always look for the means of gaining all that is desirable in this world, as aiding the advancement of civilization. It is in the introduction of this element into education mainly that the new education becomes distinguished from the old. The educator of to-day who studies the work to which he is to apply himself with intelligence and conscientious thought, endeavours to make a careful survey of the whole field of all human attainments, and from the illimitable realms of moral, intellectual, and physical knowledge seeks to glean out such as is best adapted to the purposes of his vocation—to the training of the faculties, the development of all the powers, the acquisition of the most profitable and useful knowledge; he seeks to give to every growing soul such of this nutriment as will most effectively nourish the intellect and the soul.

Professor Goldwin Smith, in his "Lectures on History"—lectures in which are stored the product of a long and fruitful life devoted largely to classical pursuits—says: "There are changes in the circumstances and conditions of education which cannot be left out of sight in dealing with the generality of minds. Great discoveries *have* been made by accident; but it is an accidental discovery, and must be rated as such, if the studies which were first pursued as the sole key to wisdom and knowledge, now that they have ceased not only to be the sole, but the best, key to wisdom and knowledge, are still the best instruments of education." This is unquestionably true; but it is easy to see, to-day, that it is not the whole truth. It fails of the whole truth in that it assumes that wisdom and knowledge, in the scholar's sense, are the sole elements of a complete and generous education. As we shall see, after very little study of the philosophy of education, we must add some thought of the development of the body to our consideration of the wants of the mind. The two parts of the human being are inseparably interlocked, and the soul of the sage cannot be fully developed to its highest perfection except in the body of a sound and healthy man. Further, as we have seen in the education which is now called technical, and which has now been brought here to highest perfection, the mutual influence of mind and body, of intellect and of the tactual faculties, is essential to success in every art, as well as to the complete development of all human powers. It is thus that we pass out of the old into the new.

Humboldt noticed the tendency of the schools to go on in a beaten track, following a long established routine, and held in their invariable orbits by a force of inertia which seems well-nigh invincible, and says: "The thing is *not* to let the schools and universities go on in a drowsy and impotent routine; the thing *is* to *raise* the culture of the nation ever higher and higher by their means." It has demanded all the influence of the greatest minds, acting through generations, to enable us to break clear of the conservatism which has held us so long in chains, and to establish a new education that is freed from shackles, and which may give us, all and each, just that education which the individual needs for the successful prosecution of his work in life, in whatever path or in whatever province that work may lie. It is only in a country like ours, in which the people have the power to proclaim what are their needs and to demand that they be considered, or in a country like old France or modern Germany, in which the classes having control of the educational systems have the privilege of calling to their aid the wisdom of the wisest of their fellow citizens or fellow subjects, and have the power of acting unimpeded by conservatism or by the ignorant prejudices of the vulgar, that such a revolution could be effected either promptly or thoroughly. But we have seen such a revolution as the Marquis of Worcester demanded, such as the philosopher Descartes proposed, such as Vaucanson and Froebel, each in his way, working at points far remote the one from the other, began within the century. It is this revolution that we find of interest, and the results of which are visible so plainly to-day and here.

Education should evidently fit each individual most effectively for the life work that may be expected with reasonable probability to open to him, to give him the means of preserving himself from danger of suffering and want, of securing a competence for himself and safety against poverty for his family, of gaining some leisure for thought and for enjoyment, and some opportunity of taking advantage of the good fortune which has been his in coming into the world at this advanced period of its history. It should fit him to perform all the duties of the citizen, of the head of a family, of a friend, and such as he owes himself to perform every duty which he owes to himself, to his family, to the nation, to the race. In the light of such a definition, we may study the form which is best given modern education.

Were it possible to study the future of each individual, it would be easy to say what would be the best general course to take with each. But this cannot be done, and we must do as we would in any other attempt to meet ill-defined conditions. We must take a course dictated by the probabilities of the case. For the man or woman who has wealth, and for whom a life of leisure is probable, we may study how to give a gymnastic training that will give the mind as well as the body its best and most symmetrical development. For the life of a person who must work for a living, we must prepare such a training as will, while giving as much of this gymnastic culture as may be practicable, provide with certainty and efficiency so much of knowledge and of special training for the work of life as will at least make him capable of taking up that work with fair prospect of success. We must make him secure against poverty first, and must give the less essential, though still important, elements of the general education second. For the average citizen, manual training and trade education are the necessaries of life, while the languages and the literatures and the sciences, so far as they are not contributory to his technical training, are for him luxuries. We may also put it down as one of the duties of the State—for it is the State which usually undertakes to supply education—to give such a training as will fit the youth to rise above the plane in which his life starts him on his journey. But it is evident that it is folly to educate the youth whose life is probably to be that of an artisan as if he were to be probably a gentleman of wealth and leisure, simply because, here and there, one among ten thousand such may possibly find use for a higher range of intellectual study. The average citizen, fortunately for our country, has neither the opportunity nor the desire to enter upon a life of leisure. Even our wealthiest men are above the old superstition that riches bring the privilege of idling in such a busy world as this, and the wealthiest among our wiser citizens are giving their boys useful as well as gymnastic training, supplementing a general education with professional or trade instruction.

There are two principal classes among the people for whom we must provide education: the one comprises those who are, by natural powers and by inclination, fitted for intellectual pursuits. The other comprehends those, in vast majority, as we are all aware, who have the constructive faculties most highly developed. Thus it is at once evident that, where a youth has shown a decided bent in either direction, his education should be modified in accordance with the talent so exhibited. But, whichever course is finally to be adopted, it is obvious that the proper first step is to begin by training together mind and body to give facility of mental and of physical action, and I would propose in every case the adoption of manual training, and teaching the use of the familiar tools of the common trades. If it were certain that the child would never need to care for himself, it might possibly be well to content themselves with giving him his gymnastic exercises only. But the son of a king may be compelled to earn his bread by the sweat of his brow, and the princes of royal houses are wisely taught trades. Every son of an American citizen should be at least as well cared for, and manual training is coming rapidly to be recognised as one of the divisions of every well-ordered curriculum in the primary schools.

But this is not all. There is a still other reason for the introduction of this manual training into our schools.

One of the wisest and most thoughtful of physicians, one who, in his time, was considered a very great authority on the physiology of education, and who wrote one of the most interesting of treatises on that subject when acting as a scientific commissioner of the United States to the Vienna International Exhibition of 1873, the late Dr. Seguin, once sent me a paper written by himself, in which he described a case of extraordinary interest in this connection, and one which is wonderfully suggestive to him who is seeking the best method of raising our youth toward the heavens through education and training of his faculties. In this paper he describes one of those singular nervous ailments which so often present themselves to the physician, and gives an account of its treatment by a novice in medicine, but a genius in what I may be allowed to call intuitive pathology. It was a woman, of course, who performed the miracle.

He says that a child was born to healthy and intelligent parents, and until six months of age, was one of the most perfect and most beautiful of healthy, hearty children. But, at that age, in consequence of some digestive irritation probably, it was seized with convulsions, and a paralysis of the left side of the body and limbs was produced. Its face lost the bright, intelligent expression formerly natural to it, and it was unable to use its limbs on the left side. In this condition it remained until six years of age, when a young lady, a friend of the family, visiting the house, became greatly interested in the case, and persuaded herself that she might, by careful training, enable the child to regain the use of its limbs. Taking up her residence in the family, she gave one year to the purpose which she thus conceived, each day carefully and systematically exercising the disabled limbs and teaching the little one to use them for all the purposes of its young life. A marvellous change took place. The child recovered the use of its limbs, and was able, at the end of the year, to handle them about as well as could any other child of its age. But a still more wonderful result, and a most unexpected one, was brought about at the same time. The child's face regained its natural and intelligent expression, and, most wonderful of all, it once more became a bright and active-minded creature, and was restored to its mother hardly less perfect in form, feature, and mind than before the catastrophe occurred.

Was there ever a more convincing proof of the mutual interdependence of the mind and the body? What a revelation is this of the influence of mind upon matter, and the effect of matter upon mind! Does it not show with absolute certainty that the healthy mind must have residence in the healthy body, and that the perfection of the body is essential to the best action of the mind, and even to the partment would simply ruin them. If I turn to the branch of science that is my own pursuit, physics, I find that it is, by the inexorable rules of the Science and Art Department, cut up arbitrarily into two 'subjects'—(1) heat, sound, and light; and (2) electricity and magnetism. If I get together, say, a class of apprentices from the optical workshops of London, and teach them optics, or if I get a class of young engineers and teach them heat, then by the rules of the Science and Art Department this is not technical education at all; there is no grant for such teaching. If I teach the opticians what they do not want, heat and acoustics, as well as their optics, then I am giving them technical instruction. Or I may teach them building instruction, or geology, or zoology, or naval architecture (not that I know anything of these branches of science), and I am equally giving them technical instruction, for these are subjects 'prescribed' as such by the Science and Art Department; but directly I settle down to teach these apprentices the optics that they want to know—the one subject that is technical to their industry—I am no longer giving technical instruction as defined by this Bill. Another consequence of this arbitrary prescription of three sciences in one 'subject' is that, in the highest stage, no one of the three can be thoroughly taught, a smattering of each being the requisite thing to procure passing of the examination and payment on its results. Again, the regulations of the Science and Art Department make it impossible, in every school working under its scheme, for more than two prescribed subjects to be taught on the same day (except Saturdays). They also put a premium upon quantity of teaching as against quality—first, by stopping payment on results if the student is clever enough to take honours, unless he has previously gone through the examinational mill of passing in a more elementary stage in a preceding year; and, secondly, by refusing to recognise the value of any further teaching to a student who has once passed the so-called honours stage of the prescribed examinations. As an additional absurdity, it may be mentioned that the Science and Art Department recognises as a teacher qualified to teach and earn payment in any and every one of the prescribed subjects of technical instruction every person who holds a degree from an English University, whether it be Master of Arts of Oxford or Bachelor of Theology of Durham. This will never do in a scheme of national technical education, in which the one important thing, so far as selection of teachers is concerned, is that they shall be in touch with the technical requirements of the respective industries which their teaching is to benefit. Unfortunately, it is true that the vast majority of the science teachers under the Science and Art Department are not in this position, but are schoolmasters who have in a most praiseworthy way, and in many cases by the help of the Science and Art Department itself, obtained some acquaintance with one or two of the sciences. Excellent though the original idea of the Science and Art Department may have been, it has certainly resulted in a vast amount of superficial and book-learnt science being taught, and in the development of a vast array of little textbooks specially designed to cram students with the minimum of knowledge requisite to earn a grant by passing the South Kensington examination. Books written for workmen by men who have never worked constitute the very antithesis of a sound material for a technical education. For the textbook and the schoolmaster who has learnt, the true modern technical education substitutes the laboratory and the instructor who has worked. This the Science and Art Department has yet to discover. In saying this I am saying nothing in disparagement of the extremely able staff of administrators at South Kensington; they know their own work: I believe they do it well, and that they honestly endeavour to promote what they think to be its usefulness to the nation. If they can break with old traditions, take up new blood, and show themselves able to come into touch with local requirements, then all may yet be well. But a fear that the evil traditions, the prevailing academic notions, and the all-too-abundant red-tape of the past may prove too strong in the future is at the bottom of the profound distrust with which this measure is regarded by some of its best friends.

"Thanks to the munificence of the City Guilds, their Technical College, which I have the honour to direct, has no need to lean for subsistence upon the system of payments by results in the prescribed 'subjects' of the Science and Art Department. I am far from saying that in the abstract a closer alliance between the teaching in some of the college classes and the examinational scheme of the department would be undesirable—that would depend upon conditions. The examination scheme would need to be modified, its requirements simplified, its standard raised. But it would be an evil day for the students of the Technical College, for its staff, *and I believe for the quality* of the instruction *which it affords, when the energies* now devoted to that which is found to be most helpful in the direct application of science and art to the various industries should be turned aside to the helot work of earning payment on results in the prescribed routine of the Science and Art Department as at present constituted. Surely it is not too much to ask that, as a necessary antecedent to the passing of this Bill, some pledge be given by Government that the Department of Science and Art shall be itself reformed."

LINK BELTING.*

THE old saying that "there is nothing new under the sun" may well be applied to leather-link belting. It is generally believed that these belts are of recent invention, but that is an error: they are over thirty years old. Mr. C. M. Roullier, of Paris, experimented that long ago with small leather links 1in. and ⅞in. long by ¾in. wide. These links had two small holes at equal distances apart, and were joined with iron bolts, which were riveted at the ends, thus making a perfectly flat surface, and in that way forming a belt entirely of leather links. Mr. Roullier's idea was to economise; he, therefore, utilised the material left over from the manufacture of flat belting. He perfected his belt and came to this country in 1862, when he patented the article here and tried to introduce it. At first it produced quite a sensation, and many tests were made; but it was soon found that Roullier's belts were not suited to running our swift-motion machinery, and they were therefore abandoned as impracticable. Mr. Roullier then introduced his invention into England, where he met with some success, as his belt was better suited to English slow-motion machinery. These belts are now largely used in England, many good improvements have been made in them, and almost every belt maker in Great Britain manufactures them. Mr. Jabez Oldfield, of Glasgow, has the reputation of making the best and most reliable link belt in Great Britain; he has also the reputation of being the originator of these belts. This is, however, an error, the credit of the invention belonging, as we have said, to Mr. Roullier. Mr. Oldfield, nevertheless, has invented many useful machines for cutting and assorting the links. He has also introduced improved methods for putting the links together.

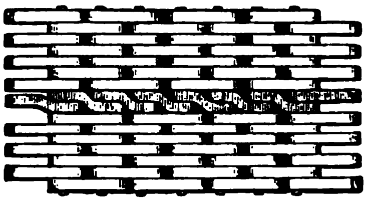


FIG. 1.

Fig. 2.

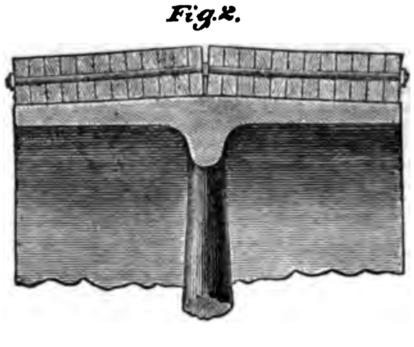
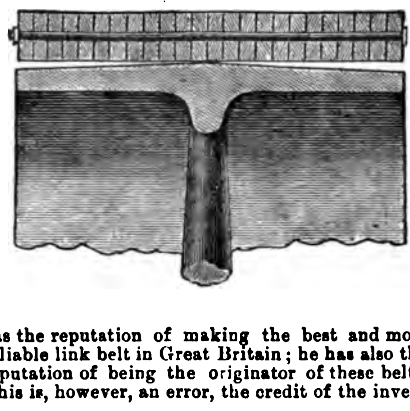


Fig. 3.



For more than twenty years after Mr. Roullier's visit, nothing was done with leather-link belting in this country. In 1882, however, Mr. N. W. Hall, of Newark, N.J., patented a link belt, composed of leather and steel links. His method was to place a steel link after every third or fourth leather one, in order to strengthen the belt. In practical use this belt was found to be very defective, because the leather links soon stretched, and thus all the work had to be done by the steel links. The whole strain coming thus upon the steel links, they in course of time cut through the bolts, and thus broke the belt to pieces. So this invention proved worthless.

In 1884 a Chicago belt company obtained a patent on another style of link belt. In this belt all the little holes in the links were lined with metal, similar to the holes in laced shoes. This produced an effect similar to that produced by Hall's patent. The metal lining of the holes cut the bolts into pieces by friction, and thus ruined the belt. Therefore this patent proved a failure also. After all these failures it fell to our lot to improve these belts so that they may now be worked successfully on our American fast-running machinery. During the past two years we have made and sold over five hundred leather link belts, which are all in actual use and doing excellent service, as is proved by many testimonials which we have received.

Our success with these belts has been so surprising that we think we have found, at last, the long looked for "missing link," not in "Darwinism," however, but in the belting line. We prophesy a great future for these belts in this country. How have we attained such success? First: We found that Roullier made a mistake in using leather offal, as, in the links of an iron chain, if one link is weak or defective, the whole chain is worthless, so in link belts, if one or two links are weak or made of poor material, the whole belt is affected by them. It is therefore of vital importance that only the best and most solid leather be used in making the links; second, the leather must be made very pliable, but at the same time its toughness and tenacity must not be injured, or it will stretch and break. These things are of great importance, and are the principal reasons for the failures of all former efforts. The leather which Roullier used was stiff, hard, and husky. He believed that the harder the link the greater its tensile strength, but upon actual test this was found to be a fatal error. Our leather links are saturated with a mixture of tallow, neatsfoot oil, &c. This makes them very pliable and increases their toughness, so that they will stand a strain three times as great as a piece of hard rolled sole leather. In manufacturing this belt, the joining together is important. The links must be accurately assorted as to thickness, and the outer links countersunk, to admit the bolt. Then the most valuable improvement of all is our "American joint" (see Fig. 1). By close inspection you will observe that it is absolutely necessary to use half-length bolts for the width of wide leather link belts. Examine Figs. 2 and 3. In the latter you will notice one length of bolt placed on a round-faced pulley. That belt must either bend or break, and in any case it will not give satisfaction; but, on the other hand, examine Fig. 2; here two half-length bolts are used, and ingeniously joined in the centre. It gives just pliability enough to lay the belt flat upon the pulley. We experimented for some time before perfecting this important improvement. We also took out four patents for different methods of joining, but abandoned them all and adopted the "American joint" system (Fig. 1) as the most efficient, simple, and reliable. It gives the belt an unbroken flat surface, and is far superior to anything so far introduced for that purpose.

We have not stopped at *flat* link belting, but have turned our attention to manufacturing round solid leather link belting, and believe that we have almost attained perfection in that line. As the illustrations clearly show, there is quite a demand for inch and upward solid round belting, and the difficulty always has been to join such a belt together. All steel hooks, &c., do not seem to satisfy. This, our new invention, is so simple that it hardly needs explanation. A belt of this kind can be taken apart in a short time, and shortened or lengthened at pleasure.

In answer to questions, Mr. Schieren said that the link belts do better for slow than for high speeds; but are well adapted wherever belts are run half-crossed, or what is termed quarter turn, when it is difficult to make flat belts lie perfectly even on the pulleys. These link belts, however, cover the entire face of the pulley. Mr. Schieren also stated that the linked belts could be made thoroughly waterproof.

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* By CHAS. A. SCHIEREN. From a paper read before the "Technischen Verein" of New York.

changed to suit the ideas of others without interfering with the construction or principles of the machine.

THE NEW ELEMENTS.

THE following remarks by Mr. A. E. Tutton, extracted from a paper in *Nature*, may be of interest in connection with the announcement of the discovery of so many new elements :—

It is now nearly twelve months since the chemical world was agitated by the memorable departure made by Mr. Crookes, in his address to the Chemical Section of the British Association, in attempting to translate into language thoughts which had been irresistibly forced home to the minds of many men of science as to the insufficiency of the theories of our modern chemical philosophy to account for the presence in our midst of those objects of ever-increasing interest, the chemical elements.

Contemporaneously with the work which has been carried on by these and other experimenters, Drs. Krüss and Nilson, who have at their disposal tolerably large quantities of Scandinavian minerals containing rare earths, have been engaged upon work of a similar nature, and have lately published in the *Berichte* of the German Chemical Society results of the highest interest, not only confirming the conclusions above referred to, but announcing that, "in place of the rare metals erbium, holmium, thulium, didymium, and samarium, we must now accept the existence of more than twenty elements."

Considering the interest which Mr. Crookes's addresses have called forth, and the important bearing of this contemporaneous work upon a subject of such paramount importance to the first principles of chemistry, it may be of advantage to give a short description of the experiments which have led to results of such magnitude.

The minerals examined were specimens of thorite from Brevig and Arendal, in the province of Christiansand, of wöhlerite from Brevig, cerite from Bastnäs, fergusonite from Arendal and Ytterby, and of euxenite from Hitterö and Arendal. The nitrates of the earths contained in these minerals gave very beautiful absorption-spectra, and a precise measurement of the positions of the lines and bands in these spectra resulted in the surprising observation that in certain minerals only a particular few of the absorption-bands of the nitrates of some of the rare earths were visible; thus, only one line out of all the lines considered to belong to the nitrate of holmium, the metal which Soret called X, was visible in any intensity in the spectrum of the nitrates from thorite of Brevig; moreover, this particular line is but insignificant, among many much more intense, in the usual spectrum of the nitrate of holmium. The more intense lines were either not at all or only faintly visible in the spectrum of thorite of Brevig; hence it is concluded that Soret's X must consist of at least two ingredients, of which one is found free in thorite of Brevig, and gives this one line of wave-length 428·7.

In these observations a single 60° prism of dispersion $A - H_2 = 4^\circ 18'$ was preferred, inasmuch as weak lines or bands cannot be distinctly seen with more dispersion, and the position of maximum darkness becomes more difficult to fix; the spectroscope was fitted with the most refined micrometer arrangement for the accurate determination of the wave-lengths, so that the whole of the work may be checked by future observers.

Ten years ago the erbium earths were considered as the oxide of a single element; but we now know that they consist of the oxides of scandium, ytterbium, thulium, erbium, terbium, holmium, and yttrium. Out of the rich data furnished by the present observations the observers believe they can prove that all those erbium earths whose nitrates give absorption-spectra are not oxides of simple bodies, but mixtures of the oxides of various new elements. Yttrium, as before mentioned, has already been shown by Mr. Crookes to consist of five constituents, and it will be interesting to see what light the workers in Stockholm have thrown upon the nature of some of the remainder.

M. Lecoq de Boisbaudran showed that by fractionation of Soret's X two new substances were arrived at, which he named holmium and dysprosium; but these are now shown to be themselves compound, for one part of dysprosium is not present in thorite of Brevig or cerite of Bastnäs, although present in the mixture called X; in fact, de Boisbaudran's dysprosium lines Dyα, Dyβ, and Dyδ are found to belong to three different elements; and the other constituent, the holmium of de Boisbaudran, is probably made up of no less than four distinct components.

We are now accustomed to distinguish as erbium that body whose nitrate solution exhibits, in addition to a large number of lines in the violet and ultra-violet, two principal lines of wave-lengths 523·1 and 654·7 respectively, of which the former *is the most intense.* But in euxenite of Hittero *much greater difference is shown*, one being extremely strong, while the other is barely visible; therefore here again the observers consider themselves in face of at least two elements, Erα and Erβ, one giving 523·1 and the other 654·7. Moreover, they have succeeded in separating the two almost completely by a method of fractionation similar to that employed by Mr. Crookes.

Cleve, in 1879, gave the name of thulium to the metal whose oxide formed the strongest base present in the mixture of erbium earths; and its salts, according to Thalèn, exhibit two absorption-bands, 684·0 and 465·0, of which the former is the most intense. Again, the variations are found to be too great for the supposition of a single earth to be tenable, one line being entirely absent in fergusonite and thorite of Arendal, while the other is strong; hence thulium must also consist of two ingredients, Tmα and Tmβ.

The observations with regard to didymium are all the more interesting as entirely confirming Mr. Crookes's statements, and Drs. Krüss and Nilson even go further in proving either that our interpretations of the indications of spectrum analysis are grossly wrong, or that didymium is composed of not less than nine distinct elements. Dr. Auer von Welsbach's symbols for praseodymium and neodymium, the two constituents of didymium which he actually separated, are discarded, and the same nomenclature adopted as in the case of holmium.

The name samarium was given by M. de Boisbaudran to an element identical with Marignac's Yβ, an ingredient of the old didymium. The nitrate of this metal gives seven absorption-bands according to Thalèn; but it is surprising that in thorite and euxenite of Arendal the line 416·7 is tolerably strong, and even very strong, without another samarium line to be seen in the spectrum; the conclusion is inevitable that there must be in this substance a constituent whose nitrate gives the line 416·7, and to this the name Smα is given, all other samarium lines being provisionally supposed to belong to Smβ.

The main result of this splendid work, therefore, appears to be that, instead of holmium, erbium, thulium, didymium, and samarium, we must, if we follow Krüss and Nilson, recognise the existence of at least twenty-two new elements, the fate of some of which may be, in the near future, to be subjected to still further subdivision. If we add to these the results previously obtained by Mr. Crookes with respect to yttrium, the astounding revelation is presented to us that, instead of six, we find ourselves in face of twenty-seven, or a clear gain of at least twenty-one new elements.

But now comes the vital question—Are these really new elements, or are they only different molecular aggregations of the atoms of a few, as suggested by Mr. Crookes? It certainly seems very remarkable that so large a number of elements should be crowded together about the central series of the periodic system, and we appear to have a repetition of the same phenomenon, in a much intensified degree, as obtains in the cases of nickel and cobalt, rhodium, ruthenium, and palladium, and of iridium, osmium, and platinum. It may, however, be interesting in this connection to remember that this precise state of things was predicted by Mendelejeff himself (*Ann. Chem. Pharm.* Suppl. 8, p. 158), and in no way militates against the new element theory. Krüss and Nilson, rather than be obliged to have recourse to the introduction of new or auxiliary theories of spectrum analysis, prefer to rest upon the simpler and apparently more straightforward assumption that these substances, whose nitrate spectra show such marked differences, are indeed *bonâ fide* new elements. The accuracy of this view will doubtless be strongly contested; but in any case the result appears likely to be equally striking; for, if future work shows its want of accordance with facts, then an entirely new field of research has been opened, and the generally accepted ideas of the structure of matter must of necessity undergo a complete metamorphosis.

THE SCIENCE OF THE TEA-KETTLE.*

THE boiling of water, although a very common and familiar occurrence, is of much interest from a scientific point of view. In a metallic tea-kettle the operation cannot well be observed; but if we substitute a beaker or flask of thin glass, such as is used by chemists, we can study the process of ebullition very closely.

When the water is first heated nothing occurs; but as its temperature rises minute bubbles are given off, accompanied by a simmering noise. These bubbles are not steam, but air which has been dissolved by the water. All ordinary water contains more or less of this dissolved air, which escapes when the temperature is raised. By removing the atmospheric pressure with an air-pump, the air will escape at ordinary temperatures; and, on the other hand, by increasing the pressure, it may be made to dissolve a greater amount, as in the case of ordinary soda-water, which is nothing but water charged with carbonic-acid gas under a high pressure. The familiar "singing" of the tea-kettle is due to this escape of air from the heated water.

If we continue to heat the water, no change will be noticed till it reaches 212° F., when bubbles of steam will begin to form at the bottom of the vessel. At first these will be condensed as they rise into the cooler water above, but in a short time will pass entirely through it, and escape from the surface. In this change of water into steam there has been no change of composition; steam as well as water is made up of hydrogen and oxygen gasses. It is a purely *physical* difference; the molecules, or particles, of the water being driven apart by the repulsive force of heat to form steam, like the sudden scattering of a swarm of bees.

Under the usual pressure of the atmosphere water is changed into steam at the temperature given above; but if we reduce this pressure, either artificially or by ascending a mountain, the boiling-point becomes lower. It will fall approximately 1·7° for every 900ft. that we rise trom the sea-level, corresponding to a fall of one inch of the barometer, or a reduction of a half-pound of pressure to the square inch. Housekeepers say that when the water in the tea-kettle boils away rapidly, it is a sign of rain, and it is true that, under the low atmospheric pressure which usually precedes a storm, the water would boil at a somewhat lower temperature; but it is doubtful if the difference would be very perceptible. Under an increased pressure, on the contrary, water may be heated far above 212° without boiling. In a boiler in which there is a steam pressure of 105lb. the temperature of the boiling water is 339·4°.

If the water contains subtances in solution, the boiling-point is raised; if saturated with common salt, for instance, the temperature of the boiling liquid is 228°. If pure water is placed in a smooth glass vessel chemically clean, it can be heated to 223° before ebullition commences; and M. Deluc found that when previously freed from the dissolved air and heated in a glass flask with a long neck, its temperature could be raised to 234°, when it would boil with almost explosive violence. There is no danger in this occurring under ordinary conditions, as the rough surfaces of the kitchen utensils would always cause the water in them to boil at the standard temperature.

When water once begins to boil it is impossible to raise its temperature any higher; all excess of heat is absorbed by the escaping steam as so-called latent heat, and is given out again when it condenses.

We often speak of *seeing* the steam escaping from the spout of the kettle, but this in incorrect; steam is an invisible vapour, and we can no more see it than we can air. What we do see are the minute drops of water into which the steam condenses on coming into the cool air. If we boil water in a glass flask we shall notice that nothing can be seen in the interior; and, by observing the steam escaping from a kettle we shall notice that there is quite a distance between the end of the spout and the point where the cloud becomes visible. This cloud of steam is of exactly the same nature as the clouds which float in the sky, and are formed by the condensation in the cool upper regions of the steam or aqueous vapour present in the air.

The power of dissolving substances which water possesses is greatly increased by heating to the boiling point; for this reason hot water is used in making tea or coffee, to extract the stimulating and flavouring substances from the leaf or berry, and in soup-making, where a large proportion of the nutritive elements of the meat enter into solution. In boiling vegetables the hot water with which they are permeated so acts upon their hard and tough constituents as to render them soft and easy of indigestion.

The "fur," or stony substance which is often deposited on the interior of the kettle, is usually carbonate of lime. This substance is somewhat soluble in water containing carbonic acid gas, but insoluble in pure water: so, when the water is heated, the carbonic acid gas is driven off, and the lime salt precipitated. Nearly all "hard" waters contain lime, and the only way to prevent the deposit is to use rain-water for filling the tea-kettle.

TECHNICAL EXCELLENCE IN PHOTOGRAPHY.*

THERE has been a sort of fashion amongst some writers on photography to speak in a slighting, indeed almost contemptuous, manner of what is called technical excellence. It has been sometimes assumed that obtaining excellence in what they refer to as the mere mechanical details

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* From the *Popular Science News*.

* From the *Photographic News*.

SCIENTIFIC NEWS.

THE death is announced of another of the old railway pioneers in the person of Mr. William Barker Buddicom, who was born at Liverpool in 1816. He was apprenticed at an early age to Mather, Dixon, and Co., of Liverpool. In 1836, at the age of 20, he was appointed resident engineer on the Manchester and Liverpool Railway, and during the time he was so employed carried out many important works. In 1838 he was appointed engineer on the joint Glasgow, Greenock, and Paisley Railway, where he remained till 1840, when he was made locomotive superintendent of the Grand Junction Railway. In 1841 he was called to France by Mr. Joseph Locke to erect works near Rouen for the purpose of constructing the rolling stock for the Paris and Rouen Railway, and he held the contract for working that railway till 1860. He was connected with Messrs. Brassey and others in making the celebrated Bellegarde tunnel on the Lyons and Geneva line, and also in constructing and working the temporary Mont Cenis Mountain Railway on Fell's system, the Southern railways, and Maremma Railways of Italy. In 1847 the dignity of Chevalier of the Legion of Honour was conferred upon him by Louis Philippe for distinguished services rendered by him to mechanical industry in France. In 1864 he retired from the practice of his profession.

The death is also announced of Mr. William Hall, a well-known builder of the famous Aberdeen clippers in the days before steam had assumed the lead. Mr. Hall had reached the ripe age of eighty-one years.

Dr. Charles Rau, curator of the Archæological Department of the National Museum, Washington, is also dead. His papers in the reports of the Smithsonian Institution will be remembered.

The following is the programme of the Manchester meeting of the British Association:—Wednesday, Aug. 31, President's Address, in the Free Trade Hall, at 8 p.m. Thursday, Sept. 1, Sectional Meetings, 11 a.m. to 3 p.m.; conversazione at the Royal Jubilee Exhibition, by invitation of the Executive Committee of the Exhibition, 7.30 to 11 p.m. Friday, Sept. 2, Sectional Meetings, 11 a.m. to 3 p.m.; lecture by Prof. H. B. Dixon, F.R.S., on "The Rate of Explosion in Gases," in the Free Trade Hall, at 8.30 p.m. Saturday, Sept. 3, Sectional Meetings, 11 a.m. to 1 p.m.; excursions; lecture to working men by Prof. George Forbes, F.R.S., on "Electric Lighting," in the Free Trade Hall, at 8 p.m. Monday, Sept. 5, Sectional Meetings, 11 a.m. to 3 p.m.; lecture by Colonel Sir Francis de Winton, K.C.M.G., R.A., on "Explorations in Central Africa," in the Free Trade Hall, at 8.30 p.m. Tuesday, Sept. 6, Sectional Meetings, 11 a.m. to 3. p.m.; conversazione at the Town Hall, by invitation of the Mayor of Manchester. Wednesday, Sept. 7, General Meeting in the Chemistry Lecture Theatre of Owen's College, at 2.30 p.m. Thursday, Sept. 8, excursions. More than a thousand members of the Association have expressed their intention of being present, and many names have already been received of ladies and gentlemen who will be associates or new members.

The accounts of the Inventions Exhibition have been published at last, and from them we learn that the receipts were £214,403, among which the following were the principal items:—Admissions, £149,825; royalties from the refreshment contctors and others, £18,627; publications, £9,580; realisation of buildings and plant (Colonial and Indian Exhibition, 1886), £16,325; surplus fund from the Health Exhibition of 1884, £15,716. On the other side the following are the the most interesting items of expenditure:—Buildings, £30,778; rent, £4,126, including £3,000 to the Royal Albert Hall Corporation; working of electric exhibits and electric lighting, £37,521; garden illuminations, £9,213; lighting the water gardens and illuminated fountains, £3,107; motive power for the machinery exhibits, £14,848; salaries of the officials, £6,219; wages of the servants £18,845; publications, £10,829; advertisements, £14,970; reception and delivery of exhibits, £5,230; medals and diplomas, £3,078; music, £17,039, including £10,192 for the military *bands*, and £6,113 for the Strauss orchestra; and £229 compensation for damage and personal injuries to visitors and others.

The exhibition of £52 10s. a year, tenable for three years, given by the Worshipful Company of Clothworkers for the encouragement of the study of physical science, open to the competition of persons who intend to commence residence as non-collegiate students at Cambridge, or as unattached students of the University of Oxford, has been awarded to W. French, of Chesterton, near Cambridge.

Several accounts of the recent balloon ascent in France have appeared in the daily papers, but until a report duly certified has been made and verified by some scientific body, it will be as well to take them with the usual caution. One paper says the aëronauts ascended to a height of 70,000 mètres! The sea-serpent and the big gooseberry are rather too stale in these latter days, so the latest excitement is an attempt to cross the Atlantic in a balloon.

On a par with other statements recently made in Paris is that of M. Pierre Delcourt that most of the butter sold in Paris is largely composed of fatty river scum which has been collected at the mouths of the great drains that bring the sewage of the city down to the Seine. M. Delcourt deliberately states that there are speculative and energetic persons who follow the butter-tasters on their rounds in the central market, and carefully collect the butter which has been tasted after it has left the mouths of the officials. This refuse is sold to the perambulating or stationary fried-potato vendors, to the *al fresco* makers of pancakes and fritters, to the simmerers of fried fish, and to poor people who look for cheapness and quantity before high prices and rare quality. He also points out that everything used in Paris as food is boldly and unblushingly adulterated. Bread has been made with old worm-eaten sea biscuits and damaged flour, and it has in this way caused an epidemic of typhoid fever more than once. Green haricots, looking in the market quite plump and fresh, have been made out of old vegetables, which have been steeped in water, caused to swell, and then coloured by chemical means. New green peas have been manufactured out of old grey ones coloured with verdigris. Wine is made chemically, the necessity of infusing the essence of grapes into it being absolutely ignored, and the very corks which are put into the bottles of popular vintages, both real and sham, have been picked up out of the river.

M. Alphonse de Candolle holds that he has established as certain, by his researches into the heredity of the colour of the eyes, the facts that women have a lrrger proportion of brown eyes than men; that where both parents have eyes of the same colour the chances are eighty-eight to twelve that the children who arrive at the age of ten years (when the colours of the eyes are fixed) wiill have eyes of the same colour; and that where the parents have eyes of different colours the chances are fifty-five to forty-five in favour of brown as against blue or grey for the children. In a paper in the *Revue d'Anthropologie* he pursues the inquiry into the relation of the brown and blonde types to health, and claims as highly probable a superiority for the brown type. He suggests more exact observation in order to obtain evidence for or against this view, that furnished by Dr. Baxter's great collection of statistics of the recruits in the American War of Secession being favourable to it.

For the examination for the L.L.A. diploma at St. Andrews, 597 ladies entered this year, as compared with 391 in 1886. Eighty-three having passed in the full number of subjects required for the diploma, are entitled to receive it. Four new subjects have been added for 1888—viz., æsthetics, the theory and history of fine art, the theory and history of music, and geography; and candidates have now a choice of 29 different subjects.

The necessity for breathing fresh air is recognised as a fact known to the human race from the earliest times; but it has always been much of a puzzle why cats, birds, and other animals invariably bury their respiratory machinery in fur or feathers when they go to sleep. Dr. Richardson, in making some experiments on the respiration of animals, has found that in currents of pure oxygen different animals are affected in diverse manners. Some, such as the cat, dog, guinea-pig, and pigeon were excited and rendered feverish by it; others (rabbit and frog) showed no such effect; in no instance was narcotism produced so long as oxygen was freshly supplied in steady current. In some later experiments, however, in order to economise the oxygen, the gas after passing through the chambers in which the animals were placed, was collected, purified from products of respiration, and then supplied to the animals again. Entirely different results were now obtained: the frogs remained still unaffected, but the warm-blooded animals all became drowsy. With time the sleep became deeper, the breathing slower, and during the third passage of the oxygen through the chambers the pigeons ceased to breathe. On removing the animals from the chamber the pigeon was found to be dead, the cat kept for a few minutes longer and then died, the dog and rabbit recovered. The explanation of the discordance in the results of the earlier experimenters follows from these results, the depressant and narcotic action having been observed in those cases where the conditions of experiment led to the reinhalation of the oxygen. The cause of the phenomenon, however, is by no means clear. The oxygen did not seem to have suffered any other change in property: it still supported combustion and the respiration of cold-blooded animals; and when subjected to a brush discharge from a metallic point connected with the positive conductor of a frictional electrical machine, it lost its narcotising power and resumed its character of an excitant on warm-blooded animals. The subject is worth a good deal of further investigation.

M. Davanne, the French chemist, has offered a prize of a thousand francs for a photographic plate giving the advantages of both gelatine and collodion. The main conditions are great simplicity in the operations, combined with the greatest sensibility. The processes sent in competition should be fully described to M. Davanne, French Photographic Society, 20, Rue Louis le Grand, Paris. Negatives and prints should accompany the descriptions, and the last day for receiving them is December 31, 1888.

By warrant under the Queen's sign manual letters patent under the Great Seal of the United Kingdom have been issued granting a supplemental charter to the Institution of Civil Engineers, extending the power to acquire and hold lands from £1,000—as in the original charter of 1828—to £8,000 annual value.

Several of the French railway companies and other public bodies have resolved on having their printing done on green instead of white paper. The reason for the alteration is that they believe the combination of white paper with black characters endangers the eyesight of their workpeople. Black on green has always been recognised as a good combination, and many railway tickets are so printed.

Applications to share in the Government grant of £4,000 for the promotion of scientific research must be sent in to the Secretaries of the Royal Society, Burlington House, before Sept. 30. They must be written on printed forms, and be duly labelled "Government Grant."

The Capricious Candle.—Put a lighted candle behind a bottle, pickle jar, or any other object having a polished surface, then station yourself at about 12in. from the object, so that it hides the flame of the candle from you, and blow with your breath. The candle will be very easily extinguished, in consequence of the currents of air that you have created around the object meeting near the flame. With a board or a sheet of cardboard of the width of the bottle, extinction would be impossible. This experiment has a counterpart that has been communicated to us by M. Harmand, of Paris. Take two bottles, instead of one, and place them alongside of each other, so as to leave a space of ½in. between them. Place the candle opposite this space, and, preserving the same distance as before between your mouth and the candle, blow strongly against the flame. Not only will the latter not be extinguished, but it will incline slightly toward you, as if through the effect of suction. This phenomenon, which is analogous to the preceding, is due to the fact that as a portion of the air cannot pass between the bottles, it flows around their exterior and returns to the operator.—*Le Chercheur.*

can reasonably expect a larger instrument to do more in planetary detail or in dividing close double stars, except where too faint for a 12in. aperture. It is very seldom that any aperture above 5in. will give such pretty results as a 5in., for larger instruments do not exhibit discs except when power is increased to such an extent as to render the fluctuations of the atmosphere unpleasantly visible.

Edwin Holmes.

AMATEUR METAL FOUNDING.

[27735.]—LET me say to our founding amateurs that the boxes may be of any shape, very often square, and can be made of wood, firmly nailed at the corners, a small strip of wood ½in. square nailed inside to keep sand from falling out, and no backs are needed, and no hole is needed in joints of flasks for "gate," as you can put a hole through the sand in top flask down to bottom one for gate; you can work away any length of time without either brickdust, charcoal, or plumbago, and if your castings are to be polished, they will be very much cleaner. Plumbago is used to give a fine skin for castings that are not to be polished, and it is very dear; blacking is much cheaper. Perhaps you ask me what you are to separate your boxes with. A little sifted sea-sand, dry; and if you can get it from fresh water, so much the better. This is the best sand you can make core of, with a little gum, flour, or peameal added.

I shall be glad to give any information on any of the various branches of moulding to any of "ours" if they just say what they want.

Cast Iron.

EXERCISES IN PRACTICAL ASTRONOMY FOR BEGINNERS.—VI.

(*Concluded from page* 558.)

[27736.]—ERROR OF SETTING OF DECLINATION AXIS WITH REFERENCE TO POLAR AXIS.

Due to the two axes not being at right angles to each other.

To determine the error.

(1) By means of the Spirit level.

[FORM EQUATORIAL 5.]

Apply the level to the Declination axis, telescope East, and level the axis.

Note the reading of the hour circle (d_e).

Move the telescope to the other side of the Polar axis and again level, note the reading, and subtract 12 hours (d_w). (Add 24 to d_w if the vernier passes Zero in moving the telescope from one position to the other, and correct both readings for Collimation error, if any.)

Then half the difference of the two readings, $\frac{1}{2}(d_w - d_e) \div$ the tangent of the latitude of the place = the error expressed in time.

If $\pm$ the angle between telescope end of declination and polar axis is $\frac{\text{obtuse.}}{\text{acute.}}$

Find the value of $\frac{1}{2}(d_w - d_e)$.

Divide this by tan. latitude of place, giving the error in time, telescope East.

Multiply by 15 to express this in arc (y).

Equatorial 6.

FOR ERROR IN SETTING OF DECLINATION AXIS.

By Star.

.... 188 .

Name of Star.

h. m. s.

Declination.

h. m. s.

Hour circle reading—12 hours. } Telescope W (d_w) =

Ditto. ditto. E (d_e) = ______

$d_w - d_e$ =

h. m. s.

Sid. Time at 2nd observation (t_2) =

Ditto 1st ditto (t_1) = ______

$t_2 - t_1$ =

2| ______

$\frac{(d_w - d_e) - (t_2 - t_1)}{2}$ =

tan. decl. of star =) s. (15 = error in time.

______ { error in arc (y).

Computer.

(2) By observation of a star of high Declination.

[FORM EQUATORIAL 6.]

Observe a star of high Declination, telescope East.

Note the reading of the hour circle (d_e) when the star is in the centre of the field, and also the time by the clock (t_1).

Move the telescope to the other side of the Polar axis, again note the reading, and subtract 12 hours (d_w), and also note the time (t_2). (Add 24 hours to d_w if the vernier passes Zero in moving the telescope from one position to the other, and correct both readings for Collimation error, if any.)

Then half the difference of the two readings, $\frac{1}{2}(d_w - d_e)$ − half the difference of the times, $\frac{1}{2}(t_2 - t_1) \div$ the tangent of the declination star = $\frac{(d_w - d_e) - (t_2 - t_1)}{2 \text{ tan. dec.}}$ = the error expressed in time.

Find the value of $(d_w - d_e)$ and $(t_2 - t_1)$.

Subtract the latter from the former.

Divide the remainder by 2.

Divide the quotient by tan. dec., giving the error in time.

Multiply by 15 to express it in arc (y).

To correct this error if means of adjustment exist, which is not often the case.

(1) With a level.

Apply the error × tan. latitude of place = $\frac{1}{2}(d_w - d_e)$ according to its sign to the reading d_e.

Set the hour circle to the corrected reading and clamp there.

By means of the proper screws at the junction of the two axes bring the Declination axis level.

(2) Fix the telescope steadily in a vertical position against the pier, and by means of the proper screws alter the angles at the junction of the axis in the required direction until the hour circle is rotated through the angle of error × the tangent of the declination pointed to by the telescope = latitude of the place.

6.—*Index Error of Hour Circle.*

Due to the vernier of the circle not pointing to h. m. s. 0 0 0 when the telescope is pointing in plane of meridian.

To determine the error.

(1) By a spirit level.

Place the level on the declination axis and level it.

Then, assuming the errors w and y corrected, the telescope is in the meridian, and the hour circle should read Zero. If not, − the reading is the error (z).

(2) By the known Sidereal Time of the place.

Set the telescope on a star.

Note the hour circle reading, and Sidereal Time.

Then the Sidereal Time − the R.A. of star should = circle reading. If not (Sidereal Time − R.A. of star) − circle reading = the error.

To correct it.

Move the vernier in such a direction as to increase or decrease the circle reading according to the sign of the error.

THE EFFECT AND APPLICATION OF UNCORRECTED ERRORS.

Although great accuracy in fixing the position of an object by means of the Equatorial is seldom required, occasion may arise which renders precision necessary; in such case, especially when there is no means of adjusting for Collimation error (x), and error of Declination axis with reference to Polar axis (y), and where some Index error (v and z) is left outstanding, the effects of these uncorrected errors are required to be known.

1.—*Index Errors* (v) *and* (z).

Their effects are to make the readings of positions too great or too little.

If the errors are $\frac{\text{positive}}{\text{negative}}$ the readings of the circles are too $\frac{\text{low}}{\text{high}}$.

They are applied according to their signs to the readings of the circles, and with contrary signs in setting the circles to find a star.

2.—*Collimation Error* (x).

Its effect (θ_1) varies with the secant of the declination of the star.

If the telescope is pointing South of the Pole, and is East of the pier, and the error is $\frac{\text{positive}}{\text{negative}}$ the hour circle reads too $\frac{\text{low,}}{\text{high,}}$ and the reverse if the telescope is West.

It is applied after being multiplied by the secant of the declination of the star, to the hour circle reading, telescope East, according to its sign.

If the telescope is West, change the sign.

In setting the circle in order to find an object, apply the error with a change of sign.

3.—*Error of Axes* (y).

Its effect (θ_2) varies with the tangent of the declination of the star.

If the telescope is pointing South of the Pole, when East of the pier, and the error is $\frac{\text{positive}}{\text{negative}}$ the hour circle reads too $\frac{\text{low,}}{\text{high,}}$ and the reverse if the telescope is West.

It is applied after being multiplied by the tangent of the declination of the star, to the hour circle reading, telescope East, according to its sign.

If the telescope is West, change the sign.

In setting the circle in order to find an object, apply the error with a change of sign.

4.—*To apply the foregoing Corrections.*

(1) To an observation in declination.

Apply u to the observed declination.

(2) To an observation in R.A.

Multiply x and y respectively by sec. declination and tan. declination of object.

Divide by 15 to bring the products into time (θ_1 θ_2).

Add z, θ_1, θ_2 to the hour circle reading.

Equatorial 7.

FOR FINDING THE R.A. AND DEC. OF AN OBJECT.

(*Application of Uncorrected Errors.*)

.... 188.

Decl. index error (v) = ______ Telescope East.

Hour circle ditto (z) = ______ Star

Collimation error (x) = ______ Decl. circle reading = ° ′ ″

Error of axes (y) = ______ Hour circle reading = h. m. s.

° ′ ″

Decl. circle reading =

v = ______

True decl. (δ) = ______

h. m. s.

Hour circle reading =

z =

$\theta_1 = x \frac{\text{sec. } \delta}{15}$ =

$\theta_2 = y \frac{\text{tan. } \delta}{15}$ = ______

Hour circle reading + z + θ_1 + θ_2 = distance past meridian (D) } =

h. m. s.

Sid. time =

Clock error = ______

True time (T) } =

True R.A. of object (T−D) = ______

Computer.

PROBLEMS IN THE USE OF THE EQUATOREAL.

I.—*To set the Telescope on an Object of known Declination and R.A.*

1. In declination.

Apply the index error (v), with its sign changed, to the declination.

See the vernier to this reading.(a)

2. Right Ascension.

Subtract the given R.A. from the Sidereal time (+ 24 hours if necessary), giving the hour angle from the meridian.

Apply the index error (z), with its sign changed, to hour angle.

II.—*To find the Declination and R.A. of an Object.*

By a single observation and the Sidereal time.

[FORM EQUATORIAL 7.]

Bring the object to the centre of the field.

Note the time by the Sidereal clock.

Read both the circles.

Correct the observed reading of declination for index error, giving the true declination.

Correct the hour circle for the effect of the errors x, y, and z.

Subtract the corrected reading from the time corrected for clock error and rate.

Remainder = R.A. of object.(a)

(a) To be perfectly accurate the correction for refraction should be applied to both circle readings, but in practice this correction may generally be ignored.

Sm.

SPIRITUALISM.

[27737.]—THE very able letter (27689, p. 536) by your correspondent, James V. R. Schwann, on "Spritualism," finishes with the remarkable sentence, "Spiritualism must be investigated by science," &c. Well, I have read Mr. Schwann's letter, but cannot find a trace of "scientific" investigation contained in it. Mr. Schwann merely finds fault with science for not investigating this supersensuous domain, this supersensuous mysticism. But in the name of "common" sense how can any man, scientist or only belonging to the uncritical portion of humanity, investigate something which is "supersensuous," or, in plain English, above and beyond the senses of man? Is it not an axiom that "man cannot transcend himself"? With what, by what means does Mr. Schwann want us to investigate something which is beyond or "supra," outside our senses? I confess my in-fish increased? To my mind it is an open question. The large increase of steam vessels has also been said to account for the destruction; but the sea is large. The contention might have some weight if it referred to rivers or lakes. I do not consider it has any when it refers to the sea. The alleged displacement of the Gulf Stream has also, according to some, had something to do with it. I do not think this need be discussed until the alleged displacement is proved. Climatic influences and cold seasons are also given as clauses; unfortunately, we cannot control these causes, and we may hope from past experience that the bad seasons will not endure for ever. Artificial baits, such as the paste made of earth-nut and sesamum seed, have been accused of destroying large quantities of fish; but the fishermen say they have never seen fish come to the surface dead after eating this bait. The cutting of marine herbs and plants has been also quoted as a cause. I am of opinion that all such cutting should be stringently forbidden; such herbs serve as a shelter and protection for all young fish. It is important to preserve them. Lastly, I would refer to the great increase of fishermen on our coasts, and the consequent increase of the nets in use, both in number and size. This, to my mind, is the cause of the present dearth. In proportion as the number of fishermen has increased, so has the sardine decreased in numbers. Possibly the relative rather than the actual numbers taken have decreased, and there are fewer fish to be divided proportionally amongst a greater number of fishermen. For a war of extermination is carried on against the fish all the way up from Gibraltar to the Straits of Dover. Whole shoals are taken in the nets called after their inventors 'Bellot et Erraud.' In one year alone, on the small portion of coast that lies between Brest and l'Orient, no fewer than 1,000 millions of these fish were captured. In support of these views I may further observe that as relates to the fisheries on the coasts of Spain, where the fish have been much pursued only during the last few years, reliable evidence was produced in the course of my inquiries that already the sardine was becoming scarcer even there. Such, then, are the results of my inquiries, which I now have the honour to lay before you. They are not exhaustive. I have studied rather the technical side of the question. There remain also the economic and industrial questions, into which I have not entered; but these deserve also to be studied, and I would propose that the whole question should be submitted to the Technical Commission on Sea Fisheries for their opinion." **E. G.**

SHOULD WE EAT SALT OR NOT?

[27740.]—MY wife desires to know whether "Vin Bleu," letter 27725, has his vegetables cooked with or without salt? This seems a pertinent question, as his experience is so different from Mungo Park's. This may make all the difference in craving and distaste for salt; perhaps he gets plenty in his food. **E. Holmes.**

[27741.]—A FRIEND who occasionally sends me a number of your valuable paper lately sent me a number containing an article on salt by "Eos." I forwarded it to an authority on such matters, Mrs. Susanna W. Dodds, M.D., Dean of the Hygienic College of St. Louis, Mo., authoress of a book on "Health in the Household, Hygienic Cookery," &c. I inclose her reply to me, and if you see fit to make use of it you are at liberty to do so. The writer has not used salt for over thirty years.

A. S. Macbean.

Lakewood, Ocean County, N.J., U.S.A.

SIR,—I have yours of the 22nd inst. with inclosure on the salt question. If the writers who are so much exercised on this question were really in search of truth I should like to have them answer the following:—

1. Why do not *all* animals hanker after salt?
2. Why is it that *some* animals are easily killed with salt? Birds and chickens for instance?
3. Why do some human beings crave salt, and others detest it?
4. Why is it that this disliking among human beings extends sometimes to whole tribes or peoples?

To say that a certain individual (human or animal) is fond of salt, proves what? We can say the same of whiskey, tobacco, and many poisonous drugs? What does it all prove? Simply that circumstances favoured the forming of these habits.

The first man you meet would tell you that horses, cows, and sheep not only like salt, but that they ought to have it. Now, the present writer happens to know where there are some thousands of as fine looking horses, cattle, and sheep as ever were reared that not only dislike salt, but they positively will not eat it; for the simple reason that they never learned how. If they should be turned out on some of our great western plateaus, where the only drinking water they could get would be alkaline or saline, the case with them might soon be different—no doubt would be.

Yes, we are creatures of habit; and the fact that we like or dislike a thing is no proof whatever as to the quality of the article. You can use the above statements in any way that you like.

SUSANNA W. DODDS, M.D.

2826, Washington-avenue, St. Louis, Mo., U.S.A.

PROPULSION OF VESSELS — PADDLE BOATS.

[27742.]—SINCE I wrote upon this method upon page 560, I have discovered another very serious objection to this arrangement. It is (see page 535) evident that if one of these "metal boards" is to enter the water at, or nearly so, the same time as its companion leaves it, the crank-shaft will be as nearly at the level of the waterline as to necessitate the employment of stuffing-boxes through the vessel's sides. This will also involve a serious loss of speed, because it will be for an exceedingly short portion of the revolution that the "board" will be acting directly in the plane of motion, the remainder of the course being going down and coming up in a sort of slantindicular orbit; finally, I believe that it might attain to ten miles per hour, but would be "nowhere with a feathering-paddle, as used upon our Isle of Man boats. 27713, "Nomoplast," is in error when he asserts that "drawing in the water from forwards into a cylinder will pull the ship forward." If a comparatively small aperture be made in a large hull, the in-rushing water will act in this way by removing the pressure from an area equal to that of the orifice; but this would not be the case when the said water would be flowing through a pipe of limited area into a cylinder which would also be comparatively limited, and in which the said water would have its direction completely reversed at each stroke. This plan is by no means so effective as the original idea of an ordinary lift pump on a large scale, lying alongside of the keel, and the lever handle brought up to the deck. A., Liverpool.

HOT-AIR ENGINES.

[27743.]—I HAVE always found that the hotter the working cylinder is the better result I obtain, and I might mention that in a description of an 8 H.P. hot-air engine, given elsewhere, the fire is shown as under the heaters, then the flue runs round the working cylinders. This engine had two cylinders of 4,000in. capacity each, and the heaters were of the same capacity. I do not think the working cylinder should be so large as the heaters. In the first models I made I used to make the heater four times the capacity of the working cylinder, but since, I have found that if the heater is twice the capacity of the cylinder the engine works with more power and speed.

The following are the dimensions of one I have just made, and have used in driving a sewing machine at a very fair speed: Diam. of displacer, 6in.; stroke, ¾in.; bore of cylinder, 2⅞in.; stroke, 3½in.

"B. R. W." must not place anything in the way of a regerator between the heater and working cylinder, as it cannot be any use there; but might arrange something as a regenerator between the top and bottom of displacer, but be careful and not introduce any waste space. **J. Seal.**

67, Carthew-road, Hammersmith, W.

MORE ABOUT ANTHELMINTICS.

[27744.]—THOUGH the disgusting entozoa of the *Tænia* type are not uncommon in Asia, they are abominably numerous in Africa, and, according to Prof. Pallas, assume epidemic attacks and monstrous proportions in S. Russia. Spencer Cobbold, in his famous book, warns us of liquid sewage as manure to pasture farms, and sounds a note of warning on the probable introduction of new and more formidable species from N. Europe in these times of locomotive invention; for Cobbold has demonstrated that we are indebted to some of our many foreign visitors for the advent of two or three new internal parasites. The permanent invasion of *T. bathryocephalus* (that *boa* of the human inside worms) may be insidiously accomplished by the horde of Muscovites and Poles, its national patrons, during their lengthy visits to any of our large cities, the ova of that monster being exceedingly tenacious of vitality. In the administration of anthelmintics, it is of the first importance to starve the enemy into submission; a powerful dose of castor oil must be given, and fasting insisted upon. The pomegranate root bark having failed with me on first trial, I bethought me of a second one, after abstention from solid food, and succeeded in slaying the slimy foe.

The medical electricians have stated that they can expel *Tænia* by a continuous current passed through the intestines. This was Dr. Golding Bird's formula for chronic constipation and obstructions. One pole is placed on the tongue, the other is attached to a metallic conductor, inserted *in posteriore*, instantly producing peristaltic action, and its natural result. I have employed the same for piles, in addition to the above disorders, resulting in great benefit to the sufferers.

I inclose sundry useful addenda which may be important to some of our readers:—

EFFICACY OF DRIED POMEGRANATE-ROOT FOR THE EXPULSION OF TAPE-WORM.—Professor Colin, of the Val de Grâce, has twice prescribed the dried bark of the pomegranate-root in preference to the fresh bark, for the expulsion of *Tænia*. In each instance Bourgeoise's formula was adopted, viz.:—

R Aquæ, 1½ pint;
Corticis granati radicis, 2oz.

Steep for twelve hours and boil down to a pint; the whole to be administered in three doses at intervals of fifteen minutes. In every case the parasite was entirely expelled in the course of three hours. Its length, in one instance, was 33ft., and its head with the double circle of hooks, supported on a filiform neck 3ft. long, was detached for microscopic inspection. In the other patient the helminth had acquired a development of 45ft., the neck was somewhat thicker, and the four suckers were perfectly distinguishable with the naked eye.

TREATMENT OF TAPEWORM WITH THE OIL OR MALE FERN.—Several communications have appeared lately in your journal in reference to the treatment of tapeworm with oil of male fern. I have had many cases, and always use this remedy; but I cannot quite understand why your correspondents give such large doses. Dr. Atkinson says that he orders one to two drachms, according to the case. I never give more than twenty to thirty *minims* in half an ounce of the mucilage. This is taken at bedtime; and if the worm is not expelled by eight in the morning, I repeat the dose, but this is very seldom required. I have had an instance in the wife of a very wealthy farmer, lately, expelling a worm of, I think, rather extraordinary length. I measured it in the presence of the patient, and it was *nine yards* long.—A. J. H. Banks, M.D.

Dr. Cobbold points out that what is considered the common form of *Tænia*—the *Tænia solium*, the armed or pork tapeworm—is really comparatively rare; and that the common form in this country is the *Tænia medio-canellata*, the unarmed or beef tapeworm. Out of 120 human tapeworms examined by the author, not less than 95 were examples of the *Tænia medio-canellata*, or beef tapeworm.

A homœopathist showed me a *Tænia*, some yards long, expelled by infinitesimal doses of something!

Eos.

TREATMENT OF BURNS.

[27745.]—DOCTORS differ! As long ago as I can remember, "Carron oil" (so named from its origin at the great foundry of that name, where it was in constant use as a soothing application in severe injuries arising from molten iron) still holds its place among North British workmen. My edition of "Beasley's Druggists' Receipt Book" contains the prescription—viz., limewater and linseed oil, equal quantities. I got a large bottle from my chemist, and it was soon distributed to applicants in my village. But in hot climates, or midsummer weather here, I vastly prefer "carbolised oil," for three reasons: Antiseptic, insecticidal, and coagulating of albumen. Here is another chemical compound reported to the *Lancet*:

"CHLORINATED SODA IN BURNS.—In times like these, when we hear of such terrific explosions in coal-mines and of boilers, the following communication, extensively circulated by your influential journal, may be useful for the relief of sufferers from those appalling accidents: It is many years ago since the case occurred which was related to me by Mr. Fincham, of Spring-gardens. He told me that his brother, a manufacturer of chlorinated lime and soda at Manchester, was returning home, and seeing a crowd at a cottage he stopped to inquire. He was informed that a man had been burned by an explosion of fire-damp in a neighbouring coal-mine. He entered the cottage, and there lay the poor fellow, black and scorched from head to foot. Having a sample bottle of chlorinated soda in his gig, he mixed one part of the solution with six parts of water. This lotion he applied to the man's hand. Though speechless, he manifested the relief it afforded him by turning his hand to have it applied to the other side. Seeing this, Mr. Fincham left a large supply of the lotion, with directions to use it in succession over the whole body. The next day he called, and was surprised to find him stripped, and enveloped in a sheet wet with the lotion, and that he was quite free from pain. He recovered perfectly without any other application. Since then the few cases of burns and scalds which have come under my care have been successfully treated with this dilute solution of chlorinated soda. A box of lucifer-matches exploded in a lady's hand. was severely scorched by the lighted ma

REPLIES TO QUERIES.

**⁎* In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[62665.]—**Shutt End Railway.**—The following is a précis of the account of the opening of the Shutt End Railway as given in the *Mechanics' Magazine* from the *Biminghan Gazette:*—The line was opened on June 2, 1829, and its entire length was three miles and an eighth. It commenced at Lord Dudley's colliery, by an inclined plane of 1,000 yards having a gradient of 2·3ft. per chain, and the coal waggons ran down in three and a half minutes, bringing up empties at the same time. From the foot of this incline the road proceeded for 1 mile 7 furlongs at an inclination of 16ft. to the mile, and on this portion the locomotive travelled, delivering the waggons at the top of an incline of 500 yards having a gradient of 2·35ft. in a chain. The waggons were passed down that in a similar manner to that adopted in connection with the first incline, and then they ran along both sides of a basin 750 yards long communicating with the Staffordshire and Worcestershire Canal. On the opening day a train of four carriages, each loaded with three and a half tons of coal, was first passed down the incline, and then the Agenoria was attached to a train of eight carriages carrying 360 passengers, the weight being—Eight carriages, 8 tons 8cwt.; engine, tender, and water, 11 tons; and 360 passengers, estimated at 22 tons 10cwt. This train ran from the foot of the first incline to the top of the other and returned at the rate of 7½ miles an hour, but the full power of the engine was not exerted. Coal waggons were then added to the train, and the number of passengers increased to 920, so that the total weight is given as 131½ tons, with which the engine started and reached the second incline, distant 1 mile 7 furlongs, in 33 minutes. The coal waggons having been sent down, the train returned at the rate of six miles an hour, and then the engine and tender, with twenty persons, had a trial trip of a mile at the rate of eleven miles an hour. It seems that the crowd much impeded the movements of the train, and that in the trip above mentioned, besides the 920 passengers actually carried, there were 300 people who were dragged along. The engine was made under the superintendence of Mr. J. U. Rastrick, of Stourbridge, who bestowed no ordinary pains on it, so as to obviate the noise and smoke found in the original locomotives. The noise occasioned by the escape of the steam from the cylinder was wholly done away with, and the smoke was scarcely more than that from an ordinary chimney. The safety-valve was much improved by a spring, so as to prevent the escape of steam from vibrations of the engine, and another safety-valve was added "entirely inaccessible to the engine-man," thus rendering the engine "infallibly secure from explosion." Another ingenious contrivance was introduced by which the engine oiled its bearings on the carriage at every revolution of the wheels. No details of the "Agenoria" are given; but possibly something more might be found in the files of the *Birmingham Gazette* of 1829.—NUN. DOR.

[62676.]—**Wire Running.**—The following system of wiring practically settles the question of the lamps nearest the dynamo being brightest: *Take one wire as near to the farthest lamp from namo as possible,* and the other take the same way, but bring end back as far as nearest lamp to dynamo. Thus, Fig. 1: Branches can be taken anywhere from the positive, but only from between 2 and 4 from the negative. If E.M.F. be taken between 1 and 2, and then between 3 and 4, it will be found to be exactly the same. This system was first used by Werdermann for his semi-incandescent lamps, but it does equally well for ordinary incandescent lighting. Another way suitable for hotels and large installations is as follows: Take mains large enough to convey current for all installation (if not larger than about 400 lamps), from top to bottom of building (same as Fig. 1), negative main to take in basement on returning, each floor to have a separate circuit, arranged as Fig. 2. These branch mains enter building at best suitable place, are continued round and back to the point of entry, and there joined and soldered and properly insulated. Sub-mains, or single lamps, or groups, are then taken off anywhere, except between 1 and 2, and 3 and 4. A main switch put in between 3 and 4, also a cut-out, keeps circuit under control, and safe and independent. Other switches and fusible plugs and cut-outs may be added according to circumstances.—OLD CHINA.

FIG. 1

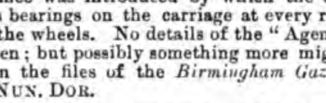
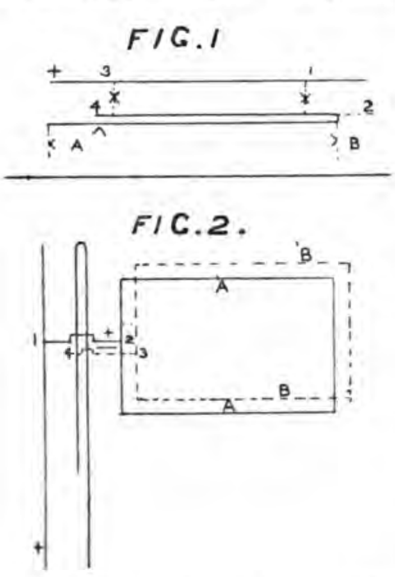


FIG. 2.



[62691.]—**Compass for Navigation (U.Q.)**—I have seen many yacht and ship compasses, but none such as you describe; they were all mounted in gimbals. That is to say, the box containing the card and magnet pivoted in centre is supported at opposite points in two or more rings, the second ring carrying the first on points at right angles to the former suspension. You can buy them at all prices from opticians and shippers.—SM.

[62690.]—**Boracic Acid.**—The following information on this subject may be useful to the querist:—The Vestry of Kensington recently referred to their medical officer of health (Dr. Dudfield) and public analyst (Mr. Cassal, F.I.C.) the question whether the addition of a small quantity of borax, or, more properly, borax with free boracic acid, to milk was injurious to health, and should therefore be treated as an offence against the Food and Drugs Act. The question is an important one, for the more strongly we reprobate adulteration and punish its perpetration, the more necessary it becomes to be sure that the offence has been committed. There is no doubt that the above named preservative is frequently used by farmers in the country and by milk vendors in towns, perhaps sometimes by both. The quantity used is said to be 7gr. per pint for milk and 14gr. for cream. As there is a manifest possibility that it may be used twice over, not to speak of the risk of its being used in excessive quantity through carelessness or ignorance, the reporters are right in assuming that each quart of milk may contain 28gr. of the preservative. This would mean an increase in the ash of 0·16 per cent., and even the half of this would be very perceptible in the analysis, for the ash of genuine milk seldom exceeds 0·7 per cent. It is manifest that this is no fraudulent addition in the common meaning of the term, for it does not add appreciably to the bulk of the milk, and cannot be used, as alum is in flour, to disguise a deficiency in quality. The antiseptic power of boracic acid is well known, and if it were proved to be innocuous its use would be commendable, as tending to prevent the waste of much valuable food material. But, unfortunately, its harmless character is more than doubtful. There is, indeed, but little direct evidence available, but that little is decidedly against the drug. The most important is the memoir of Prof. J. Förster, which has been translated from *Dingler's Pol. Jour.* by Mr. Charles Hancock, of the Kensington Vestry. It appears from this research that even small quantities of boracic acid are capable of exerting a distinctly injurious action on the human organism, hindering the assimilation of albuminoids, even in articles as digestible as eggs and milk. As this memoir by Prof. Förster may not be known to your readers I append it, or rather, the notes upon it in *Dingler's Journal.* "As Prof. J. Förster, in the journal of the proceedings of the German Chemical Society, points out, the applicability of the so-called antiseptic compounds for the preservation of food and drinks does not alone depend upon how far the same may be safely taken into the human body without any clearly noticeable results arising therefrom, such as those caused by doses of medicine; but it also depends upon what effect the use of the above named acid may produce if used as an addition to food and drink, especially if by its use a different operation takes place in the intestines, under the influence of the preserving salts, than would be the case were the ordinary food consumed in an unpreserved state; and should the effect be injurious, then it will become a question as to whether its use should not be restricted. Now, two classes of experiments have been made as to the effect of boracic acid if added in small quantities to daily food—first, on a so-called mixed diet; and secondly, on a diet consisting exclusively of milk and eggs. For three consecutive days nourishm[illegible] was taken in the form of milk, bread, vegetables, &c., which analysis showed to contain the following: 475·7grm. (dry substance), 17·33grm. (nitrogen), 104·4grm. (fat). Again, of the food taken and afterwards evacuated as fæces, as regards dry substance and nitrogen respectively the results were as follows:

	Dry substance. per cent.	Nitrogen. per cent.
Class 1.		
Exp. 1: without bor. acid	12·4	20·0
Exp. 2: with 3grm.	14·8	23·9
Exp. 3: without bor. acid	14·2	22·5
Class 2.		
Exp. 1: with 1·5grm.	6·2	4·2
Exp. 2: without bor. acid	5·2	3·1
Exp. 3: with 0·5grm.	5·8	4·0
Exp. 4: without bor. acid	4·6	3·0

Summing up the result of both classes of experiments, there can be no manner of doubt that the addition of boracic acid as a preservative—even in small doses, such as would not produce general or pharmaco-dynamic effects in the human body—has an influence upon the digestive organs of man. This influence shows itself, too, in this: that it has been proved that the expulsion of fæcal matters, especially of those containing dry substance and nitrogen—even if only by a little—is, at all events, thereby increased. It is worthy of note that the effect of boracic acid can be distinctly recognised in the intestinal discharge, even after the addition of only 0·5grm. in one day; while such discharge takes place in proportion to the quantity of the acid taken into the system, the effect continuing for some time after the acid is no longer added to the food. Further, it is of importance to point out that the influence can not only be noticed in a mixed food diet consisting of animal and vegetable matter, which in itself already contains a great deal of indigestible substances, but even in the consumption of milk and eggs, which, according to the most varied experiments, become digested and absorbed in the intestines, with the exception of a few particles on which the digestive juices have no effect. It may be explained thus: That the introduction of boracic acid into the intestinal canal is followed by an increased secretion of the digestive juices, and consequently the dry substance contained in the fæces becomes increased by reason of the fact that the normal residua of the intestinal juices are more abundantly supplied. On the other hand, it is quite possible that a lesser quantity of component particles of food—especially of nutritive substances, properly speaking—(if containing boracic acid), would be absorbed in the intestines, or even that on their way to the intestinal canal they might become mixed up with a large quantity of solid matters—e.g., thin layers of epidermis from the mucous intestinal membrane, or something of that kind in a normal state; and thus the quantity of fæces would be increased. The first-mentioned effect might be considered a favourable one; but in the latter two cases—i.e., decreased absorption or increased repulsion of cellular matter from the mucous membrane of the digestive canal would without doubt result in effects of an injurious character, effects which, in the case of frequently repeated or continuous use of the drug, would in the course of time be followed by evil consequences. Fæcal matter impregnated with boracic acid seems to differ hardly, or at all, in respect of water, nitrogen, mineral matter, as well as of neutral fats and free fatty acids found in it, from normal fæces—that is to say, when the nutriment taken is the same. On the other hand, the quantity of the substance extracted is decidedly larger (containing as it does nitrogenous elements of decomposition appertaining to the digestive juices and fat acids, obtained by submitting, by means of an acid containing alcohol, to analysis those fæcal matters discharged as the result of a diet of milk to which boracic acid has been added) than the substance extracted from the ordinary milk fæces evacuated under similar conditions. At the same time, in the ordinary milk fæces there is much less nitrogenous matter which is not dissolvable by any known process of analysis than is the cases with the fæces obtained from a diet of milk and eggs to which boracic acid has been added. Consequently, the addition of the acid to food leads on the one hand to an increased secretion of bile; but on the other, what is of infinite importance, to an increased discharge of albuminous matter from the intestinal canal—matter which, for the most part, probably owes its existence in the system to the food consumed. This last-mentioned effect, operating upon the human intestines, must certainly be looked upon as anything but a good one. Accordingly, boracic acid is not suitable as a food preservative to the degree people are inclined to think; but especially careful ought one to be as regards adding it to milk intended for the nourishment of infants."—J. J.

[62694.]—**Distilling Whiskey — Sulphuric Acid.**—Permit me to point out to "The Lydney Dispenser" that although he has occupied more than half a column on p. 566 he has not answered the simple question: What "peculiar organic disease" does sulphuric-acid beer produce? The querist's account it would take 96 hours to distil one ton of oil—eight days. It can be done in 36 hours—this is only three days—thus saving five days' labour and fuel. A few months back I read an account of the Gas Institution at either Glasgow or Edinburgh, and I remember it was asked, at that meeting, could this gas be made from petroleum? I have made gas from it ever since I erected a works. There is no difficulty in the matter, and if you can get the crude petroleum it will be better and cheaper, because, in distilling at the refineries to get it odourless and colourless, there are a quantity of chemicals used, which destroy a portion of the illuminating power, and you will find the commoner the oil the more gas produced. Seeing that ships have been fitted with oil-tanks for importing the crude oil, we may be able to get it sooner and cheaper still. Oil can be bought in Russia at a very low figure (3d. and 4d. per ton at Baku). There is no doubt that petroleum gas will be the future gas for the world. Should you require any further information, I shall be glad to give it as time may permit. I took out a patent for oil-gas apparatus only this year. —F. B. FOWLER, Patentee of Oil-Gas Works, Northallerton, Yorks.

[62872.]—**Oil-Gas.**—I beg to tender my best thanks to "Rosario" for particulars upon this subject, and to correct the impression which seems to have been given that oil-gas is unsuitable for motive power in gas-engines. This I by no means meant to imply; but only that in this respect it does not come out so favourably as for lighting purposes. When working at its maximum power, the Otto gas-engine will develop 1H.P. effective with from 14 to 17¾c.ft. of oil-gas per hour. Assuming the cost of the gas at 8s. per 1,000c.ft., the working cost of gas-engine in respect to gas would be from 1·344d. to 1·714d. per hour; whilst with coal-gas consuming, say, 40c.ft. per H.P. per hour, it would cost 1·200d. I am assuming in both instances the initial cost of gas, and not the selling price. It would, of course, work out more favourably for oil-gas if it can be produced at the low figure of 3s. 6d. per 1,000c.ft., as stated by "Rosario," and, in fact, be then equally as cheap as coal-gas even for motive power purposes; but I do not find the price of paraffin oil noted under £5 9s. per ton, or its yield of gas at more than 21,518c.ft. per ton. This refers to German and Scottish dark, heavy oils of a specific gravity of 0·900, and pale, light oils of a specific gravity from 0·850 to 0·865, yielding respectively 17,931 and 21,518c.ft. of gas per ton. I should be very much obliged if "Rosario" would kindly give me name or mark of the oil, and market for procuring it at £3 per ton, with a yield of 30,000c.ft. of gas. I find that oil-gas apparatus are largely used solely for motive-power purposes, being erected along with the gas-engine and as an adjunct to it, just in the same way as a boiler is an adjunct to a steam-engine. There seem many purposes for which such an apparatus is applicable, and I have lately heard of an oil-gas apparatus having been put up for firing pantile furnaces in the place of the ordinary fuel of coal and wood, and being more economical, and, of course, far more convenient. I should be glad for a list of purposes for which it could be advantageously employed.—MARIENBERG.

[62898.]—**Deafness.**—I think Dr. Cooper has, in some of his lectures at the School of Homœopathy, established in connection with the Great Ormond-street Hospital, drawn attention to the intimate connection during the periods of dental development in children between the ear and the teeth. Just consider what is then going on. The lumps on the neck, earache, condition of ear, of nostril, of nose-bleed all point to *struma*, and, consequently, to those medicines influencing the above symptoms, defective nutrition, development, &c. I commend to your notice any one of the many little books to be had at any homœopathic chemist's shop on the ailments of children. In the mean time, a week's course of each one of the following medicines, i.e., one medicine for each week, may benefit (a dose four times daily)—viz., sulphur, belladonna, calcarea, silica, and mercurius iodatus. Then begin again. Aconite, in my hands, has done much in relieving deafness, especially in children; but it does not influence struma.—THE LYDNEY DISPENSER.

[62900.]—**Blistered Feet.**—Try vaseline. The homœopathic medicines, calcarea, silica, belladonna, ferrum, iodine, &c., may be indicated, especially if other symptoms are present. Of course sea-bathing is desirable.—A. FRY, Lydney.

[62900.]—**Blistered Feet.**—Take a pig's bladder, cut it up in the shape you require for socks, pat it with a damp, warm cloth, to make it pliable; put this on to the feet, wear it two or three days, then change them for others. Let the greasy part come next the flesh. When the blisters are gone, soap the feet and the stockings with yellow soap; this is to prevent them blistering again. Wear Angola *or worsted* stockings; but never before they have *been washed. Wear cork socks.*—J. C.

[62900.]—**Blistered Feet.**—As a pedestrian in the lofty Himalayas, I found well-fitted boots of the best English manufacture, kept supple by neatsfoot oil, a *sine quâ non* in mountaineering. I have put on an apparently good pair of Indian-made boots at dawn, and thrown them away at night. I found goat's fat (a mountain tallow) a good unguent for an incipient blister. Immersion daily in snow-water, morning and evening, prevents blisters if you wear thick woollen home-made stockings. Alum water soon cures a broken blister, and hardens the skin.—EOS.

[62901.]—**Rolled W.I. and Steel Joists.**—The loads given in the iron-merchants' lists of sections are hardly to be taken for long spans, because the deflections caused by these loads are too large to be allowed in practice. The centre load for any section and span may be obtained from the formula $W = 4\frac{A \times S \times D}{L}$ when W is load in tons in centre, A area in square inches of one flange, S stress in tons per square inch, D depth of joists, L length of span, D and L to be measured with the same unit. Knowing the weight in pounds per foot of the section, its area in square inches can be found, also that of the web taking the whole depth of joist as depth of web. Deduct area of web from area of joist; half the remainder will be the area of one flange, to which add one quarter of the area of the web, which will give the working area A. D is to be taken from centre to centre of flanges by deducting the thickness of one flange from the whole depth of the joist. This gives the working depth of the joist. For W.I., S is five tons (per square inch); for mild steel, seven tons (per square inch). The result will be the safe load in centre, taking the area of web into account—very close to the result arrived at by taking the moment of inertia of the section as the basis of the calculation. The deflection for any case is arrived at by the formula $\triangle = \frac{W \times L^3}{2S \times D^2 \times 60}$, the notation remaining as before, except that L is in feet and D is in inches. The 60 is $\frac{1}{60}$in. (to be 100 when W distributed), and is the deflection when W, L, 2S, and D are all reduced to their respective units, 2S being 1 square inch. For floors, the deflection may be at the rate of 1in. in 40ft.; but for the front walls of a building, not more than 1in. in 100ft.—J. S. C.

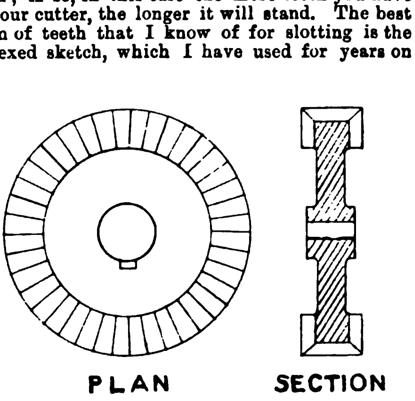
[62902.]—**Test for Platinum.**—German silver is soluble in nitric acid; platinum is not.—W. PERREN MAYCOCK.

[62904.]—**Dry Rot.**—Would not a current of air made to pass underneath floor, or, in other words, proper ventilators, secure what you desire? —A. FRY, Lydney.

[62904.]—**Dry Rot.**—Unfortunately, I have had considerable experience with this destructive element, and I have come to the conclusion that there is no remedy but thorough ventilation. I have tried boiling tar, sulphate of iron, and numerous other chemicals, without success. Given the spores of the plant, and a still, close, damp atmosphere, and it will grow in spite of all the chemicals in the world; but a draught of fresh dry air kills it at once.—FAL.

[62908.]—**Friction of Solids and Fluids.**—An excellent little work that will give you all information is Magnus's "Hydrostatics and Pneumatics": Longmans (see cap. 3, "Fluid pressure on bodies immersed").—W. PERREN MAYCOCK.

[62911.]—**Circular Cutters for Lathes.**—In making circular cutters for lathes, you must first consider what metal you are going to cut, and also the amount of work the cutter is required to do. These slots of yours are, I suppose, cut out of the solid; if so, in this case the more teeth you have in your cutter, the longer it will stand. The best form of teeth that I know of for slotting is the annexed sketch, which I have used for years on brass, cast and wrought iron, and steel, and they have given me the greatest satisfaction. I think if you take a little more trouble in hardening and tempering, you will get better results. Your hardening seems to be correct; but I should recommend you to get a piece of flat iron hot, and lay your hardened cut on the hot iron until it becomes a yellow colour, and then dip again into water, when it will be properly tempered for the work. I shall be pleased to say something more about cutters if required.—R. B. HODGSON, Birmingham.



[62912.]—**Dissolved Bones.**—Having broken the larger over with a sledge-hammer, I put them through an old corn-crusher. Machines are, however, made for this purpose; but they are expensive. Sulphuric acid is the solvent used to convert bones into the manure known as superphosphate of lime. If required for your own consumption, i.e., on your own land, it may be better to apply the bones direct, but in a coarse powder or even in ½in. pieces. Slow solution takes place in the soil. It is also thought that the mouths of the plant-rootlets have a dissolving action. If applied as superphosphate, the rains soon carry it all away; still, as a soluble stimulant during the earlier life of our turnips and mangolds as one of the great aids to stock feeding in Great Britain, superphosphate is invaluable. The dose taken up by plant-life is truly infinitesimal, both of phosphorus and of ammonia, perhaps also of calcium.—THE LYDNEY DISPENSER.

[62919.]—**Lift for Well.**—It would be far better in all respects to use two 4-sheave pulley blocks; the depth being 60ft., you will require 540ft. of rope (say, ½in.). The weight to be raised is 200lb.; a force of about 35lb. will, therefore, be necessary to move the load. Theoretically, the efficiency of the arrangement is as 8 : 1, practically as 6 : 1, on account of the enormous amount of friction in the blocks. If you use 3-sheave blocks you will only want 420ft. of rope; but a force of 50lb. will be necessary.—W. PERREN MAYCOCK.

[62919.]—**Lift for Well.**—An apparatus weighing a very few pounds, a combination of small friction pulleys, the clip or grip of the rope being regulated at will by the descending operator was, within, say, some five years, introduced to the public as an instrument for escape from the upper part of a building on fire. I have, however, heard nothing of it since. Perhaps a search in the Patent Office would assist W. C. Hunt. Before spending time and money just consider the law as to the velocity of falling bodies; for instance, in round numbers 16ft. being passed through during the first second of time, close on 160ft. would be passed through during the third second. Your scheme will land you with a crash in more ways than one. Messrs. Tangye, of Birmingham, make an adaptation of Weston's pulley-blocks, which would suit your purpose for a slow descent.—ARCHIBALD FRY.

[62920.]—**Tomatoes.**—Would S. Bottone kindly say if for recipe No. 1 the tomatoes are first peeled, and how this is done? Then the size of the bottles used, and if on boiling, when the pieces break down to a pulp, the space above the shrunken contents is filled (with pulp from other bottles) before pouring on the oil? In pouring on the oil whilst the bottles and contents are hot, will it remain on the top of the pulp or get mixed with the latter? Of what depth should the layer of oil be, and are there any condiments or spices mixed and boiled up with the tomatoes? The recipe of "Eos" seems also very good; but it is not said if any covering of oil or other material is poured upon the pulp. I have heard of salicylic acid being very good for purposes such as this, first covering the pulp with a disc of linen, and then pouring sufficient of the acid to fully saturate the linen. What is this acid, and is it quite safe to use?—M.

[62924.]—**Steam.**—The last two lines of my reply to this should be: "$p \div 2\frac{1}{2}^{0}$, and if three times $\div 3\frac{1}{2}^{0}$"; not as printed.—T. C., Bristol.

[62924.]—**Steam.**—I am much obliged to "T.C. Bristol," for his information, but I can hardly see through his efficiency. Will he kindly explain his formula: how he gets his 300 + 461 = 761; also, what is the standard of efficiency of heat engines? Second, will not 32° have to be subtracted from the feed temperature—viz., 60° − 32° = 28°?—W. W.

[62929.]—**Galvanometers.**—Your query is vague. What galvanometer do you refer to? Everything depends on the form and purpose of instrument. A telegraph lineman's "detector" is generally wound thus: Quantity, about No. 24 wire, from 0·5w. to 1w. Intensity, about No. 36 wire, from 150w. to 200w.—W. PERREN-MAYCOCK.

[62929.]—**Galvanometers.**—TO MR. BOTTONE. —Much depends on what work is to be done with the galvanometers. If to be used with very large currents with little E.M.F., a single turn of No. 16 would be ample. If for ordinary detector work, with a single cell or two of any of the usual batteries, about 20 turns of No. 30 will give excellent results. But if it is desired to measure or calculate high voltages, it is well to use a much finer wire, say No. 38 or 40.—S. BOTTONE.

[62930.]—**Literature.**—Timbs's "Abbeys, Castles, and Ancient Halls of England and Wales" action of fused KHO on a variety of substances—e.g., phloretin, quercetin, moritannic acid, catechin, scoparin, dragon's blood, gamboge, &c. It was first obtained by Hlasiwetz in 1855 from phloretin; according to Schiff, it is best prepared as follows:—20grms. phloretin and 150c.c. of solution of KHO (s.g. 1·2) are heated in a flask attached to a vertical condenser for three hours. The cool liquid is exactly neutralised with H_2SO_4, a slight excess of sod. carb. is added, and the phloroglucol extracted by an equal volume of ether, repeated four times. On distilling off the ether the phloroglucol remains, and may be purified by dissolving in water, and adding a small quantity of $Pb\,\bar{A}c$, and passing H_2S through the solution. It is then extracted by ether and recrystallised. Hydroxyquinol $C_6,H_4.(HO)_2$ is usually prepared by the action of nascent hydrogen on quinone by treating it with an aqueous solution of SO_2 or HI, or with Sn and HCl. It may be produced from paranitrophenol by Griess's method, and from pariodophenol by fusion with KHO. It may also be produced from phenol thus:—Phenol is converted into diazophenol by passing nitrous vapours into a cooled ethereal solution. This forms needles of diazophenol nitrate, C_6H_4OH,N_2NO_3, which are dissolved in dilute H_2SO_4 (1 : 2), mixed with alcohol, and ether added until solution is rendered turbid. The diazophenol sulphate crystallises out, is dissolved in water, and mixed with about 12 per cent. concentrated H_2SO_4, and heated until it becomes dark red. The hydroquinone is extracted with ether in the usual way.—SM.

[62963.]—**Mensuration of Cones.**—The formula is $0{\cdot}2618\ H\ (D^2+d^2+Dd)$, which, in your case, will be $H = 102$, $D = 163$, $d = 93$. Working it out thus, 0·2618 × 102 × (26,569 + 8,649 + 15159) = 0·2618 × 102 × 50,377 = 1,345,247c.in. You cannot have anything much simpler; but it is easier to remember the contents of a complete cone, which is (area of base) × ⅓ height. You can then calculate the complete cone, and deduct the small cone which is missing.—T. C., Bristol.

[62963.]—**Mensuration of Cones.**—The simplest rule for finding the cubic contents (or volume) of the frustrum of a right cone (which is the figure to which the question refers) is the following:—Square the diameters of the top and bottom, and add these squares to the product of the diameters. Multiply the sum of the three quantities by the perpendicular height and also by the number ·2618. The resulting product will be the cubic contents of the frustum. In the case given by "Nu," the sum to be multiplied is—

$$8{,}649 + 26{,}569 + 15{,}159 = 50{,}377.$$

Hence, the cubic contents in cubic inches equal—

$$50{,}377 \times 102 \times {\cdot}2618 = 1{,}345{,}247{\cdot}257,$$

or very nearly 778·499 cubic feet.—J. R. C., Charing.

[62963.]—**Mensuration of Cones.**—The form of solid body mentioned in this query is properly called a frustum of a cone; the cubic contents can be obtained by decimals by the following rule:—Square the diameters of the ends, add them together with the product of the diameters, multiply the sum by the perpendicular height, and the product by the decimal ·2618. The result is the cubic contents.

EXAMPLE.

Sizes of cone given in query.

$$\left\{\begin{array}{l} \left.\begin{array}{r} 93 \times 93 = 8649 \\ 163 \times 163 = 26569 \end{array}\right\} \text{squares of diameters.} \\ \;\;163 \times 93 = \underline{15159} \text{ product of diameters.} \\ \qquad\qquad 50377 \times 102 = 5138454 \times {\cdot}2618 \\ \qquad\qquad\qquad = 1345247{\cdot}2572\text{.c.in.} \end{array}\right.$$

The above applies only to frustums of round cones, The rule for simple cones, or those terminating in a point being different. I shall be pleased to give "Nu" any further information on this subject.—ENGINEER, St. Mary Church, Torquay.

[62965.]—**Cycle Lamps.**—Perhaps your wick is too small, allowing the jolting to throw too much oil up, thus putting out the flame.—SM.

[62965.]—**Cycle Lamps.**—A solution of camphor in a mixture of equal volumes of colza and paraffin oils gives a very good white light.—PRINCIPIA.

[62965.]—**Cycle Lamps.**—Try a mixture of olive-oil and camphor. It gives a clear bright light, with no smell if properly trimmed. I have travelled many miles after dark, and have never known it to fail.—ALOIN.

[62965.]—**Cycle Lamps.**—I always burn colza and paraffin oils in my tricycle lamps, and never have any trouble. Be careful not to have too much paraffin in; otherwise it may explode and burn up the lamp.—METEOR.

[62966.]—**Dynamo.**—TO MR. BOTTONE.—A two-horse power engine will drive a dynamo capable of lighting twenty 20c.p. lamps with *perfect ease. Hence* you could certainly light forty of your 10c.p. lamps. You would require a laminated ring armature about 6in. diameter and 6in. long, wound with about 8lb. No. 14, in at least 24 sections. The field magnet cores should be about 10in. long and 3in. thick, with good heavy pole pieces and thick heavy yoke. About 50lb. of No. 20 on the fields will give good results as a shunt machine.—S. BOTTONE.

[62967.]—**Thermopile.**—TO MR. BOTTONE.—I am afraid you would want nearly 500 elements to light up four 10c.p. lamps. You can build the pile in rows of 50 instead of 36. As many sets as you wish to couple up in parallel, you will connect together the similar metals, instead of the dissimilar. Let us suppose you have built up a pile of five rows of 50 each row, and that you desire to couple the five rows in parallel (each row, of course, being in series). You will connect all the five tinned-iron terminations together, to form one pole, and all the five zinc-antimony squares together, to form the other. You might get 8 to 10 volts, and 8 or 10 ampères, with 6ft. gas per hour.—S. BOTTONE.

[62968.]—**Bracing Climate.**—I think "Ubique" had better have a town built to order.—WM. JOHN GREY, F.C.S., Newcastle-on-Tyne.

[62968.]—**Bracing Climate.**—Try Sutton, Surrey; chalk soil, good air, good schools.—S. BOTTONE.

[62968.]—**Bracing Climate.**—I should think "Ubique" would find Warwickshire suit him, as it includes the highest table-land in England. The prettiest part is about Coleshill (village, 10 miles east of Birmingham). Rugby lies high, 380ft. above sea-level, and contains several schools. Norwich is also a bracing place; but would be, perhaps, too cold in winter. I know many bracing places; but they are not towns of 10,000 inhabitants.—SM.

[62969.]—**Electrical Pendulum Indicator.**—The ends of each indicator coil are connected to one common return wire; if, then, it should happen that any two leading wires from the terminals touch one another, the current dividing actuates both. Such a fault cannot be ascribed to induction, as induction currents are momentary, and in this case, if any, would be extremely weak.—W. PERREN-MAYCOCK.

[62970.]—**Iron and Steel Test.**—If a drop of diluted nitric acid is dropped on bright steel or cast iron, it will leave a black spot, due to the carbon not being dissolved. Wrought iron will not leave any mark when so treated.—PRINCIPIA.

[62970.]—**Iron and Steel Test.**—Polish a small plate of steel and a similar one of soft iron. Touch each of these with a drop of nitric acid, and you will soon see the distinguishing mark. A tool or any small manufactured article can be similarly treated.—EOS.

[62970.]—**Iron and Steel Test.**—Put a few drops of nitric acid on both iron and steel, and observe the result. The iron hardly undergoes any change, the steel turns *black*, which can be seen when the acid is washed off. The reason is that in both cases the HNO_3 dissolves the iron; but steel being a compound of iron and carbon, when the iron is dissolved the carbon is left behind, and shows as a black stain on the bright steel.—R. A. R. BENNETT.

[62971.]—**Electrical.**—TO "ROSICRUCIAN."—You had better use two wires to make a good job. Get from any electrical firm some of the small double-grooved casing, smallest size, and tar well outside and in; put in wires, also tar them, then fit on cover; and finally well tar again, especially where casing is joined. Use Stockholm in preference to coal-tar. Bury at least 1ft. below the surface.—OLD CHINA.

[62971.]—**Electrical.**—The following is an extract from Dr. Lardner's book on the "Electric Telegraph." The wires of the Magnetic Telegraph Co. are laid and protected in the following manner:—Ten conducting wires are enveloped in a covering of guttapercha so as to be completely separated one from another. Thus prepared, they are deposited in a square creosoted wooden trough measuring 3in. in the side, so that nearly a square inch of its cross section is allowed for each of the wires. This trough is deposited on the bottom of a trench cut 2ft. deep along the side of the common coach road. A galvanised iron lid of about ⅛in. thick is then fastened on by clamps or small tenter-hooks, and the trench filled in.—YOUNG SCIENCE.

[62973.]—**Pit Saw.**—See that one range is not higher than the other, and that there is no more set on one side than the other, and both ranges of teeth have the same points, not one having a pin tooth and the other a square tooth. See that you do not press forward with one hand more than with the other.—J. C.

[62974.]—**Wasp's Nest.**—Wait till the first frost comes, Jenny—no, "J. S."—and then all the wasps will be dead, and the nest deserted.—S. BOTTONE.

[62977.]—**Piano Repetition.**—TO MR. W. H. DAVIES.—A "repetition check action" to a piano is an ideal perfection which has not yet been realised. The best repeater action was the old "jack," in which the hammer was left trembling at the tip of the finger, and ready for work at half, or quarter touch. The very freedom of the hammer proved, however, a great objection, as there was a constant rebound against the vibrating string, which produced a most unpleasant twang. To obviate this, the "grasshopper" or "spring jack" was invented, to allow the hammer to escape more gradually from the string. Since then numerous patents have been taken out for checking and holding the hammer on the principle of the wedge, and some very ingenious methods have been contrived for its automatic release; but an action that will both check and repeat freely has yet to be invented. The problem is purely mechanical, and no doubt there are many of "ours" who could solve it. I hope before long to have time to describe and illustrate this interesting subject; meantime, "J. W." will have to be satisfied with the purity of tone evolved by the check, and I should advise him to give a wide berth to such pieces as "Rosellen's Reverie," unless he is a very accomplished executant.—W. H. DAVIES.

[62978.]—**Winged Ants.**—Figuier says that about the middle of August ants come forth and swarm in the air, where the coupling takes place; after which the males die directly. The females return to the nest, where the workers (neuters) cut off their wings, after which they lose the desire for liberty, and set about laying eggs.—ALOIN.

[62980.]—**Engine Conversion.**—You would, of course, get more power by altering to a condensing engine; but I should not compound under 65lb. to 70lb. Of course, you intend to use present cylinder as l.p. if compounded? If altered to condensing, you might use a centrifugal pump for circulating, as you run at a good speed. If you use a pump, gear it down 2 to 1. Area of condensing surface = say, 60in., and use as thin tubes as possible of brass. Circulating pump, if geared down as above, say, 1in. diam. × 1¼in. stroke, or a little less if desired.—T. C., Bristol.

[62981.]—**Distance of the Sun.**—The formula for finding this is $\frac{R}{\sin.\ P}$ = distance, where R = equatorial semidiameter of earth in miles. P = equatorial horizontal parallax of the sun. Most tables of logarithms give directions to find the sines and tangents of small angles; but here is a method applicable to all tables, and which I have not seen before. If the table gives sines to seconds, take out the sine of the nearest second to the one you want, subtract the logarithm of the tabular number of seconds and add the logarithm of the number of seconds of which you want the sine. Two examples will make this clear. Let us find the sine of P = 8·848″.

Log. sin. 9″	5·63981,74
Log. 9	0·95424,25
	4·68557,49
Log. 8·848	0·94684,51
Log. sin. 8·848″	5·63242,00

If the table only gives sines for each minute, the operation would stand thus:—

Log. sin. 1′	6·46373
Log. 60	1·77815
	4·58558
Log. 8·848	0·94684
Log. sin. 8·848″	5·63242

Let us now find the distance of the sun.

R = 3963·22 log.	3·59805,15
Log. sin. (P 8·848″)	5·63242,00
92,891,400 miles =	7·96563,15

Five decimals are, however, quite sufficient in our present state of knowledge of the solar parallax.—TRIA.

THE seminary for Oriental languages which has been established in connection with the Berlin University will be opened on the 18th of October. The curriculum comprises the Chinese, Japanese, Hindostani, Arabic, Persian, Turkish, and Suaheli languages; and candidates for Foreign Office service, as well as educated persons following other callings, are eligible as students.

THE results of the survey and last census of India are that the area of the Peninsula of Hindostan is 1,382,624 square miles, and the population 253,891,821. Although immense tracts of country are annually cultivated, according to the most recent survey 10,000,000 acres of land, suitable for cultivation, have not as yet been ploughed. At the same time, 120,000,000 of acres are returned as waste lands.

way you can; but if he is worth anything, he will choose his own path.)—CLAIMANT. (They are advertised from time to time; but you can obtain information at the Bank of England.)—HINTON BATEMAN. (See many replies in back volumes, or else state what is the difficulty—that is, put a definite question. We cannot spare time to guess what is the defect; but you would do better to have a return "line" instead of "earth.")—M.M.I.Sc.S. (How many readers are likely to be interested in such a question?)—INCUBUS. (For incubators, please see Nos. 935, 1097, 1009, 1075.)—GWALIA. (Any of our advertisers dealing in photographic materials will supply you with the "tin" plates, and also with directions for using them. 2. If you cannot see back volumes, procure one of the numerous cheap handbooks of the art.)—PHOTO. DARK ROOM. (Several portable tents have been described; but if you want a room on wheels, all you have to do is to construct it of framing and match-boarding, and line it with black paper.)—V. FRIAR, Hull. (Rub beeswax on the wrong side; then put a cloth over the right side and work a warm flat iron about on it until the beeswax is melted and the fibres are coated with it. This method makes cloth proof against anything but very heavy rain, while air can still pass. For many other methods see indices.)—PRINCIPIA. (Stink-closets and fume-chambers have been illustrated many times. You will find something about them in No. 1097, p. 111; but all that is needed is a chamber or cupboard with a chimney leading to the outer air, and a door that fits close enough to prevent the fumes entering the laboratory or room.)—J. J. (It is similar to japanning—a varnish which must be baked on—that is, "stoved," as it is termed. Mander's tar varnish, as it is called, is generally used for black. 2. Solid carbonic acid can be produced only by immense pressure and intense cold. What is it you mean when you ask for the "best" means of producing it? Do you know anyone who uses it? You can have liquid carbonic acid, but solid is a step too far.)—J. C. (Would it not be a gratuitous advertisement? Why not apply to the dealers for a description? If a patent, an agent will supply you with the number.)—C. W. (See indices for many recipes.)—J. F. L. (Several remedies have been suggested; but possibly cement or tar is the best. The silicate paints are excellent, too, both for internal and external use.)—PHOONGYE. (You are mistaken. It was given by a correspondent who has sent more useful information than you can digest in a twelvemonth. Now, send us a better recipe for salad dressing, or something as useful. Is that a joke about "august columns," and will they be September columns next month?)—E. H. HAMMOND. (Messrs. Trübner, Ludgate-hill, will supply it; but we believe you must subscribe for it. They do not sell single copies.)—S. C. S. (Why not look for it? Beeswax will do. The bubbles are made by dissolving shavings of Castile soap in warm water, shaking occasionally. Allow to stand for several hours, and pour off the clear liquid, to which add nearly as much glycerine. 2. Make a Daniell or a Smee cell.)—J. W. G. (Please look up the subject in back volumes, or read "The Gas Engine," by D. Clerk, Longmans.)—A DUTCH SUBSCRIBER. (We do not know. It was stated that they are made in Vienna; but no doubt an advertisement in the Wanted Column would attract the attention of the maker.) EOS. (Not your mistake. The correspondent was referring to a stupid statement which appeared in one of the daily papers about "inverted cones." You used the term "incurved.")—CHESHAM. (A mixture of gas and air is blown into the hollow iron, which in some cases is made to reverse, so that the upper side which gets hot can be used alternately. They are all subjects of patents, and, being useful, are strictly guarded.)—TELEGRAM. (You must really try such an experiment for yourself. Telephone wires are not usually supported by balloons.)—T. J, PIT LADDIE. (We do not remember the book; but if it is in existence no doubt one of the Newcastle booksellers can procure it for you.)—A. M. (Do you mean a metal speculum, or what? Full details about the construction of glass specula in back volumes.)—TINMAN. (Yes, certainly; the canning trade is an extensive business in all three countries. It would, however, be advisable to endeavour to get an engagement before starting.)—LU. (We must refer you to the catalogues of the publishers.)—G. S. S. (Actually there was something about it so recently as p. 492.)—FITTER. (Probably by looking through the "Sale" column you might find such drawings offered. It is not a subject for a query, as you will understand by reading the "Hints" above.)—J. HENRY. (Put in some oil or grease, and try again. 2. No, why should it? Commonly done by the "trick-riders.")—ENGINEMAN. (Most of the questions are from examination papers. As to the condensing water, which is a practical question, calculate from the low-pressure cylinder only.)—T. (Why not wait a week or two—at all events, until it gets into the "Unanswered" list? Meantime, you can experiment.)—ALBUS. (See indices. All such preparations are better left alone.)—A. J. GROSE. (The present volume commenced just twenty-five weeks ago. If you will kindly wait a few weeks longer you will be able to consult the index of the present volume, and will discover the pages on which the articles referred to appeared.)—JAS. TENNET. (No stamps or advt. have reached us, and no remittance accompanies your present letter.)—A VERY ANXIOUS ONE. (Ordinarily speaking, there is no remedy but the knife. Let your friend see Dr. Allinson, 1, Duke-street, Portland-place, W., the medical adviser of the *Weekly Times and Echo*; he has successfully advised in some similar cases, and will not recommend an operation unless it is absolutely necessary.)—F. A. M. (We are obliged by the offer, but we can only insert as ordinary letters.)

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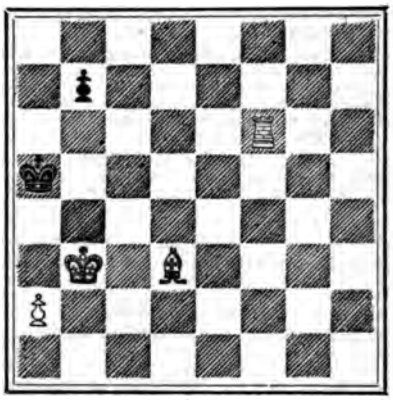

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Photographic Lenses.—Suter's 9 by 7 rapid lens, Suter's 12 by 10 wide angle lens. What offers?—S. E., 74, Tollington-park, London, N.

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Square **Mahogany Camera**, with capital portrait lens, 1 dark slide for 7½in. plates, as new, £4, or good exchange.—FRANCIS, Rochford.

American Orguinette, long roll of music, secular, new, value £3 14s., cash £2 15s., or good exchange.—FRANCIS, Rochford.

Wanted, a gentleman's **Silver Watch**, good timer, in exchange for a very good sewing machine.—W. GOODYEAR, New-road, Spalding.

Will exchange **Musical Box**, six tunes, cost £3 10s., for anything useful. What offers?—W. GOODYEAR, New-road, Spalding.

For sale or exchange, one **Vertical Blowpipe**, 5s. 4d.; one ½H.P. cylinder pattern, 2s. 3d.; one box of drawing instruments, 1s.; exchange electric bells or vacuum tubes.—JOSEPH WRIGHT, 87, Leach-street, Farnworth.

Exchange 11 volumes "**Barnes on New Testament**," quite new, for "Boucher's Pocket Calculator," or good drawing instruments; approval.—MUIR, 11, Queen-street, [illegible] Hartlepool.

Wanted, offers for 25 parts **Quiver**, and 25 parts "Lett's Magazine"; take stocks and dies, or 3d. copy, anything useful (genuine).—W. RAYNER, Marple Station, near Stockport.

Wanted, a **Collection of Stamps**, in an album or loose.—L. W., Alpe-street, Ipswich, Suffolk.

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Scrap Brass wanted, 56lb.; exchange new 2½in. **Electric Bell**, Leclanché cell, push, and 100 yards I.R. covered wire.—36 Holly-street, Dalston, E.

Scrap Brass wanted; exchange for 2lb. 22 G. S. **Wire**, silk-covered, paraffined, and 5lb. 36 H.C. copper wire, green [illegible] covered.—As above.

Model Tin **Railway Churn** suit milkseller's window. Treadle Sewing Machine, requires slight repairs, lot of Conjuring Apparatus. Exchange.—W. BUTTERWORTH, Tutbury, Staff.

Joiner's Cramp, wrought iron, 2in by ⅝in. 4ft. long flat thread screw 1ft. long. What offers?—F. ROBINSON, 65, Fernhead-road, Paddington.

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Wanted, 18-carat gold **Horseshoe Pin**, for **Cuttriss** ELECTRO-MOTOR, drive small lathe, cost £3 15s.—Particulars ARTHUR CAWLEY, Fairfield House, Warrington.

Wanted, **Fret-Cutting Machine**, Improved Lester, or Companion, in exchange for INFLUENCE MACHINE (Parts), ENGLISH MECHANIC, Vol. XLII., and 46 other numbers, "Photographic News" for 1886, and Jan. to July, 1887.—DELL, 38, Goldstone-road, W. Brighton.

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Wanted, **Anvil**, not less than 2cwt., and 2 second-hand Brass Instruments. Exchange.—JOHN FODD, care of J. Olive, Middle Wall, Whitstable.

2½ Iron **Bench Lathe**, good condition, cost 30s. Will exchange for bells battery.—G. T., 71, Seaside-road, Eastbourne.

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"**English Mechanic**," Vols. XLI., XLII., and XLIII., and 40 numbers clean, unbound. What offers?—C. J. R., 83, Euston-street, N.W.

ASTRONOMICAL NOTES FOR SEPTEMBER, 1887.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 59 56·15 A.M.	10 41 16	8 18 48N.	10 41 19·86
6	11 58 18·57 „	10 59 21	6 28 24 „	11 1 2·63
11	11 56 36·07 „	11 17 21	4 35 18 „	11 20 45·39
16	11 54 51·10 „	11 35 19	2 40 11 „	11 40 28·15
21	11 53 5·77 „	11 53 17	0 43 46 „	12 0 10·91
26	11 51 22·20 „	12 11 16	1 13 14S.	12 19 53·67

The method of finding the Sidereal Time at Local Mean Noon at any other station will be found on p. 382 of Vol. XLIV.

Small spots appear at not very frequent intervals on the Sun's disc.

At 9 a.m. on September 23rd the Sun is said technically to "enter Libra," and autumn is supposed to commence. He is, in reality, at this instant some 3½° almost due West of η Virginis. This is the theoretical date of the Equinox; but the nearest actual approach to it in London will not occur until the 25th, when the Sun will be 11h. 59m. above the horizon, and, of course, 12h. 1m. below it. Towards the end of the month the Zodiacal Light may be seen in the East before sunrise.

The Moon

Is Full 47·3 minutes before Noon on the 2nd, and enters her Last Quarter at 3h. 3·2m. p.m. on the 10th. She will be New at 1h. 59·8m. p.m. on the 17th, and enter her First Quarter at 5h. 3·9m. in the early morning of the 24th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	13·3	11 41·7 p.m.
6	18·3	2 32·5 a.m.
11	23·3	6 21·6 „
16	28·3	10 58·6 „
21	3·9	3 36·1 p.m.
26	8·9	8 5·1 „

The Moon is in conjunction with Saturn at 2h a.m. on the 14th; and with Mars at 6 o'clock the same evening; with Venus at 4h. p.m. on the 17th, and with Mercury 6 hours later; and, lastly, with Jupiter at 6h. a.m. on the 20th.

Mercury

Is a Morning Star at the beginning of September, but comes into Superior Conjunction with the Sun at 6h. p.m. on the 10th, after which he, of course, becomes an Evening Star. He is pretty obviously, indifferently situated for the observer during the greater part of the month. Moreover, he is very nearly circular, and his diameter never exceeds 5″.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	10 10·1	13 8·2 N.	11 28·8 a.m.
6	10 47·1	9 38·7 „	11 46·1 „
11	11 22·3	5 47·6 „	0 1·5 p.m.
16	11 55·3	1 50·0 „	0 14·8 „
21	12 26·4	2 4·5 S.	0 26·2 „
26	12 56·1	5 50·1 „	0 36·2 „

A study of the above ephemeris will show that Mercury starts from a point to the East and just to the North of Regulus, and after traversing the rest of Leo, terminates his path this month in Virgo, where he will be found, on the 30th, rather less than 2° North of Spica in that constellation.

Venus

Is an Evening Star at the beginning of the month. She comes into inferior conjunction *with the Sun at 1 p.m. on the* 21st, after which she will be a Morning Star. Very poorly placed indeed for detection with the naked eye, she is now a telescopic object of the highest interest, and, at and about the time of her inferior conjunction, the student should lose no opportunity of observing her most exquisite hair-like crescent, like a thread of burnished silver. Particular attention should be paid to the visibility, or otherwise, of the dark body of the planet at this time. Her diameter will then be 59″ exactly.

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
2	χ Aquarii	5½	†11 7 p.m.	N.N.W.	203	190				
24	29 Sagittarii	6	10 43 „	Dark	146	180	‡11 24 p.m.	Bright	226	264
25	*f* Sagittarii	5	11 27 „	Dark	91	125	‡12 30 „	Bright	292	330
26	B.A.C. 7053	5½	5 35 „	Dark	96	73	6 55 „	Bright	281	270
26	ο Capricorni	5½	5 36 „	Dark	96	73	6 55 „	Bright	280	269
26	υ Capricorni	5½	12 1 „	Dark	61	93	‡12 48 „	Bright	331	7
28	42 Aquarii	6	10 14 „	Dark	59	65	11 1 „	Bright	348	1

† A near approach. ‡ Moon has set. A description of the construction and use of this table, illustrated by a diagram, will be found on p. 383 of Vol. XLIV.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	12 11·8	8 48·1	1 30·2 p.m.
6	12 8·0	9 14·8	1 6·8 „
11	12 0·9	9 8·6	0 40·0 „
16	11 51·3	8 27·7	0 10·8 „
21	11 40·5	7 15·4	11 40·4 a.m.
26	11 30·2	5 41·4	11 10·5 „

So that Venus travels backwards through a very blank part of Virgo.

The night sky is now a perfect blank, Mars, Jupiter, Saturn, Uranus, and Neptune being one and all invisible for the purposes of the observer. In the absence of anything more interesting, the student may probably care to examine the minor planet,

Pallas,

which came into opposition to the Sun on August 30th, and may now be seen as a yellowish 7th magnitude star during the major part of the amateur's working night. Our ephemeris is given for intervals of ten days.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	22 6·2	5 6·5	11 23·0 p.m.
11	21 59·1	3 1·9	10 36·6 „
21	21 53·0	0 54·5	9 51·4 „

So, at the beginning of the month, Pallas will be a very little to the South-East of θ Pegasi, and will travel backwards down into Aquarius.

Shooting Stars

May be watched for on the 1st—2nd, 6th—7th, and again on the 10th.

Greenwich Mean Time of Southing of Eleven of the Principal Fixed Stars on the Night of September 1st, 1887.

Star.	Souths.
	h. m. s.
Vega	7 50 31·35 p.m.
δ Aquilæ	8 37 5·40 „
Altair	9 2 29·59 „
$α^2$ Capricorni	9 28 56·23 „
α Cygni	9 54 39·93 „
α Cephei	10 32 52·85 „
α Aquarii	11 16 50·31 „
ζ Pegasi	11 52 35·29 „
Fomalhaut	12 8 7·51 „
Markab...	12 15 48·91 „
ι Piscium	12 50 44·47 „

The Method of ascertaining the Greenwich Mean Time of Southing of either of the Stars in the above List on any other night in September, as also that of determining the Local instant of its Transit at any other Station, will be found on p. 384 of Vol. XLIV.

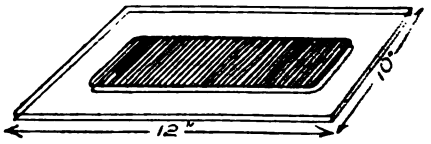
ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS.—XVI.*

By S. R. Bottone.

§ 58. FULMINATING PANES, or Franklin's plates as they are also called, are easily made by coating both sides of a sheet of glass with tinfoil, to the extent of half of the entire surface, leaving the margins all round clear glass. The glass should be chosen with the same precautions as to insulating power as in the case of Leyden jars (§ 57), and the corners of the tinfoil should be *rounded*, as rounded ones dissipate electricity less than pointed ones. Good paste or glue (thin) will do very well to stick the foil down to the glass. When *quite* dry, any superfluous glue or paste may be removed from the edges of the foil and glass by means of a slightly damped rag. The tinfoil should be lightly burnished with a bone or ivory knife-handle. As a futher protection against sparking over, it is well to varnish round the edges of the tinfoil with a coating of good shellac varnish. In charging this condenser, it must be borne in mind that one surface must be connected to earth or other large conductor while the other is receiving the charge; otherwise its capacity is very limited. A very convenient size and form of the Franklin plate is shown at Fig. A.

§ 59. Owing to the facility with which these glass plates are broken, they are not much used at present as condensers. Other insulators, having at once the advantages of being lighter, less fragile, more flexible, and of higher specific inductive capacity than glass, are now used in all instruments intended for practical work. Of these, good paper, free from holes, soaked in melted paraffin, stands, if not alone as the first, in the very first rank. Next comes paper soaked in good shellac varnish; then thin sheet ebonite, which can be bent by heat to any shape; and, lastly, good indiarubber cloth. The mode of making a condenser, with either of these insulators, will be the same in each case, so the student will do well to try his hand at a Fizeau's condenser, as being at once the most useful and least expensive.

A



§ 60. *Fizeau's Condensers.*—These are employed for two purposes: (*a*) to increase the efficiency of induction coils, by taking up the "extra" current induced in the primary; (*b*) to measure electrostatic capacity. Condensers for coils may be of any dimensions between 9in. by 7in. and 2in. by 4in., according to the that is, for the finer kinds of diatoms; still, for the coarser kinds, say four out of five species at the very least, Canada balsam, taken all round, still remains as good as any other medium yet brought forward. Although balsam is comparatively colourless in its natural state, it gets to be a very deep yellow when hardened by means of heat; this colour is, however, scarcely noticeable when in in a very thin layer under a covering-glass. If over-hardened, balsam becomes brittle, and the cover is easily detached by a blow or rough usage; on the other hand, if under-hardened, not only will the slide be too tender to handle, but the refractive index will be considerably lower than should be the case.

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Styrax.—This is a medium about which a deal of misconception exists. As a matter of fact, no styrax, so far as I am aware, has yet been used as a mounting medium for diatoms or anything else; but I must explain. The true styrax is a product of *Styrax officinale*, belonging to the order *Styraceæ*. It is a native of Greece, the Levant, and Asia Minor, and was the source of the original and classical storax. It has, however, now wholly disappeared from commerce, and I much doubt if it be obtainable in this country, its place, so far as our British pharmacopœia is concerned, being now supplied by the product of *Liquidamber orientale*, belonging to a totally different order—viz., the Altingiaceæ. This substitute can be purchased at any chemist's. When getting it, "strained styrax" or "styrax colat" must be asked for. It has a strong resemblance to very thick treacle, is full of fine dirt, and, I think I may add, of moisture also. There is yet another false styrax, sometimes called "American styrax," which is the product of "*Liquidamber styraciflua*," or "sweet gum," a tree found in the Southern States of America, mostly, I believe, in damp situations. This latter medium is not, however, obtainable in England, and it is only comparatively recently that I have been able to ascertain where it could be obtained in the States, as even in its native country it is difficult to get hold of. I shall be happy to give the address to anyone desiring the same. Like the other false styrax, this American styrax is also supplied in a rather dirty state. As the true styrax has no existence so far as we are concerned, I shall now speak of the other two media simply as "styrax" and "American styrax." Both the styraces, which were first introduced by Dr. H. van Heurck, of Antwerp, can be dissolved in either benzole or chloroform, and afterwards filtered. They are apt to deposit a fine sediment in the bottle some considerable time after filtration, which I consider to be due to the presence of moisture contracted during the process of obtaining these resins, the prepared media being what I believe is called in the varnish trade "chilled." If only in small quantity the heat applied during the process of mounting will drive it off again; but it is better either to pour off the upper clear portion into another bottle, or to use a "capped balsam bottle" with a suspended glass rod for mounting, and which is never allowed to touch the bottom and stir up the sediment. Whilst on the subject of this sediment I may here state that I once had a small quantity of the ordinary styrax in a pot, which I placed in a cool oven and left there for some considerable time until it became perfectly hard. I then dissolved it with difficulty in alcohol, filtered it, evaporated nearly the whole of the alcohol off again, and thinned it down to a proper consistency with chloroform. Although very dark this styrax is as clear now as it was when first prepared, now over two years ago. The ordinary styrax is somewhat difficult to harden. The best way of doing so is by a long continued heat, a considerable amount of which it will bear; but usually this styrax is not finished off hard, but merely tough, and I therefore always strengthen my mounts by the addition of a ring of cement to the covers. If the styrax be overheated it becomes charred, and small specks of carbon can be seen disseminated through it when viewed under the microscope. Styrax is a very useful medium for the finer kinds of diatoms, which it shows up much clearer and brighter than balsam. Some forms, almost invisible in balsam, are shown up with great distinctness in styrax. For the coarser kinds of diatoms this medium is not really needed. American styrax, unlike the other, hardens just like balsam, but when heated it becomes extremely fluid. Having a high refractive index it is particularly useful for the finer diatoms. On account of its fluidity when heated I should be inclined to confine the use of this medium to the smaller diatoms, lest the cover should, during the process of mounting, sink down on the larger forms and crush them.

Balsam of Tolu.—I have never had anything to do with this medium. I did once think of taking it in hand, but before doing so I referred to Watt's "Dictionary of Chemistry" (belonging to a friend of mine), and as something was mentioned about *crystallisation* I decided to leave it alone. Since *then there have been complaints* made about this *objectionable property*. On the other hand some microscopists continue to use it, and seem satisfied with it.

Gum Dammar has also been used as a mounting medium; it requires dissolving in some solvent, such as benzole; its advantages are that it is colourless and dries quickly; its disadvantage is that when quite hard it is about as friable as chalk. I consider its proper place is in the preparation of "ringing" cements, to which it gives a nice gloss. A number of other resins have also been tried; but I don't know that any of them have shown any advantages over Canada balsam or styrax, and I am unable to report upon any of them. Although slides of diatoms mounted in any of the resins will stand fair treatment, they will not bear any amount of rough handling. It must not be forgotten that diatom valves are composed of silex, a brittle substance; if, therefore, the balsam, styrax, or other medium be tough, and the cover glass be rubbed or wiped somewhat roughly, the medium will yield to a slight extent; but not so the diatom valves, which consequently will get cracked, though the fragments will continue to be held in position by the medium in which they are mounted. Balsam slides may be perfectly hard at the edges of the covering-glass, but only tough in the centre part; if such slides be left to themselves for a few days in a cool place, the density of the balsam will become a little more homogeneous in consequence of the diffusion of the residual solvent in the centre part throughout the mass, though the outer portion will always remain a little harder than in the centre, as the solvent gets dried up almost as soon as it reaches the circumference.

Chemicals.—The sole object of using chemicals as mounting media, is to obtain a higher refractive index than is afforded by the resins; unless such refractive index can be obtained they have no *raison d'être*. So far as my experience of them goes, they are either difficult to manipulate or they cannot be relied upon for permanency, with, perhaps, the single exception of monobromide of naphthaline, which, however, I do not consider to be any advance upon styrax, as diatoms mounted in this medium do not exhibit anything like the brilliancy given them by stryax. I should be disposed to give the palm to phosphorus it having an extremely high refractive index. I have never worked at it myself, but from all accounts it is very difficult of manipulation; it requires being dissolved in bisulphide of carbon, but no more of this must be used than absolutely necessary, as otherwise the high refractive index is considerably reduced. Complaints have been made about phosphorus slides not being permanent, but, on the other hand, I believe that Mr. Stephenson, who first made use of this medium, has perfect phosphorus slides in his possession which have been mounted for some years past. Prof. H. L. Smith's and Dr. S. Meate's media are both of the same class, having the elements of sulphur, arsenic, and bromine in each; slides newly-mounted in these media are superb, but from what I have heard, and from my own experience of Dr. Meate's compound, I should say that neither of them is to be relied upon; sooner or later a granulation sets in, and it is only a question of how long it will be before the whole of the mount is thus disfigured. I believe that some microscopists may be found who may be disposed to think that some slides mounted in Dr. Meate's medium may prove permanent, to which I answer that the large number of failures is more than a sufficient reply; a medium is not to be depended upon unless you can rely upon having a larger proportion of permanent slides than, say, one out of a dozen mounts. It has struck me that possibly the non-permanency of these two media is due to the evaporation of the bromine, and that if a proper cement were found for confining the same, they could then be used with every confidence in their efficiency. Prof. H. L. Smith has also introduced two other chemical media with high refractive indices, but lower than those just referred to. Of one, called "Stannous Chloride Medium," I know little or nothing, and am unable to say whether it has proved permanent or not; the other medium, a preparation of antimony bromide and boroglyceride, is in my hands, as well as in those of a correspondent of mine in America, a distinct failure; at first, all was superb, but after a short time crystals began to make their appearance and gradually spread all over the mount, completely spoiling it. I have seen an account of another chemical medium, viz., sulphur in aniline, and thought I would try my hand on same, but, to my astonishment, on trying to dissolve the sulphur in the aniline I found it to be insoluble, though a friend of mine, a chemist, tells me that sulphur dissolves freely in aniline. Under these circumstances I am unable to give any opinion on this medium, further than that if the solution can be prepared and permanently sealed on a slide it ought to be satisfactory so far as regards the refractive index, but has the objection of being a fluid. A medium of high refractive index is certainly a desideratum, but it must be permanent, and if one could be discovered which could be prepared and manipulated by any microscopist not having special knowledge of chemistry, why so much the better. On the other hand, it is a comfort to the ordinary run of diatomists to know that there are really only few diatoms that absolutely require such high refractive media.

BELT HOLES AND BELTING.*

I STEPPED into a mill the other day where several articles were in process of manufacture. In one corner of the building a little wood-working concern was located. In another part a textile concern used part of the space, and also used power from the one engine in the basement of the building. In one of the departments I was much disgusted at the engineering methods used in cutting belt holes. Some of them looked as if a foundry weight used for breaking old iron had fallen through the floor. Still other holes looked as if a hole had been cut at random, then the belt put through the floor and the cutting continued until the belt ran free. One or two places were seen where a patch 3ft. by 4ft. had been nailed on the floor to cover the assorted cuts and gashes in the floor which were made when getting the belt holes in the right position. One belt which ran down through the floor at an angle of 45° had holes (it was a 4in. belt) 5in. wide and 17in. long. The man who "set up" the machine had "guessed" where the belt would come, and he had proved himself anything but a Yankee. One more belt I will tell about. It was a "quarter twist," and the two belt holes seemed to have been cut exactly opposite where they belonged, and the cutting had been continued in two circular quadrants, until the belt was got free from touching the floor. The holes looked much like the mortises in the cam which closes the split nut on a thread-cutting iron lathe.

Such barbarous work is only worthy of being done by a "wood-butcher," or by a pickaxe carpenter," of whom we often have all too many fooling around machinery and passing for "good millwrights. A "quarter-twist" belt hole is just as easy to lay out as is a hole for a crossed belt, yet the work made in trying is simply awful. The best method (to my knowledge) of cutting quarter-twist belt holes is as follows: Draw two lines on a bit of board or a piece of paper. Let these lines represent the two shafts, and the distance between them must be laid off to scale. If there is plenty of room, the lines may be laid off at full distance on the floor of the shop. Next locate the floor, and draw a line representing its top. Draw two lines a few feet apart, and let these lines be perpendicular to or square with the shaft lines. Draw an end view of top pulley on top shaft line, just touching perpendicular line. Draw side view of lower pulley or lower shaft line, making middle of pulley at intersection of shaft and perpendicular lines. Next connect the other side of top pulley with this intersecting point, by a line which will represent one line of the belt, and also show the place where it strikes the floor. Now draw end view of lower pulley on lower shaft just touching the other perpendicular line, precisely as upper end view of pulley touched first perpendicular line. Draw side view of upper pulley on its shaft line, and connect as before, only running belt line to opposite side of lower pulley. The floor line can now be marked as before, and next comes the marking off holes in plan on the floor.

There must be a hole through the floor for the purpose of dropping a plumb line, and this line will touch the centre of both pulley faces, but this line will not represent the track of any belt. However, with this line as a starting point, lay off the distances found on the floor line in the drawings just made. Use a little judgment, and you will put the first distance lengthwise with the lower shaft, and the second distanee parallel with the upper shaft. If any doubt exists in the mind as to why this was done, draw a side view on the floor of both pulleys, the centre of their faces both touching the plumb line, then upon tracing the course of the belt you will find it to run exactly in the centre of each pulley, and to pass right through your distance marks on the floor.

Next bore two holes through the floor, inclining the bit to correspond with the two connecting belt lines, made in the first and second drawings. After these holes are bored draw a tape line through them and around both pulleys, just as the belt is to run. From the tape line you can lay off the angles the belt holes will make. You can also allow for the slack in one side of the belt, which will surely be there when the work is being done. This latter method is a kind of rule of thumb proceeding, but it can be called the graphic method, and thus disguised will perhaps suit some people better. The only thing, or the principal thing, to bear in mind when putting up quarter-turn belts is this: A belt must have the side of one pulley directly in line

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* By J. F HOBART, in the *Manufacturers' Gazette*.

In making further experiment with varying strength of current, it was found that when too strong a current was employed a brown colour only was produced.

To render "metallo-chromy" practically applicable to nickel-plated articles of ornament, there are several points that must not be neglected. The coating of nickel must be something more than a mere film, otherwise a voltaic couple will be set up between the nickel and the underlying metal when immersed in the acetate of lead solution, and the nickel will strip or peel off; a fair coating of nickel is absolutely necessary. The metal of which the article is made (say brass, for example) should be free from small cavities or hollows, otherwise these imperfections will mar the beauty of the coloured film. In the early experiments of Nobili, Becquerel, Gassiot, and others, various methods were adopted to give form or design to the metallo-chromes, but probably a few other suggestions may not be unacceptable. In producing the colorations upon nickel-plated surfaces, the author adopted the following method:—Thin copper wire was worked up into patterns of various design, as a cross, star, anchor, &c., and in the centre of each pattern a vertical wire about 6in. long was attached by means of silver solder and the blowpipe: thus, to form a cross, for example, two short pieces of thin copper wire were taken, one piece being about ¾in. long, and the other ½in.; these being arranged crosswise were soldered together. To the centre of this a vertical wire was attached in the same way, to serve as the conducting wire for connection with the battery. To produce the coloured film in this design, the conducting wire of the cross was first connected to the negative pole of the battery; a nickel-plated plate was then immersed in the acetate bath and put in contact with the positive pole as before; the wire cross was then steadily lowered into the bath and allowed to nearly touch the plate, when the coloured design at once began to form. To hold the pattern exactly in its right position—that is, horizontally—was at first somewhat difficult, but a little practice soon overcame the difficulty; if not held in such a position that all parts of the cross would be at an equal distance from the plate, the coloured impression would be wider in some parts than others, and thus spoil the effect. To overcome this it was found necessary, when immersing the wire pattern, to let it touch the anode for an instant, and then withdraw it to about 1/32nd of an inch from the plate, when the coloured film immediately commenced.

Colouring or Staining Brass.—In finishing ornamental brass work, different processes are adopted to produce varied effects of colour; thus "dipping acids," variously composed, are used to produce certain shades of yellow, from pale lemon to a rich orange, while other substances are employed to impart a more or less black stain upon certain classes of brass work for optical instruments and other purposes. To produce a black stain upon brass, a solution of chloride of platinum is generally employed, but since this is an expensive salt, its employment is necessarily limited in its application. To obtain a black colour which would be applicable to large pieces of brasswork, and at the same time less costly than the platinum salt, the author made a series of experiments. Well knowing that brass was far more difficult to "stain" than copper, the following method was adopted, which not only produced an intense black stain, but also varying shades of brown, from chocolate colour to a deep sepia tint. After trying many different substances, in solutions of varying degrees of concentration, the process given below was finally hit upon, and the results obtained were in the highest degree satisfactory, both from an artistic and economical point of view. Bearing in mind that the black deposit—improperly called a "stain"—produced upon brass by means of chloride of platinum is very easily rubbed off, the author resolved if possible to obtain a firm, adherent film which would resist ordinary rough usage. Since these results could not be obtained upon brass, it was determined to give this alloy a slight coating of copper in a sulphate of copper bath in the first instance. The brass article, after being dipped in a mixture composed of nitric and sulphuric acids and water (ordinary dipping acid), was well rinsed, and then immersed in a sulphate of copper bath composed of 1lb. of sulphate of copper, 1lb. of sulphuric acid, and one gallon of water. In from five to ten minutes, with the current from a single Daniell cell, the deposit of copper was sufficiently thick for the purpose intended, when the article was removed from the bath and well rinsed in hot water. A solution of sulphide of barium (about 5 grains to an ounce of water) was then poured into a vessel and the coppered article, being held by its suspended wire, at once immersed. On coming in contact with the sulphide a light brown tone was immediately produced, which gradually deepened until, after a few moments' immersion, the surface assumed an intense but brilliant black. On removing the article at this stage it was first plunged into hot water, then into boiling water, and afterwards set aside until dry, which occupied but a few moments. The black film thus obtained was very firmly adherent, and when rubbed with a chamois leather it soon acquired a brilliant polish. Other articles of various forms were subsequently treated in the same way, and when it was desired to obtain a chocolate brown colour the piece was only allowed to remain in the sulphide solution about half a minute, or even less, when a most pleasing brown tone was obtained, possessing quite a metallic lustre. Sulphides of ammonium or potassium may also be used, if desired. It now became evident that very varied effects could be produced in this way; for example, parts of an ornamental specimen of brass-work could be stained brown, other surfaces black, portions could be left in the natural colour of the brass, and other surfaces could exhibit the rich pink-red hue of electrolytic copper. The idea was soon carried into effect in the following way:—The surfaces which were to remain yellow (whether matted or burnished) were coated with a film of paraffin, applied by gentle heat, the piece of work was then placed in the copper bath and moderately coated with copper, after which it was well rinsed, finally in lukewarm water; it was then wiped dry with a piece of clean soft diaper. To produce the brown and black colorations upon various parts of the work, two pastes were made with jewellers' rouge and water, to which was added more or less sulphide of barium, according to the tone of colour required; these pastes were laid on the parts to be coloured with a brush, the operation being done as quickly as possible, so as to obtain uniform results. When all these surfaces had been treated in this way, the article was held under a tap, the water turned on, and a soft, long-haired brush freely used to remove all traces of the rouge mixture. The object in using a stream of water for this purpose was to prevent the sulphide of the rouge paste from staining the copper surfaces, which were to be retained in their natural colour. It was found, however, that a slight discoloration appeared on portions of the copper surfaces, arising from the cause referred to, but these were afterwards removed, as also traces of oxidation, by dipping the article for a moment in a moderately strong solution of cyanide of potassium, and then rinsing it thoroughly in boiling water, which also had the effect of removing the paraffin from the brass surfaces. The piece of work was then again rinsed in boiling water, and lightly brushed to remove further traces of paraffin; after this it was wiped dry; the brass surfaces to be left bright were then burnished, the black or bronze-coloured parts were polished with a chamois leather where necessary, and the article finally coated with a thin film of colourless varnish.

COMPARATIVE VALUE OF STEAM AND HOT WATER FOR TRANSMITTING HEAT AND POWER.*

If steam and hot water 400° temperature be respectively used for some heating purpose, such as cooking, requiring nearly that temperature, the steam will give up its latent heat and be converted into a small quantity of water at the final temperature, while hot water can only give up its sensible heat represented practically by the difference between its original and final temperature. If the fall of temperature be from 400 to 399°, the water would impart substantially one thermal unit for each pound of water circulated over the surface, while the steam would impart over 800 thermal units for each pound of water condensed. If a difference of 2° were allowed, the water would impart substantially two thermal units for each pound of water circulated, whereas the heat supplied by the condensation of one pound of steam with same limits of temperature would be but slightly reduced, though the relative quantity of water required to be circulated to equal the results obtained with one pound of steam would be reduced one-half. By allowing a still greater reduction of temperature the water would appear at less disadvantage. For instance, with a difference of temperature of about 11·15° the water would impart 11½ thermal units for each pound of water circulated and the steam 842 thermal units for each pound condensed. [Temperature due to 235lb. gauge or 200lb. absolute pressure, 400·89; temperature due to 205lb. gauge or 220lb. absolute, 389·74°—difference 11·15°. Total heat above 32° in the two cases respectively, 373·75 and 362·17—difference 11·5 thermal or heat units. Total heat steam of 235lb. gauge pressure, 1204·21 heat units. Subtract 362·17 heat units due to final temperature, gives 842·04 heat units, available from condensation of steam between limits of temperature stated.] This is doubtless a greater reduction of temperature than could be allowed for cooking, and yet it would require (842·04 ÷ 11·52 =) 72·71 times as much water circulated to do the same work as would be required if steam were used. In this case, then, 72·71 pounds of water would necessarily be heated at the station, pumped to the point where the heat was required and then be forced back again to the station at a lower pressure and pumped into the boiler to be reheated, for each pound of water evaporated if steam were used as the medium of transmission. The steam would be transmitted by causing a slight difference of pressure from the heating station to the point where it was used, and its surplus pressure would return the water of condensation back to the station, where one pound would require to be pumped in the boiler for each 72·71lb. by the water system.

As the temperature at which the heat is to be applied is reduced, the preponderance against the water system somewhat diminishes. For instance, if steam at 70lb. pressure be required to operate engines, it may be obtained by directly expanding down the steam of 235lb. pressure, which would result in a beneficial superheating of 25·87 thermal units per pound of steam thus expanded. If, however, the steam were supplied from hot water at 400·89° temperature, corresponding to the pressure of 235lb., only 10·2 parts in 100 would, on reducing the pressure to 70lb., flash into steam at that pressure, so in that case 10·2lb. of water would necessarily be heated at the central station, transmitted to the point where steam is required, and if high-pressure engines were used, 9·1lb. would necessarily be transmitted back again, and finally 10·1lb. pumped in the boiler for each pound weight of steam used, instead of the one pound which would be required to be evaporated at the central station in the case of the steam plant. [Total heat steam of 70lb. gauge or 85 absolute pressure, 1178·34 heat units, which, subtracted from 1204·21 heat units due to 235lb., shows 25·87 heat units for superheating. Temperature due to 70lb. gauge 316·08 corresponding to 286·26 heat units above 32°, which, subtracted from 373·75 heat units due to 235lb., leaves 87·49 heat units available for making steam with water, and subtracting same from 1178·34 heat units, total heat due to 70lb. gives 892·08 heat units required for steam of 70lb. Hence, there will be required 892·08 ÷ 87·49 = 10·2lb. of water circulated per pound of water evaporated into steem of 70lb. pressure.]

For heating purposes the temperature could under favourable circumstances, be reduced to 227° in the coils, corresponding to a pressure of 5lb., in which case, without repeating the operations above described, there would require to be circulated from the heating station to the point of supply and back to such station, 5·69lb. of water for each pound of steam utilised at the point of supply, or for the heat which would be imparted at the temperature corresponding to such pressure, for each pound of steam, which in a steam system would be evaporated and sent direct from the station. [Temperature due to 5lb., 227·96°, equivalent to 196·66 heat units above 32, which latter, subtracted from 373·75 heat units in water due to 235lb. pressure, gives 177·09 heat units per pound of water, and subtracted from 1204·21, total heat due to 235lb. pressure, gives 1007·55 heat units available from steam between same limits, so that there will be required (1204·21 ÷ 177·09 =) 5·694 times as much water circulated as steam.]

The above statments may be easily verified from the figures given in the bracketed passages, and the great resistances found in pumping water through pipes at high velocities being known, there would seem to be no reason why anyone should think of using water rather than steam for the purposes above referred to. The subject has, however, been agitated for a number of years. Little plants, to show what could be done with water heated to a high temperature have been built from time to time, but apparently did not command the capital necessary to start the business on a large scale. Another revival has recently been attempted, however, based chiefly on the favourable report of an unusually well-informed engineer of experience and acknowledged ability, to whom, it is a pleasure to say, the writer is personally indebted for many valuable suggestions as to proper courses of study at an earlier period of life. Mr. Isherwood, in forming his opinions, has evidently, however, failed to consider some of the most important elements of the problem, and occasion is thereby made for an abstract discussion on the merits of steam and hot water so far as possible, without reference to the merits of a particular system and the details of the same.

It has been stated in the public press, quoting from the report, that a cubic foot of water at 400° temperature contains 34⅔ times as much heat as is contained in a cubic foot of steam at the same temperature, and it is therefore concluded that "the areas of the pipes will be in this proportion, making their diameters in the proportion of 1 for the water and ($\sqrt{34⅔}$ =) 5·89 for the steam." Also that "the thickness of the material of the pipes for equal strength would have to be about six times greater for the larger steam pipe than for the

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* By Chas. E. Emery, extracted from a paper presented at the Washington Meeting of the Mechanical Engineers.

Wickson had prepared, showing both transverse and longitudinal sections of the compressed and uncompressed woods side by side. In the transverse sections the distortion was most apparent, the large, open cells of the parenchyma being squeezed out of all resemblance to their former appearance, while the effects of the steam and infiltration of hot, ore-bearing waters were seen in a complete change in the colour of the wood. In the longitudinal sections it was an interesting fact that the glandular dots characteristic of coniferous wood, which were finely shown in the uncompressed section, were completely obliterated in the other. Mr. Hanks stated that he had repeatedly made assays of such timbers, and had clearly shown the presence of both gold and silver, thus apparently showing that the deposition of these metals was a process still going on. At the meeting held on July 27 several exhibits were made of bacilli which are believed to occasion disease in man and animals.

Whitworth Scholarships.—The following is the list of candidates successful in the competition for the Whitworth Scholarships, 1887:—James Whitaker, 21, engineer student, Burnley, £200; John Calder, 20, mechanical engineer, Glasgow, £150; John Smith, 22, carpenter, Belfast, £150; Nicholas K. Turnbull, 21, mechanical engineer, Glasgow, £150; James C. Talbot, 23, engineer, Southampton, £150; Arthur F. Horne, 25, mechanical engineer, Moreton-in-Marsh (formerly of Glasgow), £150; Edward J. Duff, 23, engineer, Glasgow, £150; Robert N. Blackburn, 20, engineer apprentice, Liverpool, £150; William Thomson, 20, engineer apprentice, Glasgow, £150; William W. F. Pullen, 20, engineer apprentice, Cardiff, £100; Edwin Griffith, 20, engineer apprentice, Glasgow, £100; Frederick C. Tipler, 23, assistant chemist, Crewe, £100; Thomas H. M. Bonell, 24, analytical chemist, Swindon, £100; Richard J. Redding, 22, metallurgist, Plumstead (Woolwich), £100; Arthur W. Sisson, 25, mechanical draughtsman, Lincoln, £100; Arthur H. Abbott, 22, engineer, Great Yarmouth, £100; George Hough, 23, engineer, Wolverton, £100; Harry G. Christ, 19, engineer apprentice, London, £100; Harry D. Griffiths, 21, engineer apprentice, Cardiff, £100; Denholm Young, 24, engineer apprentice, Edinburgh, £100; Benjamin G. Oxford, 20, engineer apprentice, Liverpool, £100; Bernard H. Crookes, 21, engineer student, Liverpool, £100; George J. Wells, 23, engineer, London, £100; John Eustice, 23, engine fitter, Camborne, £100; Augustus H. H. Bratt, 24, engineer, Plumstead (Woolwich), £100.

The Degeneration of the Teeth.—An article recently published in an evening contemporary very properly criticises the theory started in an American dental journal that vegetarian diet would, if universally adopted, produce an edentulous condition of the jaws in the course of a few generations, utterly regardless of the fact that vegetarian races have magnificent teeth. The pathology of this condition is stated to be *disuse* and consequent atrophy of muscles and jaws, then degeneration, and ultimately suppression of the teeth entirely. That comparatively little employment of teeth has something to do with their degeneration in civilised nations admits of no doubt; but how many thousand years must it take to make man edentulous when there are so few evidences of a tendency in that direction. The wisdom teeth are said to be disappearing because they are so often ill-developed and frequently never erupted, and the same remark may sometimes be applied to the upper lateral incisors; but many Egyptian mummies and Etruscan skulls two thousand years of age exhibit the same conditions, yet there is no race of man edentulous. "Are the teeth of the present century worse than those of the last?" is a question by no means easily answered, for we have only general observations and no statistics to go by. Dental surgery is a modern art, and too much separated from its parents—medicine and surgery—to satisfactorily decide the question. Moreover, dentists only see those people who have defective teeth. Again, much more importance is attached to teeth than in former days, and they consequently receive more attention. It has often been pointed out that the vast improvements in medical and surgical treatment serve to keep alive a large number of weaklings who would otherwise have died, and these often have a progeny of similar frailty, whose teeth we may legitimately conclude partake of the general infirmity. On the other hand, dental disease, if early treated, as is now done, may be to a great extent stamped out. Of course, the teeth of civilised nations are worse than those of savages, although, as has been remarked in our columns, *those of the latter are by no means free from disease.—Lancet.*

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

THE VERY LATEST FORM OF SOLAR QUACKERY—MENSURATION OF A CONE—THE ECLIPSE OF 1889, JAN. 1st—"SATURDAY" SCIENCE—PROVING (?) A WATERY COMET!—THE EARTH'S EQUATORIAL RADIUS—MOON'S NODES, &c.—SPECTRUM OF LIGHTNING.

[27751.]—I DO not think that we ought to laugh too much at the Chinamen who, on the 3rd instant (as related in your "Scientific News" on p. 555), fired their ships' guns during the Lunar Eclipse to frighten away the dragon that was devouring the moon, when such a letter as the following can find a place in a leading daily paper:—

"THE DROUGHT.

"SIR,—Some of your readers may like to be reminded that the Great Drought of 1868 broke up with the total eclipse that took place in August—about the 18th, if I remember rightly. There is to be a total eclipse, partly visible in England, as I believe that was, on the 19th of this month.—I am, &c., "VERBUM SAP."

If the writer of this letter, whoever he may be, had signed himself "Verbum Stulto," he would have adopted an infinitely more appropriate signature. In the first place, the total solar eclipse of August 18, 1868, was wholly invisible in this country, the line of central eclipse starting from somewhere near Cape Gardafui, traversing Hindostan and Borneo, and passing just to the north of Cape York in Australia; while, in the next, any one has only to turn to Symons's "British Rainfall, 1868," now lying before me, to see that the allegation that the breaking up of the drought was coincident with this invisible eclipse is absolutely false. On. p. 83 et seq. of that publication Mr. Symons gives a list of "Dry Periods in 1868," for 29 Stations in England, three in Scotland, and two in Ireland, which I would urge anyone interested in this subject to study for himself. The mischief of such rubbish as I have quoted lies in the fact that an overwhelming proportion of its readers take for granted that no one would dare to make a perfectly definite assertion if it were destitute of foundation; and hence never take the pains to compare it with recorded facts.

"Nu" (query 62963, p. 570) has only got what is known as the frustum of a cone to measure, and not the whole cone itself. As he says that he does not understand algebra, I will give him an arithmetical rule for determining the volume of his frustum, which he will find applicable in all similar cases. He must first find the areas of the two ends by squaring their radii and mutiplying the results by 3·1416. This means, in his own example, that to find the area of the top, he must multiply 46·5 by 46·5, and the product by 3·1416; and to ascertain that of the bottom, must multiply 81·5 by 81·5, and the product by 3·1416. He will find in the first case that this will come out 6792·925 square inches; and, in the second, 20867·293 square inches. Next, he must multiply these two results together, and extract the square root of the product. This will, in the present case, be 11905·88 square inches. Now, we must add these three results together, and we shall get 39566·098 square inches. The last result we must further multiply by the height of the frustum (102in.), giving 4035741·996 cubic inches, and finally dividing this by 3, obtain 1345247·332 cubic inches as the volume of our frustum. Had the cone been complete, the process would have been much easier, as we should only have had to take one-third of (area of base × height of cone). "Nu" disclaims all knowledge of algebra; but omits to say if he understands logarithms. If he does, he can materially shorten and simplify the work.

In reply to "Rosicrucian" (query 62972, p. 570), Totality of the Solar Eclipse of 1889, Jan. 1st, will endure for 2min. 0·6sec. in lat. 38° 43·8′ N. and long. 124° 21′ W. This is a point between Cape Mendocino and Benicia in California. In lat. 39° 41·5′ N. and long. 121° 25·4′ W. the duration will amount only to 1min. 54·9sec. This is about 117 miles to the North of Sacramento.

A "Saturday Reviewer" has (to cull a phrase from that Arbiter elegantiarum which he adorns) "been at it again"; for in a recent number I find an article beginning: "The Chi Nü of the Chinese Myths . . . . strictly consists of three red stars to the north-west of the Milky Way—α, ε, and ζ Lyræ"! As a specimen of popular science this has not very recently been excelled; in fact it is almost worthy of a place in a South Kensington textbook of astronomy. How any human being who has seen it can call that brilliant sapphire-coloured star Vega "red," or even apply that designation to the topaz tinted ζ, or to the double-double ε (of which one pair is yellowish and the other bright white), passes my comprehension. But I am not quite sure that the gifted being whom I am quoting is not rather greater in his power of localisation than he is in his chromatics, for to anyone familiar with the face of the sky, "to the north-west of the Milky Way" is positively delicious as a descriptive bit. The stone of the historical witness of the Old Bailey, which was "as big as a lump of chalk," seems to have been described with strictly cognate accuracy. I should not have noticed this astonishing pseudo-scientific hash but for the attitude assumed by your contemporary generally towards all who do not happen to have received a Classical education, and the persistent way in which every one who would put a foot too much or too little into a hexameter or pentameter is treated as a "cad" unworthy to sit down in the presence of a student of the "humanities," and the person who could pronounce, say, Vecti′gal Vec′tigal as a Philistine worthy only of the outer darkness. When one sees such woful blundering in anyone claiming to dictate to the civilised Universe, the temptation to exclaim "Ἰατρὲ, θεράπευσον σεαυτόν" is extraordinary.

It seems almost impossible to believe that so shrewd a thinker and astute a disputant as "E. L. G." really seriously supposes that he is *arguing* in letter 27732 on p. 583. But, for the nonce, I will treat that astonishing effusion as though it really was meant for reasoning, and say that it is certainly not I who ever, in these columns or out of them, have contended that a great partial flood ever extirpated "whole faunas," or "even . . . . a single species." Floods of the most devastating character may well have occurred without any such effect as that; and what is more, may, by this time, have left no recognisable traces behind them. Geologists who read this correspondence will know perfectly well that the allegation of your correspondent that gravel beds are lodged and "diluvial effects" "stamped in the valleys of the whole globe" is stuff and nonsense, pure and simple. "Blessed," says the proverb, "is he who expecteth nothing, for he shall not be disappointed"; and as I know the impossibility of any valid proof of the existence of a watery comet being given by "E. L. G." (or anybody else), I am not in the smallest degree surprised that he has failed to furnish even a plausible imitation of it. "Doubtless many do exist" . . . . reminds me of the stock phrase of the undergraduate up for an "Exam.": "It may be easily shown," which (being interpreted) signifies that he doesn't in the least know how to show it. As for what "Zöllner thought likely," unless my memory is more treacherous than usual, Zöllner thought that Slade's knot-tying trick was the genuine work of some extra or supernatural power; and further, that it was explicable on, and furnished an argument in favour of, the hypothesis of quadridimensional space! With reference to the assertion that "every part of our lands, not demonstrably younger than fifty centuries, has been deluged, but everywhere with waters going down hill," &c., I appeal to every one of my brother geologists whether there is any more evidence of that than there is of "E. L. G.'s" "said fall (which can be proved was about fifty centuries ago)." I reiterate, unhesitatingly that this is just what can *not* be proved; and that "E. L. G." may go on asserting it, *more suo*, until he is black the face, without convincing any one in the smallest degree familiar with the evidence. I should extremely like him to attend a meeting of the Geological Society, and propound such stuff before that assemblage of experts and competent critics, as he thinks good enough for his brother readers of the ENGLISH MECHANIC. Finally, I protest against his references to Genesis and St. Peter. If texts are to settle a question of science, argument becomes at once futile and impertinent. What I, and the overwhelming proportion of my brother readers ask for, is not "notable predictions," by whomsoever uttered; but sober reasoning founded on universally admitted physical facts.

While in entire agreement with "Tria" (reply 62981, p. 592) that five decimals are quite sufficient in our present state of knowledge of the solar parallax, I would point out that according to the absorbed = 8. To take our 2in. shaft, running at 1 revolution, by virtue of the increased diameter, we have doubled the velocity and thereby multiplied the coefficient by 4; at the same time the circumference increasing directly as the diameter we have doubled the distance moved, and therefore the *power* absorbed = 8; but of course the work absorbed per revolution varies simply as the square of the velocity × distance moved (= of course circumference of shaft), therefore in the small 1in. journal the work absorbed varies simply as the velocity 2 = 4, and in the 2in. one as the dia. cubed, since in the small journal we have squared the frictional res. by doubling the number of revolutions, whilst still keeping the distance moved per revolution the same; in the larger shaft we double the distance moved per revolution, and consequently the work. Mr. Gray appears to use the term *power* in the ordinary engineering sense; I do not. I hold that work = resistance overcome through space, and power = work done per unit time (one minute as a rule).

Mr. Gray's authorities are quite conclusive as to the reduction of the coefficient with the load; but he will notice that Mr. Tower states that "The frictional resistance increases more rapidly than the velocity; but *not nearly so rapidly as the square of the velocity.*" Therefore the power absorbed in shafting varies not nearly so rapidly as the cube of the diameter; but something between the square and the cube.

Govan. **G. T. Pardoe.**

ON THE LAWS, REACTIONS, AND CONSTRUCTION OF SOME FORMS OF PRIMARY BATTERIES.

[27757.]—I WAS compelled to leave off in the middle of my description of the Lalande-Chaperon battery owing to the influx of Jubilee and other work. Having now more leisure, I propose to commence where I left off. I have yet said nothing of the efficiency of the cell. Here are facts collected from what Mr. Stanley C. Currie says:—

A set of six cells (size not given) give on an average an output of 6,000 ampère hours (useful) work, with a consumption of 120lb. of zinc. Prof. Tait gives the E.M.F. as between ·83 and ·94 of a volt per cell on a circuit of high resistance. The limit of fall, however, on open circuit was limited to ·6 volt per cell—"that is to say, one can get 6,000 ampère hours out of above cells at a useful rate of discharge, say, 35 amps. without the E.M.F. falling below ·6 volt (per cell.) Taking these figures, a set of six cells should give 6,000 × 6 × 6 = 21,600 watt hours."

For charging accumulators, Prof. Jamieson gives, for charging accumulators, 4·28lb. of zinc = 1H.P. hour.

The efficiency is not high, of course, owing to the low E.M.F., but if the figures quoted by me in my last letter are correct, I fail to see why this battery did not come into general use. I should be glad of information on this head.

As far as I can learn, the Newton cell is on the same lines, except that oxide of lead (presumably litharge) is used instead of oxide of copper.

Having, however, described the Lalande cell at length, I do not think it advisable to go further into this cell, which is very similar to it, as far as I can learn.

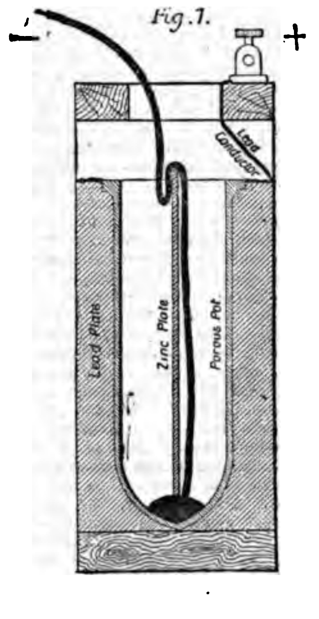
Turning now to the zinc lead peroxide cells, I will describe Bailly's, a cell of which I have had some practical experience, and which is most interesting.

This cell (now introduced by the Globe Electrical and Engineering Company, of Westminster, under the name of the "Phœnix Accumulator") is the invention of M. Phillimond Bailly, of Paris, where these batteries are largely employed both for lighting purposes and for power. They are of two kinds, lead-lead and zinc-lead. In both forms the lead element is constructed on the Planté principle, but with M. Bailly's improvements, which he compares to "the venous system of the human body," as the main conductor ramifies throughout the mass and picks up the current from every part. A sheet of lead is cut into a sort of fringe (Fig. 1), a long piece being provided for the main conductor, so as to dispense with any soldered joints; into the fringe lead wool is woven so as to form a sort of basket-work, which is tightly pressed between the space left by a porous pot or plate, and the outside receptacle; porous plates, as a rule, are objectionable, as they cause internal resistance. This is overcome by using a material which is more than porous—in fact, is honeycombed with interstices. These plates are cut out of solid blocks of sand which have been submitted to hydraulic pressure, and can be worked into any shape. The surface of the lead plates thus constructed is very large, the lead wool giving a surface of 1·5 square mètre for each 2·21b. of lead, and every part of the mass is permeated by the fringes, which, being of larger section than the lead wool, cannot be destroyed. *M. Bailly has had lead-lead* accumulators in regular *work for eighteen months,* which have improved with constant charging and discharging until 28 amp. hours per 2·21b. of positive plate is now obtainable. The zinc-lead type of battery differs from the other in that, for the positive plate is substituted a strip or rod of zinc amalgamated in a special manner. Fig. 2 shows a section of a battery circular in form of the ordinary zinc-lead type.

The lead wool is contained in the receptacle outside the porous pot, the constant amalgamation of the zinc being provided for by shaping the pot so as to contain a small amount of mercury, and connecting the leading wire so that it is immersed in the same.

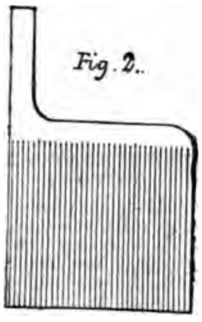
The first idea of using a zinc-lead battery is certainly due to M. Reynier, who did not, however, use ordinary metallic zinc, but coated lead or copper plates with zinc electrolytically. In the zinc-lead battery the action is as follows: The zinc is attacked by the sulphuric acid, and the peroxide of lead behaves as a depolariser; consequently the E.M.F. is higher than a lead-lead couple, being, in fact, 2·35 volts, or rather more. In discharging, the zinc plate dissolves in the dilute acid, forming sulphate of zinc, which is decomposed on recharging, metallic zinc being deposited on the zinc plate, and the sulphuric acid being again set free. Thus the zinc is never consumed, but only dissolved and redeposited.

Fig. 1.



The action as regards the lead plate is precisely similar to that in the Planté cell, and need not, therefore, be described; but experience with various designs of secondary batteries appears to show that for lasting qualities under hard work the Planté type, though slow to form, is more durable than those in which oxide paste is used.

Fig. 2.



The advantages claimed for the Phœnix accumulator may be summarised as follows: The capacity steadily improves with use, and the peroxidised plate cannot shake loose; short-circuiting is impossible, and a very large discharge can be obtained without injuring the electrodes; the internal resistance is very low, much less than in any battery in which porous plates or pots are used; the E.M.F. of the lead-zinc type is 2·35 to 2·37 volts, as compared with 2 volts from other batteries using lead-lead, which gives the advantage of requiring less cells for the same E.M.F., and as each is much lighter than the lead-lead type, the total gain in weight is very important. Experiments made with the Phœnix batteries, which have been employed for the past six months for lighting offices and workshops, show that although there is a certain drop in E.M.F. where zinc is employed, this is unimportant, and does not affect the lighting if a moderate current is taken. For purposes such as electrical welding and for driving motors where a very large current is taken, the fall in E.M.F. is of little consequence. The following comparison of sizes of Phœnix batteries and the last size of Elwell-Parker batteries may be of interest:—

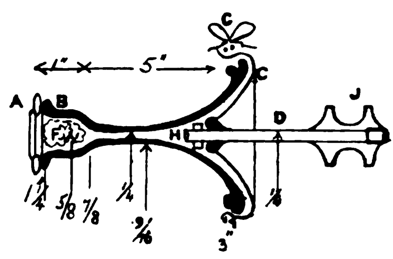
	Phœnix.	Elwell Parker.
Capacity in amp. hours...	50	60
Weight complete with acid	17lb.	32lb.
Max. normal discharge...	10 amps.	9 amps.
Dimensions (external) ...	14 × 5in.	10½ × 3 × 8in.
Capacity in amp. hours	100	110
Weight complete	45lb.	55lb.
Max. normal discharge...	30 amps.	16 amps.
Dimensions (external)...	11 × 10½ × 4½in.	10½ × 6 × 8in.

In connection with these batteries a new insulating material is employed termed "Phœnix Varnish," which is employed for cementing the ends of the celluloid and for lining wood cases, and it is claimed for this that the insulating properties are as high as Chatterton's compound, while the cost is the same as paraffin wax. It melts at a higher temperature than the latter, and is not so easily detached. I mention this as I have seen many inquiries lately for such a material as this, and although I have not tried it, I believe it to be good. I may add that the above forms of accumulator can be seen and tested by any electrician desirous of so doing at the Globe Company's office, 7, Carteret-street, Westminster.

Electrician.

SURGICAL SUCTION PUMP.

[27758.]—I SEE in the "E. M." of August 12th that another case of death from the attempt to save life by using the mouth as an air or suction-pump has occurred in the person of a Mr. W. Connor Lysaght at the Bristol Infirmary. Why should this be? I beg leave to submit the following sketch of an appliance for the job, and hope that some surgical instrument maker will be found to take it up and put it in the market. I am tolerably acquainted with the various appliances, but know of nothing that can be relied upon for such a purpose, applicable as an exhauster, quick in its action, simple, not likely to get out of order by lying by, and no valves. Such you have here. The idea is taken from a sketch of a hand pump I had seen some 20-odd years ago, that was constructed for the sinking a well through a bed of live sand. It is true we can do nothing for the unfortunate individual that has been sacrificed: but we may prevent any other useful member of society from being sacrificed under similar circumstances. If no surgical instrument makers can be found to take it up, surely we can find some amateur or practical mechanic to do so, and the expenses might be raised by a penny subscription from the subscribers of the "E. M."—a mould made to cast them in, the material that they are to be made of, pewter, the same as the common pewter syringes, and in memory of Mr. Lysaght—call it the Lysaght—and if got up by the subscribers of the "E. M.," might be distributed among the hospitals and infirmaries. Was there not a premium for such appliance some time back? I fancy I have some recollection of such, but do not recollect seeing any answer to the same.



Description of sketch: A is a stout washleather washer connected with beeswax and rosin to trumpet mouth; B is the body, made of wood, glass, or pewter; C is a diaphragm of sheep, lamb, or kid, or of any skin dressed as such, tied with a packthread around a groove at G, and made fast on the tubular spindle of D at H, with a nut or washer against a collar I, made fast by soldering on spindle of D, and can be made of any hard wood. The spindle does not come right through, but the hole is through; and in manipulating with the exhauster, the thumb is operated in lieu of a valve. I do not think any other description of it is necessary.

In operating a piece of sponge is put into warm water and squeezed dry, and is put into the recess F and the washer wet.

Jack of All Trades.

Sky Parlour, London East.

Now, not only in every blacksmith's shop in Great Britain are these Norwegian nails in daily use, but they are exported to every country where horses are shod, thus depriving England of a vast and ever-increasing industry, both in the manufacture of the iron (notably at Lydbrook, in the Forest of Dean) and of the nails.

I invite opinion as to the actual cause of England being thus superseded.

The Lydney Dispenser.

NOTES ON THE CONCERT-ROOM ORGAN.

[27763.]—HAVING read Mr. Audsley's two articles on above subject, and taking a great interest in such matters, I venture to suggest that in the attempts to revolutionise the art of organ building he has overstepped the mark. In the first instance, the sore point appears to be that at least half the pipes of an organ are not inclosed in a swell-box, and that in consequence of this they blurt out the same tone from Jan. 1 to Dec. 31. Any organist or organ builder will naturally ask, Why should they not? and would like to know if Mr. Audsley is not aware that when pipes are inclosed in a swell box a certain amount of tone is sacrificed. Let anyone, for experiment sake, sound a chord on the open diapason of the great organ, and then directly following the same on the duplicate stop of the swell (open), and they will (after making allowance for the softer voicing of the latter) notice the loss of penetrating power.

Are the organists of the future to be confused with three or four swell pedals? Just imagine anyone having to prepare the same in forte passages of a chorus such as "Unto us a child is born," &c. I think that readers of the "E.M." will agree with me that the time has not yet arrived to pooh-pooh the great organ works of Handel and Bach, and in playing the fugues of the latter, a multiplicity of swell pedals would be a positive nuisance.

It must be borne in mind that our organ builders are not blind to the requirements of the age, and that whatever means they might adopt for making each manual expressive, the expression is, to an extent artificial, when compared to that of orchestral instruments, as the amount of tone is regulated after the wind has passed through the pipes, and therefore limits the diminuendo and crescendo.

Doubtless some of the stops of the solo organ ought to be in a swell-box; but we shall not do amiss if, for the sake of contrast, the choir, great, and pedal organs are allowed to remain as they are. The idea of the manuals being away from the organ is, of course, a reasonable one; but why should the organist be privileged to hear the effect of his own performance any more than the members of the orchestra? I will here remind Mr. Audsley that as an exception to his statement "that every other concert-room organ in England displays the same unsatisfactory state of affairs," he has overlooked the one at Albert Palace, which has a reversed console away from organ.

Carolus Rex.

[27764.]—YOUR correspondent, "A Lover of the Organ," in his remarks (in letter 27715) uses rather sweeping and erroneous statements concerning organ builders by saying "*all* French and English organ builders advocate placing as much of the pipes in one or more swell boxes as possible, in accordance with Mr. Audsley's views." Such is *not* the case, inasmuch as many of the older firms, and indeed many of the recently established ones, do not fall in with Mr. Audsley's views at all—"more's the pity," for a perfect organ should be expressive in all its departments. He also states that the "great" reason against the system is that the confinement in a swell box *entirely destroys the tone*. This is *not* the case: it is simply a matter of the great expense attendant on such an arrangement. For if the "great organ" were boxed in, the front pipes would be necessarily so, and the appearance and artistic arrangement of the "front" rendered useless—unless the front were a "sham or dummy" one; but this would entail a set of duplicate pipes nearly as costly as a "speaking front" to give an appearance of an organ being there. Again, pipes are *not* injured in tone by confinement in a box—quite the reverse. Again, English organists and builders *have* heard the effect of finely-voiced pipes in an unconfined space—in fact, they have heard finely-voiced pipes in all sorts of positions and all sorts of buildings. Again, reeds are *not* spoiled by being placed in swells. If they are coarse the swell box improves them, and does not "much spoil" them, as stated. I never heard that putting Herr Schulze's pipes in a box caused the fine quality to disappear; nor, indeed, did any other person. Again, we *can* make such pipes as Schulze produced—ay, and voice them, too. In fact, English organ builders, as a rule, are second to *none, either in construction of mechanism or pipes, and they are no way inferior* to any German or Frenchman in being able to voice a reed or flue pipe. When we hear of "big" things in France, Germany, and America, and even in Russia, we should not lose sight of the fact that £ s. d. without limit produces these, and I believe that if we got an order to produce an organ that could be played in England and heard in America, we could do it, if some millionaire would lay the electric cable for us. We are truly thankful for ideas from other countries, and no doubt they are for our achievements; but to dub us all, both organists and builders, as never having heard this or that, or that we *can't* make pipes, is "rather" strong. I may add that I hope to see the day when Mr. Audsley's views will be generally adopted as far as means and space will permit, and also to state that Mr. Best is *not* the *only* one who can manipulate an organ fairly well, as we have a "few" at least as dexterous with hands and feet; but modesty does not allow them to "blow their own trumpet."

Wm. Robinson, Organ Builder.

Preston.

ORGAN MATTERS.

[27765.]—THE best book for amateurs (letter 27747, p. 587) on organ tuning is by A. Hemstock, of Diss, Norfolk, price 2s. 6d., obtainable from the author direct. The stopping of a Principal and 15th is probably a "game" that as an experiment is "not worth the candle." **Carolus Rex.**

[27766.]—I HAVE much pleasure in replying to "Chamber Organ's" letter in your last issue. There is not a really good book on Organ Tuning known to me; but there is a pamphlet, entitled "Organ Voicing and Tuning; a Guide to Amateurs," which "Chamber Organ" will doubtless find useful. It was published by C. W. Brabner, London, in 1879; and can be procured from William Reeves, 185, Fleet-street, London; price 1s. 6d.

Now, with reference to his organ stops. Here I find some little difficulty, for not having examined those he wishes to convert, I cannot assure him of a successful issue. In such an instrument as he describes there can be no doubt that two stopped flutes, of 8ft. and 4ft. tone respectively, will be infinitely more valuable than the noisy principal and fifteenth. The question is, can the said principal and fifteenth be converted into decent Lieblich-Gedacts? There is just a danger of having too much stopped tone, seeing that there is a stopped diapason already in the organ. If there is room on the wind-chest, I should advise doing away with the fifteenth and inserting in its place a very small-scaled string-toned stop of 4ft. This would add variety and mix well with the covered stops. He should by all means carry the open diapason down to CC.

I know so many organ builders capable of doing what is required, at a moderate price, that it would be invidious to name any one; but "Chamber Organ" cannot do better than employ the firm he names. **G. A. Audsley.**

SHOULD WE EAT SALT OR NOT?

[27767.]—I ACCEPT all opinions against the use of this mineral product—*cum grano salis!* Galton, the South African traveller, only found one small tribe, the "Ovampos," who were ignorant of its savour. Now, all the springs and minor rivers of that wide region are strongly impregnated with the same. I could rarely get a thirst-quenching draught of *Aqua pura*, except from the iron tanks at the farmhouses, constructed to catch the rainfall; the prevalence of Tænia having frightened wise people from getting a water supply at the dams on the low lands, which swarm with the ova of parasites left on the soil by sheep and cattle, and constantly washed downwards by every storm besides. Tea and coffee are rendered very nauseous by brackish water, and I have often thrown the tempting liquid away, it so resembled the apothecary's black dose. When I was driven to drink in desert places, I have chewed the succulent stems and leaves of *Portulacaria afra* (employed by the early colonists as a pleasant substitute for rhubarb in puddings, being sub-acid), or like the wild men and wild quadrupeds, I have found great relief in munching the juicy foliage of the large Mesembryanthemum (or Hottentot fig). Those salt-seeking creatures, the gazelles, are usually found very far away from any water, browsing continually on this cool vegetation, which has often saved the lives of lost explorers. I have met with isolated imitators of Adam all over the world—men and women—who have argued that even bread is superfluous and unwholesome, and that the "fruits of the earth" are sufficiently nutritious without adding to our food list. It is stated that Adam and his wife, on their expulsion from the Garden, covered themselves with th- "skins of beasts"; of course, they killed t[illegible] and we may naturally suppose, ate them, having no longer any fruits to support [illegible] being mentioned at no great length of th[illegible]ing the above event, leads us to suppose that it had become well known, and most probably added to the insipid flesh meals. The learned Government botanist of Ceylon (quite another Linnæus in his devotion to science) practised the frugivorous *regime* rigidly for 30 long years, at the end of which period he found himself prostrated by premature senility, and was actually carried on board ship, with the good medical advice of adding animal substances to his hermit's bill of fare! Perhaps the constant survey of "Adam's Peak" in his close vicinity (where a pseudo-gigantic footprint is exhibited as a relic of the Patriarch), and the glorious beauty of those gardens at Peradenia, prompted the professor to take the great first gardener as his model! That holy vegetarian of the East, the Brahmin, adds quantities of clarified butter and baked flour cakes, sugar, and salt to his numerous dishes, washed down by immoderate draughts of cow's milk—a dietary more than nutritious to a lazy priest. Why is free muriatic acid found in the gastric juice of a healthy human being, salt in his blood, bile, and urine? Why are the same absent, or very deficient, in all cases of Asiatic cholera? I am writing with the table of comparative analysis before me. Why does a solution of salt injected into the veins of a cholera patient at once produce the most hopeful symptoms, though but generally *temporary*, the heart and stomach being *too feeble* to benefit by the treatment? Dr. W. B. O'Shaughnessy, of the Calcutta Medical Hospital, whose school of anatomy dissected sixteen human bodies daily, was the first experimenter in this line. His report on the Chemical Pathology of Cholera was published by the London Central Board of Health, page 64, January, 1832. The operation was accordingly performed by Drs. Latta and Lewins, of Leeds, and with perfect success, and Dr. Girdwood, of London, rescued by its means five utterly abandoned cases. In many instances the measure failed through the inexperience of the operators and the *introduction of air into the veins*. In no one instance did it do any harm, or accelerate the progress of the disease. Seventeen cases were recorded of its success. Now I think this is a crucial test of salt being non-poisonous to the human system, a decoction of tobacco leaf or pure alcohol (for those who like to compare two potent narcotics with muriate of soda) would have destroyed life rapidly.

Dr. W. B. O'S.'s analysis of *healthy* gastric juice—the chief agent in digesting our food, says:—"The acid has been proved to be the *muriatic* with traces of the *acetic*." Hence the moderate use of table salt forms a necessary constituent in the digestive laboratory.

Addiction to salt is very exceptional. I know of no race of men but the Mohammedan fanatics of Egypt—both Turks and Arabs—who eat it in quantity that they may produce intense thirst, and so be enabled to imbibe copious draughts of water from old Nile (that mysterious river almost deified by time and tradition). Nearly the whole world eats salt sparingly, as they do mustard, that valuable digestive condiment, and pepper, that less-known febrifuge and antiseptic (of which I may possibly tell you more some day). The pigeon, unless he gets a liberal supply of salt, becomes diseased, and flies away to some other home where he has discovered his medicine. "Salting" them is a well-known term amongst the dishonest fraternity of bird stealers, who make up a compound of clay, mortar, and rock-salt on a house-top, where they entrap these winged wanderers.

All the equine genus appear to have an instinctive love of the mineral. I have been encamped in a desert where the small water supply was undrinkable to me, yet my mules and horses fought over it and were continually imbibing the saline element; the beef of the cheap butcher's shops throughout India is so infested by Cysticercus that medical inspectors go their rounds of examination, and the sheep belonging to Europeans receive a daily allowance of rock salt; otherwise they will not fatten, but become diseased. All Government cattle and troop horses receive a certain quantum of the mineral, due to the long experience of veterinary surgeons. In the vast Indian Empire salt has always been considered as ranking next to grain in dietary value—a necessary of life, and not a luxury, as opium, alcohol, and tobacco. I was astonished and amused just before leaving the East at a confession made by a certain President of the United States on his travels. He said to me: "I thought no Englishman ever lived to 30 years of age in India! I had always been told so; but here are you and several others I have met lately, quite strong and healthy, who have lived more than that term in the country! A very old mental saying of an expressionless face is this: "No salt in the composition." I have only met salt haters among drunkards—black [illegible] white: in the melancholy case of a [illegible] Englishman in good circum- [illegible] salt-cellar [illegible] peatedly that when a man is bitten by a venomous snake, he always calls salt sugar—it tastes so sweet to him! I fully believe there may be equivalents to the action of muriate of soda. I have before noticed that. I have hunted the larger fauna of India in the newly-burnt plains; revelling in white ashes were the greedy quadrupeds, from the rhinoceros to the wild boar, eating the crude soda. There are many salt-loving plants and trees in the vegetable kingdom, among esculents, notably the sea kale and asparagus, which absorb a large amount; hence in horticulture we bestow a large amount of the mineral to compensate for their inland culture: moreover, it is a cheap and efficient insecticide. What life, be it animal or vegetable, can withstand corrosive minerals—copper, mercury, and arsenical salts in particular? Even a coal heap near the roots of a timber tree I have seen bleach the foliage and subsequently kill the trunk. Salt is a widely-known antiseptic. It was remarked by a wise head during that memorable cholera invasion of '32 that large salt eaters and consumers of home-brewed bitter ale and sound cider gave the best returns of health. **Eos.**

[27768.]—DR. S. DODDS is quite correct when she says, page 586, that "the fact that we like or dislike a thing is no proof whatever as to the quality of the article," hence, of course, the exceptional circumstance of certain animals disliking salt is no proof of its being injurious. Be it remembered that Dr. Allinson used the statement "that animals in natural state would not touch it" in support of his contention that it was so.

I suppose no one will try to prove that it is always necessary to take additional salt at time of eating our food. What is argued is that salt is absolutely necessary—how or when we take it is not important. Dr. Dodds asks questions, the ability to answer which appears to be the voucher for one's desire to know the truth of the matter, although why it should be so seems rather obscure. The first is, Why do not *all* animals hanker after salt? It has already been stated that all animals do hanker after salt if deprived of it. Of course, if they have sufficient in their food or drink they may not do so. Dr. Dodds certainly says that she knows thousands of healthy animals who will not eat it; but what Dr. Dodds should do, if she can, is to prove that they do not obtain any; in this case, of course, none will be found in their blood, none in their urinal or lachrymal secretions, which would certainly be an extraordinary circumstance. I should here like to ask Dr. Dodds a similar question, supposing that she, like most people, considers scarlet fever infectious—Why do not *all* people take scarlet fever?

The second question is, Why is it that some animals are easily killed with salt?—birds and chickens, for instance? (I always thought a chicken was a bird, but no matter). Well, chickens are not easily killed with salt. On the contrary, "The Practical Poultry Keepers' Guide" (11th edition), published by Cassell, in the directions given for feeding chickens, it states: "A little salt should always be added." At a farm where I am at present staying many fowls are kept, and the people tell me that they never heard of salt being bad for fowls.

Questions 3 and 4 need not be considered, for that portion of them not treated under one and two is foreign to the question.

I now wish to ask Dr. Dodds another question: She states that if the animals mentioned by her, and which have never learned to like salt, were removed to a place "where the only water they could get would be alkaline," the case with them would no doubt be different—*i.e.*, I suppose they would not only eat salt, but like it. The taste of salt is not alkaline, and therefore it is not a case of learning to like it. Why, then, is there no doubt that the case with them will be different?

Let the anti-salt-eaters bring forward clear cases where animals have been entirely deprived of salt, and have not in consequence suffered in health; we may then believe that salt is unnecessary. The experience of "Vin Bleu" and a correspondent in your previous issue prove nothing, except, perhaps, that of the latter, who says that since he has left off taking salt he has continued in his usual good health. Salt-eating, then, did not do him much harm, since he has not improved in health. Why should people take upon themselves to persuade others not in a position to study the matter for themselves to abandon so universal a practice of taking with their food a substance which men who have studied the subject say is absolutely necessary—animals deprived of it quickly dying, but which if supplied with an extra quantity improve in appearance and health;—a substance which, to most persons at least, is very palatable and appetising, which places in the hands of poor agricultural people a means of preserving food—to them a most important matter;—a substance which nobody as yet, so far as I know, has proved to be injurious, which has been used from the most remote times? I think that persons so doing are mischievous. The use of minerals in the body is little understood; they may, however, and inquiry shows that they probably are, of the utmost importance. It was once thought that fish placed in distilled water died because of the absence of dissolved air; but Dr. Ringer has shown that the cause of their death is the absence of the minute quantities of certain salts contained in ordinary water, the presence of these salts preventing the disintegration of tissue of gills which otherwise takes place. For all we know, common salt may play as important a part in our economy, and I think until it is proved beyond question that its use is distinctly and practically injurious, people would do well to take no notice of those persons recommending the abandoning of its use.

I am writing many miles from home, and quite away from books of reference, with only your last issue before me. In making references to your correspondent, I have only my memory to rely on; I trust, therefore, that any misquotation may be excused and corrected.

Coniston, Lancashire. **Kensingtonian.**

[27769.]—I HAVE little doubt that much of the intemperance that prevails in England proceeds from our excessive use of salt in cooking. The English army in the Peninsula were notorious for their intemperate habits; and it is a very significant fact that Sir John Burgoyne says, in a letter written among them, and printed in his life, that the Spaniards were astonished at the quantity of salt the English soldiers used; from which it is to be inferred that the Spaniards take very little of it, and they are celebrated for temperance. The most abandoned drinker I ever knew almost buried the very little meat he ate in salt. Sir Walter Scott was unable to leave off whiskey, though strictly charged to do so by his medical advisers; and it is incidentally mentioned that he was a great salt swallower.

If wives, who complain of the curse of drink, would put little or no salt in the water they boil their vegetables in, and sprinkle little or none over their roasting meat, their husbands would be able to resist the demon much more easily than they can at present. I verily believe that a crusade against an intemperate use of salt would in very many cases prove more remedial than direct attacks on excess in drink. **A. G.**

[27770.]—IN the letter for which Mr. Macbean (p. 586) has made himself responsible, there is a slip of the pen which it may be as well to point out promptly. Dr. Susanna W. Dodds is made to say: "If the writers who are so much exercised on this question were really in search of truth." I thought we English Mechanics were in search of truth. **Nun. Dor.**

GAS-BURNERS AND GAS COMPANIES

[27771.]—GAS companies are so frequently attacked in the Press—generally by those who show they know nothing about gas—that the following suggestions may be of interest to your readers as indicating the manner in which gas engineers are prepared to deal with the public. They are remarks from a paper by Mr. G. Hislop, read before the North British Association of Gas Managers:—The loss of gas through imperfect means of combustion is a fact so well known to every intelligent gas engineer or manager that I have thought it quite unnecessary to submit experimental proof in support of it. The value of the loss in Great Britain has been variously estimated, and 40 per cent. of all the gas consumed has been named; but assuming it to be 25 per cent. only—and that no one will dispute with me for one moment—and, taking the annual quantity of gas sold, as given by Mr. Newbigging, viz., 92,637 millions; and taking 25 per cent. of that quantity at an average rate of 3s. per 1,000 cubic feet, we have a sum of not less than £3,473,887. But this does not by any means represent the value of gas lost, if considered in relation to the results now obtained by some of the regenerative lamps in use. The estimate refers to preventable loss even by the use of proper burners of the more common type.

It is unnecessary to ask why the gas consumers, as a rule, quietly pay for such loss. They pay for it as a rule with utter ignorance or unconsciousness. The question involves a knowledge of chemistry—the chemistry of combustion—and the knowledge of aëriform bodies in general, whereas very few possess such knowledge to enable them to devise or adopt means for its prevention; indeed, under the circumstances, I feel inclined to accept the proverb or aphorism, that "ignorance is bliss," while abhorently rejecting the complimentary sentence, that "it is folly to be wise," since when the remedy of an evil is beyond the power or capacity of an individual, he may, after all, be better without the knowledge of its existence. This, however, by no means justifies the existence of an evil, so long as its existence is within the knowledge of others immediately concerned, and who possess, or ought to possess, the knowledge and capacity requisite to cope with it. I maintain, therefore, that it is the duty of every gas company and corporation to bridge over all deficiencies in science or general knowledge on the part of their consumers, and supply them with the means of economically consuming the gas they deliver. In every department of trade or commercial enterprise the producer is careful to show up to his patrons the special features, capabilities, or superiority, it may be, of his over all other competitive productions, in order that with such knowledge the value of the products may be enhanced. I think it unfortunate, however, that in the matter of gas supply these principles and precautions have been entirely ignored, and that, in my opinion, to the discredit of all concerned. We not infrequently find gas committees and their engineers advocating the so-called reform of abolishing meter rents (a subject which I must confess I have little sympathy with); but here is a subject of vastly greater importance, and one which no one seems to trouble his head about. I contend that if gas companies and corporations were, in the direction I have indicated, actuated more by a spirit of self-sacrifice and justice to those who really contribute to the pecuniary success of every gas undertaking, it would, in my opinion, do more to consolidate gas interest than anything I can conceive, and render competition from oil, electric light, or any other illuminant, next to impossible.

I submit, therefore, that gas committees should commit this important matter to their engineers or managers as part of their duties, as until the gas has been consumed, and that in such a manner as to develop the highest amount of light which the most approved burners of special construction, and at moderate price, can permit, the gas manufacturer has not discharged his duty; and the question now comes, what are the best means of securing such an object? And I must answer it, for having condemned an existing evil, I should be prepared to propound a remedy. This I am able to do from the study of the question and from practical test. The irregularities of pressure over an area of gas supply are well known to you, and the whole question resolves itself into one of reducing that pressure to a certain uniform amount at the point of combustion, depending upon the quality of gas supplied; that is to say, with gas of from 20 to 22 candles illuminating power, the pressure should be reduced to $\frac{4}{10}$in.

From 23 to 25 candle, $\frac{5}{10}$in.
" 26 " 27 " $\frac{6}{10}$in.
" 28 " 29 " $\frac{7}{10}$in.
" 30 " 31 " $\frac{8}{10}$in.

These data given as a starting point, the whole of a town should be carefully surveyed and the pressures in the street lamps determined at every lamp pillar after the removal of the regulator (the lamps offering the most certain and reliable results). From the pressure so found deduct an average of $\frac{1}{10}$in. pressure for resistance due to the working of the meter, and, say, $\frac{3}{10}$ths for loss by friction in the distributing pipes, or in all $\frac{4}{10}$ths; and supposing the maximum initial pressure to be $\frac{16}{10}$ths, there remains, after deducting the $\frac{4}{10}$ths, a pressure of $\frac{12}{10}$in. at the point of combustion, and which, in the case of 26 to 27-candle gas, is 100 per cent. over the required amount, and which will more than account for the loss indicated at the outset.

A series of special burners to meet the varying conditions of pressure on the different districts, as well as the different rates of consumption, may be got at a rate varying between 6s. 6d. and 8s. per gross, depending upon the number ordered; and I think it right here to acknowledge the kind services of Mr. Bray, who devoted a considerable amount of time in getting up these burners and in carrying out my views in the production of the whole series. These consisted first of all of four different pressures, and under each pressure six different sizes, viz.—2½, 3, 3½, 4, 4½, and 5 cubic feet per hour, and all having stamped upon them both district pressure and cubic feet per hour. With a small gasholder and suitable pressure gauges, the pressure of the district may be produced in a few seconds in the presence of a consumer, and the size and power of each of the above hourly-quantity burners may be seen, and selections made of those he may think best suited for his house, shop, or warehouse, as the case may be. Printed slips may be issued to all consumers to be filled up, signed, and returned, giving the number and sizes of burners he may require, and on referring to the table of district pressures, which is alphabetically made up, it is at once seen what kind of burners to supply; or a man may be sent to put them in, especially in the case of large premises, or where there may be an undue variation of pressure, as in such a case the pressure ought to be found in the different departments, in order to supply the proper burners. The cost of so doing is of small moment when the immense advantages are considered, and, moreover, these burners would not require renewal oftener than from two to three years.

When this system was introduced into Paisley, about four years ago, I modestly estimated the saving to the consumers as equal to at least 9d per 1,000 cubic feet, with gas at 8s. 9d. It met with considerable favour from all classes of consumers, and by many it was pronounced the best thing of the kind ever introduced. I regret to say, however, that within eight months of its introduction, the cost, small as it was, was objected to by one or two members of the Gas Corporation, and the whole consigned to oblivion. But that circumstance does not in the least affect the soundness of the arguments I have advanced.

Quid Rides.

PRACTICAL ELECTRIC LIGHTING FOR AMATEURS.*

[27772.]—In these articles it is not intended to cover the whole subject, but to simply give the amateur an idea of the best way to go to work. To this end we will take a small domestic installation of 80 to 85 16c.p. lamps (nominal 20c.p.) The first thing to be done is to make a rough sketch of each floor showing the shortest route of the cable and branches, and also the number and position of the lights in each room, and also showing whether all such lights are to be alight at once, and if not, how many are to be. This done, we can proceed to consider the arrangement of mains from the dynamo to the branches. Now, there are two main systems, one the circulation system, in which the mains are taken from the dynamo right through the district to be lighted; this has the defect that if the main has any appreciable resistance, then we shall either overrun the lights at the near end to run the farther lights at normal brightness, or *vice-versâ*, unless we insert compensating resistances in the nearest branches, which is very wasteful. It is, therefore, advisable, if not essential, to adopt in large work the distribution system, or its equivalent; in a large installation a drop may be allowed between each centre and lamps of lower voltage used for the further centres, but this would be a nuisance in a small dwelling-house, where we wish the lights to be interchangeable—that is, when the lamps become unpleasantly blackened and too dull for use in the living rooms, we should put them in the bedrooms or other place where a first-class illumination is not required. The distribution system consists in supplying all the branches from one or more centres supplied at constant petential from the dynamo room, the difference of potential at the dynamo terminals being varied according to the demand for current from the external circuit, consequently, we can use a considerably lighter main lead from the dynamo than we otherwise could. It will be seen, however, by referring to the estimate given on page 368, No. 1160, June 17, that supposing we could work with only half the weight of main lead, we should save only £3 5s., or only 1 or 2 per cent.; it is, therefore, hardly worth while using this distribution system on so small a scale, and therefore we will adopt the simple circulation system in our installation. It should, however, be mentioned that if the dynamo room is at any distance from the house, we might use light leads from the dynamo to the house, switch board, and regulate the engine from there by electrical governors and pressure wires run back from the house. But in this case our dynamo is practically in the house, and therefore the length of mains is only twice the distance from the top to the bottom of the house—I say twice, because there are two wires, lead and return, and these have to be reckoned for in estimating the resistance. Now to commence. We first take a general survey of the house and get an idea of its plan. The above-mentioned case is the one considered. We find it consists of three main floors, the ground-floor consisting of kitchen, scullery, larder, pantry, dining-room, entrance hall, and lavatory. We find one light is quite sufficient for the kitchen, the same for the scullery, larder, and pantry. As to the dining-room, we find that in ordinary use two lights are quite sufficient, but as the room is arranged with sliding doors to divide into two smaller rooms, we arrange a 3-light pendant over the dining-table and a single-light bracket in the smaller division. Again, two lights are required in lavatory, but as only one is burning at once they count as one as regards the wiring and fuse; also one light for the entrance hall, this must be independent of the lavatory lights. Mark all these on plan of ground-floor. Now for the next floor: we find on this a landing requiring one light, the drawing-room, one bedroom next to drawing-room, and a bedroom at a slightly lower level. The drawing-room also has a balcony attached to it which requires to be lighted. (N.B.—This is a good place to use up our blackened lamps.) We find that four old lamps will be wanted for the balcony and three good ones for the drawing-room, and that the balcony and drawing room lights very often require to be all on together (mark this on sketch of second floor), and also the fact that as the drawing-room is over the dining-room, the latter should be wired from above, especially as the electroliers in the latter have to be pendants. The fuses should be marked as being above and the switches in the room below. To continue, we find that the bedroom lights on this floor are down a passage about 10 yards long (mark this as 20 yards), and also one light in each bedroom, the bedroom next drawing-room being over the kitchen (we mark it as such), and that kitchen and scullery lights are to be supplied from this branch. Continuing upstairs, we find halfway up to the 3rd floor a single bedroom (mark this one light); on 3rd floor we find two bedrooms requiring lights, a dressing-room, and also the landing itself, wants one light (mark this), and also that an attic above requires to be lighted occasionally. We have now found the total number of lights required (with the exception of one or two odd ones which cannot be specified), and also got an idea of the method of wiring. In order to find the current to be supplied, we must find out how many lights are required at once, and we find that the maximum number of lights required at once is never more than about 13 or so = say, 17 ampères at 50 volts, this equals 1·14H.P. actually in the lamps; but as in these small machines we cannot count on much more than 65 to 70 per cent. commercial efficiency in actual practice, we had better allow not less than 2H.P. on the engine pulley, say, 3 indicated H.P. Now to calculate the sizes of mains. The actual maximum current taken off the mains at any time never exceeds 17 ampères, but as 14 ampères are taken off at a point less than two-thirds of the distance from the dynamo (or house switch-board, according to arrangement of engine-house), we shall be safe if we calculate as if 13 ampères were being taken off from the extreme end of the mains. To determine the res. we must consider what variation we can allow. Now, 2 or 3 per cent. is the most that can well be allowed, as even in a 100-volt lamp 2 volts are sufficient to make a perceptible difference in the light (the light varies roughly as the 6th power of the E.M.F.), so in our 50-volt installation we will not allow more than about 1 or 1½ volts variation or drop of potential at full load, therefore 1 volt 13 ampères = res. of mains = ·077 ohm, or ·064 ohm per 100 yards. Turning to a list of wire resistances and weights, we find that this has as the nearest size ·066 ohm per 100 yards a strand of 7/14—that is, seven wires, each of No. 14 gauge, laid up into a strand. Now, it is hardly wise in a permanent job to allow a low insulation res. to pass while the highest class is better than is needed in house work, so we will take a medium class; the price of this is 1s. 1d. per yard. It is best to make a list of what is required as you go on (marking the maker's No. and class letter to facilitate reference when ordering). We now have to consider the best position of the junction of the branches with the main. We find that the hall-light and lavatory lights can be conveniently supplied from above as well as the dining-room lights, so we arrange all our branches to be taken off one junction; this has the advantage of reducing the No. of joints, which are the weak points of an electrical circuit. A wire (twin wire is best) is then taken from the junction-box through a small fuse, which is a simple arrangement for putting a piece of tinfoil or alloy of tin into the circuit. If the current rises above a certain safe value, say, by a short circuit, this foil becomes hot enough to melt, and so breaks the circuit before damage is done to the insulation of the wire, and perhaps causing a fire. There are several varieties of fuses to be had; in one a length of lead or tin wire is clamped between two screws, in another the wire is replaced by pieces of tin or alloy foil separated from each other and inclosed by slips of mica. The foils are then clamped between two contact plates. They should be fixed in a position easily got at to replace them; but if properly fitted the installation should not require their use, as it is only faulty work or damage to wires that causes a short circuit; they must be fitted, however, as a matter of precaution. After leaving the fuse, which need not be fitted to both wires, the wire is run down as much out of sight as possible to the hall light, where the outside covering is taken off for a few inches, and one wire cut, the two ends are taken, the one to the back and the other to the front contact of the switch, the twin wire is then continued to the lamp-holder and screwed on. The switch need not, of course, be near the lamp; it may be in the most suitable place with regard to the decorations, provided too great a length of conductor is not thereby inserted. The wire specified (No. 16 B.W.G.), however, allows of any reasonable

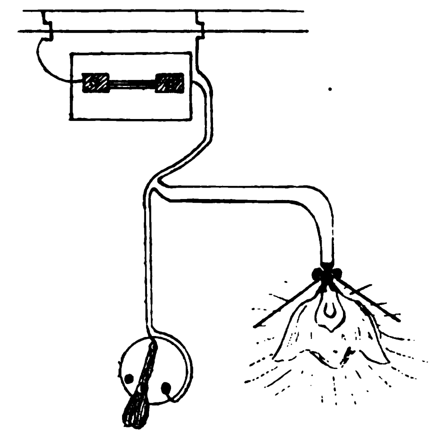


FIG. 1.

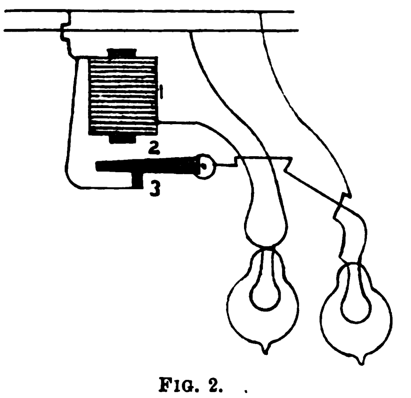
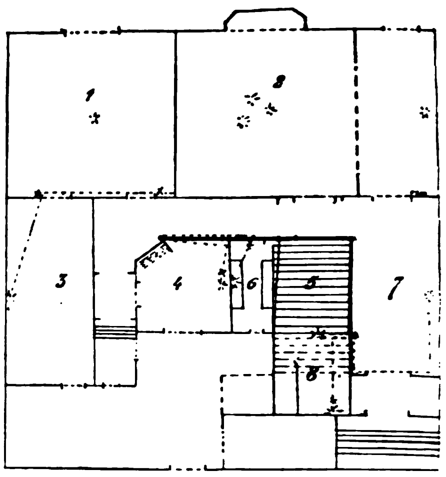


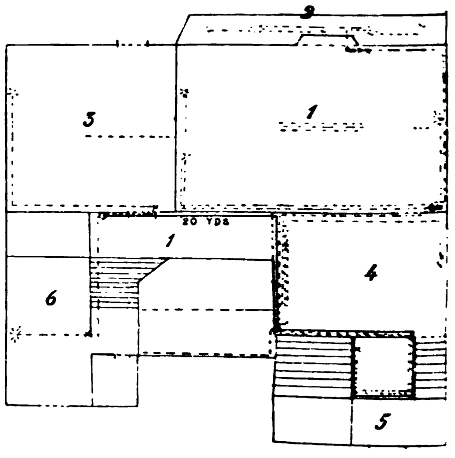
FIG. 2.

1, Coil; 2, Armature; 3, Bottom contact.



PLAN OF FIRST FLOOR.

1, kitchen, one light; 2, dining-room, four lights; 3, scullery; 4, larder (cellar and engine-room under) one light, each wanted occasionally; 5, stairs to second floor; 6, pantry, one light; 7, hall, one light; 8, lavatory, two lights.



PLAN OF SECOND FLOOR.

1, drawing-room; 2, balcony; 3, bedroom; 4, landing, one light; 5, lower landing (over lavatory and porch); 6, bedroom, one light; 7, passage.

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over one halfpenny, or, say, 2d. per hour for our 8H.P.; therefore, the total average cost per night, running from sundown to 11 p.m., will be 10·306d., or £15 3s. 6d. per year. This, of course, assumes that we run at full power all the time, which would not be the case in practice. If running all night, we must add to this the cost from 11 p.m. to runrise. This will mean an additional 2,553 hours per annum, and at ¾d. per hour (assuming that it takes rather under a ½H.P. to keep the machinery moving at full speed and light), it will cost us only £2 13s. 2¼d. per year additional, or 1·75 per night additional. There is no need to count in the lights that might *perhaps* be wanted after 11 p.m.; they would so seldom be wanted in an ordinary house of this size. This would bring the total cost for fuel up to 12·356d., or rather over 1s. per night, if run at full load. To this must be added the depreciation (sinking fund) on the plant and other charges. A well-made dynamo should last 20 years at least; but as these small ones run at a very high speed (2,000 per minute), we will say 10 years' life. This makes it cost us £2 5s. per year sinking fund, and, say, 2 per cent. repair fund = 9s. more = £2 14s. Interest is not accounted for, as this is supposed to be got in increased comfort and saving to decorations, &c. If required, anyone can, however, charge at whatever interest he is willing to lend £200 for. Taking the engine at 20 years' life = 5 per cent. + 1 per cent. repairs, = 18s., total cost = £5 8s. per annum. Wiring at 5 per cent., say, 11s. per annum; lamp renewals at 5s. each; and 1,200 hours life, which is frequently exceeded, £12. This is only reckoned up to 11 p.m. = 1821 hours per annum.

The depreciation and interest charges constitute the fixed annual charges. The others vary with the hours of running. Allowing 1lb. of waste and one quart of oil per week (liberal allowance), we have, waste at 3d. per pound, 13s.; oil at 3s. 9d. per gallon, £2 8s. 9d. Total cost per annum:

	£	s.	d.
Coke at 15s.	17	16	8¼
Oil at 3s. 9d.	2	8	9
Waste	0	13	0
Lamp renewals	12	0	0
Engine depreciation, 20 years life, and repairs	5	8	0
Wiring	0	11	0
Total cost per annum	£38	17	5¼

Charging the whole cost on the hours of full load lighting cost per hour = say, 5·25d. This would, of course, be reduced, if we used less than 8H.P., or if we shut down at 11 p.m. instead of sunrise. It will be seen that this is a very expensive means of lighting if we compare it with the cost of gas even at 4s. Whether it is worth the outlay (nearly £1 per week when we have help) must be decided by each one for himself. The writer has never heard or seen it tried; but throws out as a suggestion whether it would be a good plan to fit two pulleys to these small dynamos, each having a band capable of taking the full load without slip. This would cost but little more, and would be a practical guarrantee against extinction of the light by breakage or slipping of a belt.

When a dynamo is allowed to generate a current, this current magnetises the armature core in a direction at right angles to the field, and as the magnet strength varies (within certain limits) as the current × turns of wire on armature (ampère turns), and therefore the distortion of the field will vary as the current; if, therefore, we clamp the brushes, and vary the load (current), we shall vary the lead, and this causes sparking and loss of potential; for, the neutral point being at a point at right angles to the field, shifting the brushes forward or backward means that we are either taking the current off at a point having a lower induced E.M.F., or that part of such E.M.F. is running against a counter force, in either case reducing the difference of potential at the terminals. In large machines this can be (and is) overcome by making the field so powerful as to entirely overpower the armature; but this cannot be done in small ones on account of the great weight of the machine in proportion to its output for small sizes. The brushes must be carefully fitted to the commutator and bed fairly on it; the best way for the brushes to bed on commutator is for the ends to bear obliquely, and the thickness of brush to be such that it bears on two adjacent segments. The brushes should bear just hard enough to prevent jumping, and no harder; but if the foundation is firm the vibration is inappreciable. There is no need for a belt tighteningarrangement in small machinery—a link taken out of the band is quite enough, and takes ten minutes' work. The oil running from the drip pipes of the dynamo and engine-bearings should be caught in a tin or zinc tray, filtered and used again; a great economy will result. The writer hopes these articles will be of service, and if he has left anything unsaid will send a supplementary article if *desired.* **Engineer, Govan.**

LECLANCHE FOR QUANTITY.

[27773.]—MANY queries have appeared of late under the above heading, and replies having been given by Mr. Sprague and others capable of forming an opinion, the following from "Harris' Galvanism, with Appendix by Robt. Sabine" (electrician to Messrs. Siemens Bros.) will be interesting to many who have been experimenting like myself. On page 203, after describing the usual form of Leclanché with zinc rod, Sabine says: "This form is, in some respects, convenient, although it displays, we think, a want of practical electrical knowledge on the part of the constructor, particularly in the relative dimensions of the two poles."

On the next page he says: "The resistances of the elements we have measured were unnecessarily great on account of the zinc pole being unnecessarily small—a construction the inventor, for some unaccountable reason, has preferred to the usual form." This subject is treated at length in "Niaudet's Batteries," a book which, in my opinion, if brought up to date, would be simply unique.

On pages 17 and 185 Niaudet says: "The fact was established by Wollaston when he encircled his zincs with copper that there is an advantage in single-liquid batteries in giving a greater surface to the conducting electrode than to the soluble electrode. The same reasons hold good for imperfectly depolarised batteries, such as that of Leclanché; it is seen how the inventor reduced the zinc to a small rod." Still, on page 183 it states (after giving the reasons which determined Leclanché in the choice of the dimensions given to the soluble electrode): "As no zinc is consumed while the circuit is open, there is no inconvenience in increasing its surface. Consequently, there is a means of reducing the resistance of a Leclanché cell by using a zinc cylinder instead of a rod, if in any particular instance it might be of advantage."

Reading the above, and having a great difficulty with a short bell circuit (one bell a vibrator, the other single stroke), I determined to try the advice given by Niaudet, of using a very porous cell, and completely encircling it with a zinc plate. The result far exceeded my expectations—in fact, from my point of view, the bells ring perfectly, although before the ringing was very faint.

I should state the two cells were in a place not only difficult of access, but permission to inspect them was refused, except at long intervals, so that it will be seen no other cell but the Leclanché was likely to answer. First of all, let me say (as I have many times previously) do not use a porous cell, especially a sealed one—they never work satisfactorily. Get a piece of open canvas, and sew the sides like a hose; then get a round piece of wood for the bottom, cut a groove round it, well soak it in paraffin, and then, putting the canvas over this, tie it tightly with waxed twine, well pulling it into the groove, and you will have a cell not offering one-hundredth the resistance of a porous one, and its pores will not easily be clogged. If they do, a swill in warm water will put all right again. The above plan is similar to that adopted by Grenet; but he made a mistake in using salt instead of sal-ammoniac, thereby losing the benefit of his improvement by changing the solution for a weaker one.

Niaudet's work gives excellent advice respecting climbing salts, agreeing with mine given on p. 435, Vol. XXXIII. "E.M." He says, page 98, "Climbing, however, can be avoided by proper care and attention. The manner in which these salts are formed is very easy to understand. In the beginning, either by a slight movement or otherwise, some of the liquid is thrown upon the sides of the jar. Evaporation causes the disappearance of the water, and leaves crystals. Immediately, capillary action sets in, either between the crystals and the side of the jar, or along the side of the crystals, and a small quantity of liquid thus rises above the general level. Evaporation again causes the formation of new crystals, which is facilitated by the thinness of the layer. This action continues step by step horizontally and vertically."

On page 186 is given Leclanché's reason for amalgamating the zincs — viz., to prevent the formation of crystals on them. Personally, I do not think this a question of importance, because I have had zincs wear just as long unamalgamated as amalgamated.

John J. Gilbert, A.S.T.E.
Birmingham, Aug. 16.

SODA IN CASES OF SCALDING AND BURNING—DISINFECTANTS.

[27774.]—I WAS struck with the recommendation of sodæ bicarb. for application to burns, contained in a recent issue of that marvellous emporium of information the ENGLISH MECHANIC, and very soon afterwards had an opportunity of putting it to the test of practice. My little daughter burned her wrist somewhat badly with a hot iron; I ordered rags constantly moistened with the bicarbonate solution to be applied. The soda, however, far from relieving the pain, greatly augmented it, and caused an appearance very suggestive of proud flesh, so that I was compelled to acknowledge that somehow or other the treatment did not suit the case, and to revert to the use of plain water. Can anyone suggest the cause? Soda was especially advised for "severe burns," so that I felt perfectly safe in prescribing it in this instance.

Can any brother reader explain the rationale of the ordinary disinfectants—chloride of lime, carbolic acid, lead nitrate, and "Sanitas"? Is the action of all similar?

Pemberton, Aug. 16. **T. Howard.**

[27775.]—AFTER sending in the letter on "Burns," p. 514 (27699), I went off to the country, and being beyond reach of the "E. M." did not see the letter of inquiry by "Acier" till my return; hence the delay.

The strength of solution which I have found to answer best is 1oz. of either soda or salts to one quart of cold water. If the burns or scalds are skin-whole, the solution can be used stronger; if the skin is broken and the patient complains of nipping, then add more water. But when the remedy is called for there need be no ceremony—prompt action at once. Throw a good handful of soda into a basin of cold water, dip in the cloths, and apply without delay, as in a minute or so the solution will be strong enough for use. Should the face, head, or neck be involved, keep the soda solution in use till Epsom salts can be got, as they are best for those parts. The advantages of these two remedies for burns and scalds may be summed up as follows: Ready to hand, safe to use, simplicity of application, real and entire freedom from pain, prevention of sloughing or waste of tissue, and preservation of skin, the result being that, no matter how extensive or complicated the burn may be, the cure is radical and complete in a very short space of time, with no hollows or cicatrices left behind, provided that the cloths are *always kept wet* with solution. I may as well mention at the same time that a solution of Epsom salts is the best dressing that can be applied to wounds or sores that are hard, inflamed, and painful, or sloughing; it not only gives relief from pain, but it quickly induces a healthy, healing action, stops at once all waste of tissue and destruction of skin, so that the wounds heal up with hardly a mark left behind. **Dens.**

NEW VOLTAIC CELLS.

[27776.]—I LEARN that Dr. C. R. Alder Wright, F.R.S., and Mr. C. Thompson, both of St. Mary's Hospital Medical School, have contributed to the Chemical Society some preliminary experiments on batteries, in which the electro-positive metal zinc is replaced by solutions capable of oxidation. The ordinary porous cell arrangement is used, and similar plates of carbon or platinum. The plate of lower potential—that is, the electro-positive plate or the plate replacing zinc—is immersed in the reducing, and the other plate in the oxidising solution. Steady currents are thereby produced, the energy of which will shortly be determined. Among the couples which have already been tried are the following. In each case we place the electro-positive first. 1. Sulphurous acid against chromic liquor (potassium dichromate and sulphuric acid), sulphuric acid and chromic sulphate being formed. 2. Sodium sulphite against alkaline potassium permanganate. Here sodium sulphate and hydrated manganese dioxide are formed. 3. Chromic hydrate dissolved in caustic soda against chromic liquor. Here sodium chromate is formed in one cell and chromic sulphate in the other. This is a particularly interesting reaction as the chromium in one cell is oxidised, while that in the other is reduced. By intermediate treatment the action of the cells might be made reversible. 4. Solution of potassium ferrocyanide opposed to chromic liquor. The ferrocyanide becomes ferricyanide according to the following equation: $6K_4FeCy_6 + 2CrO_3 + 6H_2SO_4 = 6K_3FeCy_6 + 3K_2SO_4 + 6H_2O + Cr_2(SO_4)_3$. 5. Solution of lead oxide in caustic soda against alkaline permanganate hypochlorite, or hypobromite. Here the lead monoxide becomes peroxide, which deposits in a solid form. Can any of your readers throw any light on this subject? **E. M. F.**

MAGNESIUM LIGHT FOR PHOTOGRAPHIC PURPOSES.

[27777.]—I NOTICE an article in your valuable paper of August 12 on the above subject, and as it is quite possible that accidents may arise from the use or manufacture of the formula given for the above purpose, I beg to point out the dangerous character of the combination.

First, then, the formula [illegible]
potash in conjunction [illegible]
highly detonating
second section of
The second

phosphorus, is of all compounds containing a chlorate the most sensitive, and detonates with great violence on the least friction, and is equal in violence to a fulminate; so that I have no hesitation in condemning the use of such unscientific and unnecessary combinations. The magnesium light can be produced with perfect safety from the powdered metal for photographic purposes, of a high actinic power, without the use of useless and dangerous chemicals, and my object in writing this letter is to warn the experimentalist who intends to adopt the formulæ, of the dangerous nature of both preparations, more especially of the destructive character of that containing the amorphous phosphorus, and classed by me in the first rank of detonants of the Fulminate class, to which the phospho-chlorate belongs.

Wm. Henry Browne,
Analytical and Consulting Chemist for Explosives.
The Laurels, Aldbrough, Hull, Aug. 8.

TEMPERING BY ELECTRICITY.

[27778.]—YOUR readers will be pleased to hear that a method of tempering steel springs by electricity has been recently adopted here by the Sedgwick Mainspring Co., and the following details will give an idea of the method adopted which has already met with much success:—In one part of the room stands what is known to the trade as a one-light dynamo. The conductors from the dynamo lead to another part of the room, to a bench on which stands an ordinary tempering bath. One of the conductors connects with a point within the oil bath, and the other to a point without. The piece of flat soft steel wire that is to be tempered to the blue colour is fed under the contact point on the outside of the bath first and then under the one on the inside. When it reaches the latter the circuit is complete, and the wire immediately and uniformly becomes heated. No means have been taken to measure the current exactly for the purpose of doing the whole work mechanically. The variation in the percentage of carbon in different pieces of steel forbids the delicate process of tempering from becoming a purely mechanical piece of work. Therefore, with the electric current as with a fire, the colour of the steel determines the length of time that it shall be heated. Several advantages are claimed for this process of tempering. The chief one is that the steel does not have time to oxdise after it has been heated to the proper colour before it is under cover of the oil, and consequently that the steel wire is of the same thickness when it is tempered as it was before it entered the process. The heating is uniform throughout the length of the spring, and there is less liability of defective spots. The process is a rapid one, the springs being heated and passed into the bath at the rate of four inches a second.

Chicago, Aug. 1. **Edwin Strong.**

USEFUL AND SCIENTIFIC NOTES.

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A SUBMARINE tramway is to be constructed in Normandy. It will run along the sands between the watering places of Deauville, Villers, Cabourg, and Houlgate during the bathing season, from July to October. The rails will be pulled up for the winter. These sands are dry at low water, so there will be little difficulty in making the tramway, which is to be driven by steam.

Lowe's Improved Window Sashes.—An improved arrangement of window sash has been recently patented by Mr. R. A. Lowe, of Chislehurst, by means of which the ventilation of a room can be secured without the creation of a draught, and yet the sash is securely fastened. When closed the window is air-tight; but when the lower sash is raised into the second position, a current of fresh air can pass freely between the meeting rails, and having an upward direction as it enters the room, cold draughts are prevented, while the apartment is sufficiently ventilated, the sash being at the same time fastened securely. The fastening for the lower sash is on the principle of the parallel ruler, and acts as a draught excluder when the window is closed. The upper fastener is automatic in action. A pull on one cord releases the catch, and the sash is then easily lowered by gentle traction on the cords, while the sash is returned and automatically locked in position by the reverse operation. It will be readily understood that by these arrangements the ordinary fastener on the meeting rails is dispensed with, and consequently the highest windows can be manipulated with the greatest ease. When it is desired to raise the lower sash in order that fresh air may enter between the meeting rails, an ivory button, with a horizontal line, indicates the position in which the fastener falls into the second slot and securely lo[illegible] window to be left [illegible] no risk

REPLIES TO QUERIES.

◆◆◆

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[62513.]—**Telephonic (U.Q.)**—What does W. Jackson want? He appears to have left out half his connections. Of course, his telephones cannot work so.—C. PROVIS, Emsworth.

[62517.]—**Reflecting Galvanometer (U.Q.)**—The following is from the last edition of Sprague's "Electricity":—"The coils are connected in pairs leaving four ends, which are connected to binding screws, so that if the coils are exactly alike and carefully adjusted, they may be used differentially. Fine wire (40) is generally used, and a R. of 8,000 or 10,000 ohms laid on."—C. PROVIS, Emsworth.

[62562.]—**L.N.W., S.E., and G.N. Locos. (U.Q.)**—(1) L.N.W.: "H.V." will find an interesting account of (No. 173) "Cornwall's" performances, by Mr. C. Rous Marten, in Vol. XLIV. No. 1,126, p. 172. I do not know any dimensions, except that she is a single engine with 8ft. 6in. drivers—the largest wheels of any loco. in the world. Doubtless you would find details in Mr. West's sheets. (2) S.E.R.: 202 on my list is an old single, built in 1862—drivers, 7ft. 1in. diameter; leading wheels, 4ft. 9in.; trailing, 4ft.; cylinders, 16in. by 22in. If 202 is now a bogie-express engine, she will probably belong to the 7ft. four-coupled class, with 19in. by 26in. cylinders. No. 154 and 158 belong to the 150—160 class, and have four-coupled wheels 6in. diameter; leading bogie with 3ft. 6in. wheels; cylinders, 18in. by 26in. diameter; of boiler, 4ft. 4in. (1) G.N.R.: No. 229 belongs to class 229—240; 7ft. singles; cylinders, 17in. by 24ft.; built by Kitson, Sharp and Stephenson. No. 235 also belongs to this class, and there are no 6ft. 6in. singles on the G.N. If you want details of the 7ft. 6in. singles, I can give them. (4) M.R.: No. 1,532 is, I believe, a four-coupled bogie side tank; coupled wheels, 5ft. 3½in. diam.; trailing bogie with 3ft. 0½in. wheels; cylinders, 17in. by 24in.; total heating surface, 1,219 square feet; 1,150 gallons in tanks; weight, 46 tons.—REYMOND.

[62658.]—**Kiln.**—Without doubt there is no floor so suitable for drying grain as the old-fashioned wove wire, the strength of which depends upon what class of work it has to do and the size of the floor. Don't think of cast-iron plates. I have taken up tons of them and replaced with wire with a saving of 30 per cent. in fuel. But what does "Malt" think about drying with the waste heat from boilers? If the querist will send further particulars, I will do my best to answer him.—KILN FITTER, Ware.

[62731.]—**English Language.**—We most sertainly kould dispense with C, even to spell Tshitshester Tshurtsh, and espeshally if we had, as all Europeans need, but all Asiatix enjoy I suppose, a letter for the quite simple and very kommon sound in most, if not all, tongues that we express by *sh*. Sutsh is Europe's poverty in the alphabetik line that Germans have aktually to kombine three letters, *sch*, wherever it komes. By an exaktly konverse absurdity, Russians have a single komikal konsonant always put for a triple kombination. The dish they kall "stshee"; they spell by two letters; this komikal one and *i*. As to the alleged large Keltik element in English, I find in a skrap from Boyle's *Chronology* this enumeration of sourses of our words, kounted in Johnson's Dixionary:

Saxon or original English	1,665
From Latin direkt	6,732
Through Frentsh	4,812
Greek (sinse mutsh inkreased)	1,148
Foreign Gothik or Teutonik—viz., Dutsh, Swede, German, Flemish, Iselandik, Danish, &c................	1,066
Italian (mainly kommershial)	211
Keltik (Welsh, Gaelik, Erse)	111
Spanish (mainly military)	56
Hebrew and Arabik......................	29
Total..................	15,830

—E. L. G.

[62694.]—**Distilling Whiskey—Sulphuric Acid.**—TO W. J. GREY.—H stands for hydrogen, dear W. J. G.; as a comical fellow you now pose, I see; S stands for sulphur—what a stink it can be; O stands for oxygen, 'tis as sour as thee; a tiny 2 was o'erlooked by that chap at Lydney.—THE LYDNEY DISPENSER.

[62694.]—**Distilling Whiskey—Sulphuric Acid.**—If sulphuric-acid beer is what its name describes it to be, i.e., containing free H_2SO_4, then the eminent authorities quoted by me must be regarded as—well, anything but gentlemen by people continuing to drink H_2SO_4 dilute, or else these people must be very regardless of their own bodies. Immerse a thin sheet of zinc, or of iron, in your dilute H_2SO_4. What happens? Destruction as a chemical body of either the metal or the acid. Now what takes place when the said acid is put into the laboratory of the human body?—THE LYDNEY DISPENSER.

[62767.]—**Mechanics.**—If Mr. J. Taylor would make his query just a little plainer, he might possibly obtain an answer. As it is, he has occupied space with an engraving, and asked a question which "no fellah" can understand. That is, by beating one's brains about it might be possible to guess at what Mr. Taylor means; but why should readers be expected to do that? However, if Mr. Taylor will kindly explain what on earth he means, I will see if I can help him.—NUN. DOR.

[62773.]—**Sundial.**—I hardly expected that the paragraph I posted here on Sunday last would appear in this week's issue; but such is the progress of science nowadays, or, as someone put it, "the annihilation of space." I am now tempted to add a few more remarks that may help those who are anxious to set up an inexpensive dial by means of which they can know the time of day to within 10 or 15 seconds of the truth. I know that since the electric telegraph came into general use the time is usually got from the nearest office, still I am sure there are many who would rather receive the intelligence direct from "Sol" himself than secondhand from Greenwich. The only difficulty that presents itself is the erection of a stile or gnomon. A very simple and excellent gnomon may be made of a piece of telegraph wire drawn tight between two studs fastened to a wall—the indicating line not being either side of the wire, but its centre, which the eye can at once ascertain. Now, suppose you want to set it up against a wall having a southern aspect, drive a long stud of bar iron into the wall. Let it be strong, so as not to bend with the strain to be afterwards exerted on it by the tension of the wire. This stud to have an eye at the top, through which the end of the wire is to pass. Now to find the position of the eye of the stud, above, which, of course, is to be nearer to the wall, if not actually on a line with it. There is the rub. Observe where the shadow of the top of the long stud strikes in the morning. Mark it with a pencil, again about four hours after, and again about four after that. Now procure reel thread, or, better still, fine wire. Connect the point of the stud with each of the points where its shadow struck at the above intervals. Then, like a diligent spider, find three points on the said threads equidistant from the top of the stud, say 2ft. distant from it. To these three points fasten three other threads of equal length, say 3ft. each. Bring the other ends of these last threads to meet. The point where they meet is the point sought. Join this by a straight line with the top of the stud, and you have a line "parallel to the earth's axis." In this line, or parallel to it, strain the piece of telegraph wire, and the gnomon, or stile, is complete in a style cheap, original, and easy of accomplishment.—D. DOYLE.

[62777.]—**Drawing.**—"Young Machinist" can obtain elastic webbing fine enough for his purpose—or rather for what I imagine his purpose to be, as he does not give very definite information; but he cannot obtain anything that will stretch "only one way." If he would say what it is he wants to achieve, no doubt some of your readers could help him? At present he seems to be in "Fogland."—BICONVEX.

[62781.]—**Electro-Motor.**—Why not apply to Prof. Ayrton or Prof. Perry, if the description in Prof. Thompson's book is insufficient? Plenty of electro-motors have been described, down to the minutest details, in these columns, and there is quite enough information in Thompson's books for anyone who does not want somebody else to do the work for him.—E. G.

[62785.]—**Green Japan.**—Is "green japan" anything more than a "green" pigment ground up and mixed with stoving copal? It may be: I don't know; but if I were "J. C." I should try a few experiments. He says it is to "dry in the oven," and presumably he knows; but I guess that the "varnish green" which is used to paint locomotives with may suit him, and he can get that at any colour-shop where the business is understood.—NUN. DOR.

[62788.]—**Enlarging Lantern.**—This querist will find a variety of methods of making enlargements by referring to back volumes. If he really cannot see them, and will state definitely what it is he wants to do, I will see if I can help him. At present his query is a nice "confusion."—NUN. DOR.

[62806 & 62939.]—**N.E. and G.E. Compound Engines.**—I send two sketches and a description of Mr. Worsdell's patent starting gear; they are taken from *Engineering* for June 17. Referring to the drawings, it will be seen that the principal features are the starting valve D, Fig. 2, and the intercepting-valve H, Fig. 1. The latter is a flap-valve, and is situated in a chamber formed in the exhaust pipe from the high-pressure cylinder, the

Fig. 1

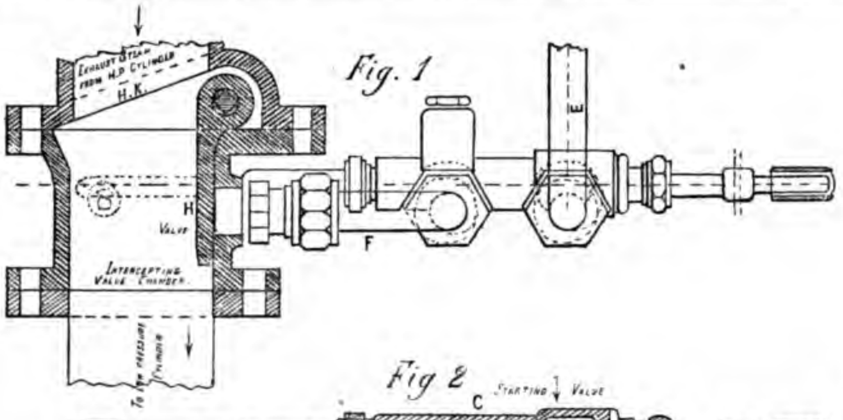
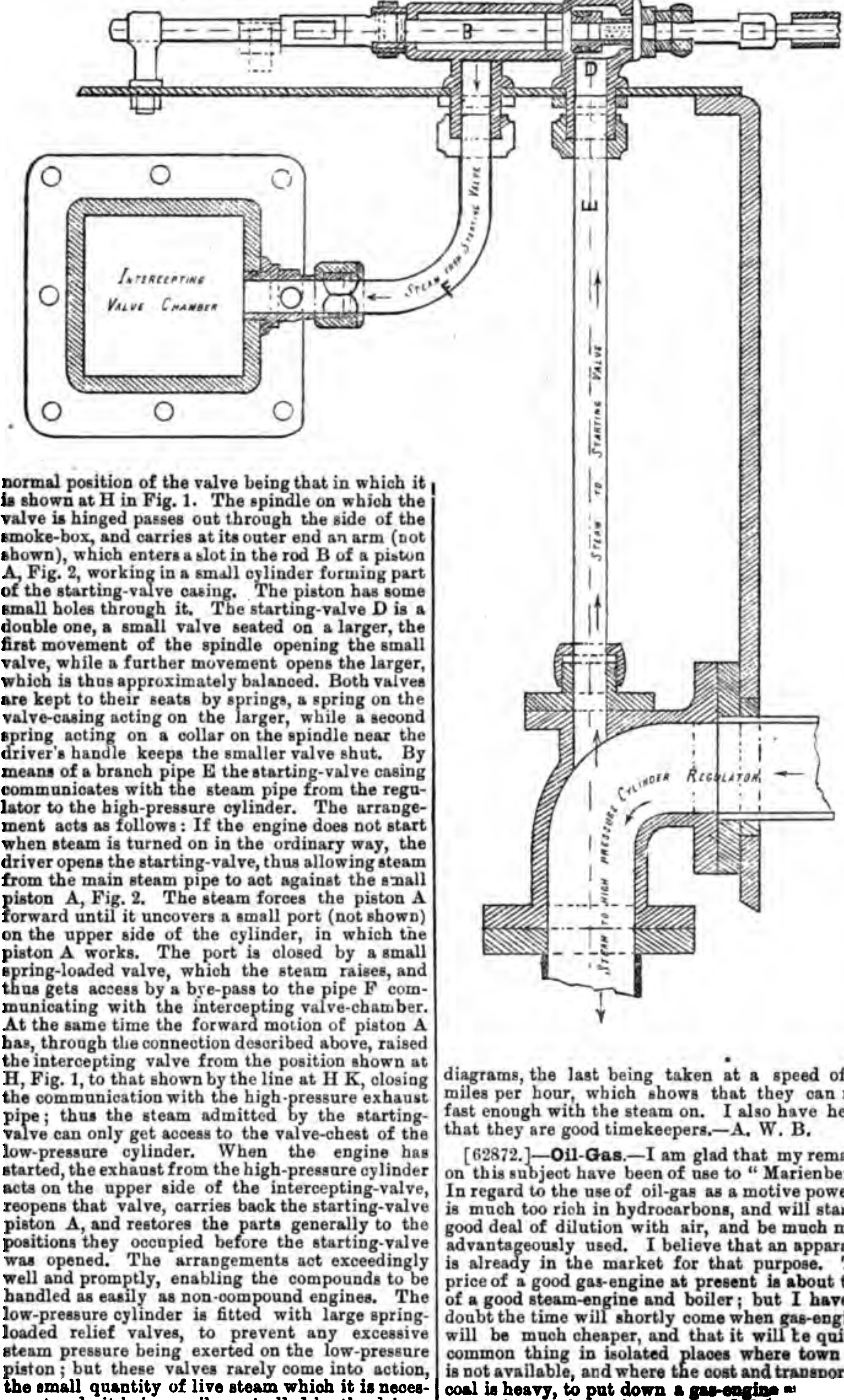


Fig 2


C
Starting Valve
B
D
E
Intercepting Valve Chamber
Steam from Starting Valve
Steam to Starting Valve
Cylinder Regulator
Steam to High Pressure Cylinder

normal position of the valve being that in which it is shown at H in Fig. 1. The spindle on which the valve is hinged passes out through the side of the smoke-box, and carries at its outer end an arm (not shown), which enters a slot in the rod B of a piston A, Fig. 2, working in a small cylinder forming part of the starting-valve casing. The piston has some small holes through it. The starting-valve D is a double one, a small valve seated on a larger, the first movement of the spindle opening the small valve, while a further movement opens the larger, which is thus approximately balanced. Both valves are kept to their seats by springs, a spring on the valve-casing acting on the larger, while a second spring acting on a collar on the spindle near the driver's handle keeps the smaller valve shut. By means of a branch pipe E the starting-valve casing communicates with the steam pipe from the regulator to the high-pressure cylinder. The arrangement acts as follows: If the engine does not start when steam is turned on in the ordinary way, the driver opens the starting-valve, thus allowing steam from the main steam pipe to act against the small piston A, Fig. 2. The steam forces the piston A forward until it uncovers a small port (not shown) on the upper side of the cylinder, in which the piston A works. The port is closed by a small spring-loaded valve, which the steam raises, and thus gets access by a bye-pass to the pipe F communicating with the intercepting valve-chamber. At the same time the forward motion of piston A has, through the connection described above, raised the intercepting valve from the position shown at H, Fig. 1, to that shown by the line at H K, closing the communication with the high-pressure exhaust pipe; thus the steam admitted by the starting-valve can only get access to the valve-chest of the low-pressure cylinder. When the engine has started, the exhaust from the high-pressure cylinder acts on the upper side of the intercepting-valve, reopens that valve, carries back the starting-valve piston A, and restores the parts generally to the positions they occupied before the starting-valve was opened. The arrangements act exceedingly well and promptly, enabling the compounds to be handled as easily as non-compound engines. The low-pressure cylinder is fitted with large spring-loaded relief valves, to prevent any excessive steam pressure being exerted on the low-pressure piston; but these valves rarely come into action, the small quantity of live steam which it is necessary to admit being easily controlled by the driver. I forgot to mention in my last reply (p. 519) that the crank axle is of a special pattern, designed by Mr. Worsdell, to enable it to be entirely finished on the lathe, the webs being circular discs 1ft. 10in. in diameter, placed eccentrically on the crank-shaft. I have never travelled behind a G. E. compound myself, and know nothing of their powers *of running* downhill; but, in the paper I have *quoted from, there are a series of* indicator diagrams, the last being taken at a speed of 65 miles per hour, which shows that they can run fast enough with the steam on. I also have heard that they are good timekeepers.—A. W. B.

[62872.]—**Oil-Gas.**—I am glad that my remarks on this subject have been of use to "Marienberg." In regard to the use of oil-gas as a motive power it is much too rich in hydrocarbons, and will stand a good deal of dilution with air, and be much more advantageously used. I believe that an apparatus is already in the market for that purpose. The price of a good gas-engine at present is about that of a good steam-engine and boiler; but I have no doubt the time will shortly come when gas-engines will be much cheaper, and that it will be quite a common thing in isolated places where town gas is not available, and where the cost and transport of
coal is heavy, to put down a gas-engine a
retort (to supply motive power and lig
ings) as being more economical
engine; indeed, I believe it to
moment. As "Marienberg"
me the kind of oil which I
and giving a yield of 30,0
giving names, that I r
prices of the Scotch oil
from 2½d. to 3d. per gall
from £2 15s. to £3 4s. I

as an average price; I may, however, here
Scottish oil market is now getting into a ra
settled state in consequence of the strik
men and an attempt on the part of the co
to form what may be termed an "oil r
keep up the prices. I do not think
movement will meet with success, as
mense amount of crude oil, refined
paraffin scale, of which large quantities are
from America and elsewhere, and the
solid paraffin) made into candles in this
will not allow the prices to rise. As to th
oil, the Scotch companies now make an oil
for gas making, this being what is called
treated" oil, of a specific gravity about 85
oil is of rather a dark colour, but by tr
with acid, &c., and redistilling, an oil of g
colour is obtained. But as the colour
making is of no value, the treatment is b
undone. A heavier oil, about 900, also
for gas making, was, up till lately, pro
such quantities that a market could not b
it at a very low price. I believe that som
companies now dispose of it by splitting i
a lighter burning oil and a still heavier
quoting £3 as the price, I thought that "
berg" would require oil in such quantities
would buy direct. But if it has to filter
several hands before reaching him. I have
the price will be much higher. As to yie
per ton, in my last letter I quoted Dr. M
figures as giving 32,492ft.; so that in givi
I did not stretch the figures. The yiel
and also quality of gas produced, owing t
retort used and the way in which the
tributed over its surface; but it is quite a
thing to produce 100ft. of gas from 1gal. of
even taking "Marienberg's" yield as 21,51
oil at £4, this would only bring the gas per
5s. 3d., which would still show a considerab
over coal-gas. I also notice Mr. T. B.
letter on this subject. I should not ha
remarks on his letter, but he made seve
ments of such glaring inaccuracy that
allow them to pass unnoticed—all the more
gives them as one having experience in thi
In the first place, he says, "The illu
power is not four times that of coal-gas;
extravagant exaggeration." I may ans
that depends on how you look at it. Ordin
gas as supplied to most towns in England
14 to 16 candles, with an exception here a
Now, I can quote authorities on this
show that well-made oil-gas is from 54 to 6
one even making it 64. I must say that I
fail to see where the "extravagant exagg
comes it. I put it myself at the very
estimate of three times of that of average
I also entirely object to his comparison of
electric light. Both coal and oil gas have
often treated by thoroughly competent
have any mistake made about it, while th
light has not. I quite agree with him,
that the electric light is much over-rated.
of so-called 2,000 candle-power has come
anything from 200 candles up to somethi
great deal than 2,000. I have many
produced more light from an oxy-
mixed jet of about 400 candles tha
from any of dozens of 2,000 candle lamps
can see burning every night. He then s
gas is about two-thirds more illuminati
coal-gas." This is an exceedingly poor
Take, say, eighteen-candle coal-gas. A
thirds to it (12), this makes it equal 28
This is perfect rubbish, and no estimat
seen of the light of oil-gas has been less
double of 28, the only exception being
from crude oil, where the light is put
candles. As Mr. Fowler states, he is usi
oil. This may in some measure explain
not entirely. He also says, "If you can
crude petroleum, it will be better and
This is another mistake. Crude oil neit
as rich a quality of gas, nor such a qua
it as the refined oil, nor is it cheaper in
run. The explanation of this is very
Crude oil contains a great variety of
matters from the lightest naphtha of specifi
from 680, and which will boil at less tha
and ranging through all the oils of
densities up to solid paraffin and tarry
Now, in making oil-gas the retort has to
proper heat to suit the density of the
used. If it is too hot, the gas comes o
very poor quality, or in what may be
burnt state, and is of no use for lightin
other purpose. If good gas is a
[illegible] simply dilutes the g
This is exactly th
[illegible]

paraffin, and tarry matter, and gives when brought over at a proper heat a gas of first-rate lighting power and more of it. As the subject of oil gas-making is at present a very progressive one, I am afraid Mr. Fowler's experience is very far behind, and the sooner he gets it brought "up to time" the better. I am, however, thoroughly at one with him as to the great future for oil-gas.—ROSARIO.

[62898.]—**Medical Electricity—Deafness.**—"Eos" is not the first Indian Nabob I have had to pull up on his haunches. He should consider that probably the sufferer is not in a position to incur the enormous expense of "nothing but the very best electrical treatment by an expert," and which said expense my own personal experience (for which I resided in London a whole year) justifies me in saying is generally of no permanent value whatever. Can "Eos" produce any one medico-electrical expert who will undertake such a case as 62898 refers to, extending over several months' treatment, upon the "no-cure no-pay" principle? This is the crucial test. The sufferer may have lost time. "Eos" counsels him now to lose much money—and more time also, according to the experience of—THE LYDNEY DISPENSER.

[62900.]—**Blistered Feet.**—At a game-dealer's shop get some stag's suet, melt it, cast it into any convenient shape, and keep it for use. To use it, melt a little in an iron spoon and dip into it a bit of soft, old, clean rag, apply it on the affected part and put on your stocking; you will be able to walk at once; the blister will soon heal, harden, and fall off with bathing. Tried and warranted.—NIMROD.

[62900.]—**Blistered Feet.**—Put a dock-leaf next to the sole of the foot inside the sock. This will prove both a cure and a preventive. To cure mal-odorous perspiring of the feet, wear at night the socks or stockings that have been used during the day. I have known the above remedies succeed perfectly. The latter was recommended by a medical man. Bathing the feet in chloride of lime and hot water will check the perspiration, and remove odour without injury to the constitution. This, too, was the advice of a regular practitioner.—G. A.

[62901.]—**Rolled W.I. and Steel Joists.**—In reply page 590, in the formula for deflection and what follows, "2 S" should be "2 A."—J. S. C.

[62911.]—**Circular Cutters for Lathes.**—I hope R. B. Hodgson will tell us more about these. How does he grind the little cutters he illustrates? How are those with round edges as for fluting rymers made, and how ground?—F. A. M.

[62912.]—**Dissolved Bones.**—Bones can be dissolved by proceeding in the following manner:—Provide a wooden trough, 12ft. long, 4ft. wide, and 1½ft. deep. Protect its interior from the action of the acid by a coat of pitch. Spread over the bottom of this vessel the bones to be vitriolised, and add about one-third their weight of water; next pour uniformly over them half their weight of brown acid, or one-third their weight of white acid; mix quickly with a wooden spade, and let the mixture stand for three days, stirring three times a day. The manure may then be removed to a covered yard and kept until required, which should not be for a month or two at least. Bones which have been boiled are most easily dissolved, because they have been deprived of a great part of their organic matter. I think that "The Lydney Dispenser" is wrong in stating that the rains soon carry superphosphate out of the soil, as it has been proved that the roots of our cereal and other crops go a great depth into the soil in search of food, and also the soil has the power of retaining substances useful to plant life. I further disagree with the "Dispenser" when he assumes that plants only take "homœopathic" does of phosphorus calcium and ammonia, as wheat, beans, flax seed, red clover, cabbages take up large quantities of P_2O_5 and CaO_2. They also use large quantities of NH_3, which they get both from the air and in solution in the soil.—PERTHSHIRE CHAP.

[62920.]—**Tomatoes.**—TO MR. BOTTONE.—First, the tomatoes must not be peeled; the bottles must be filled to the neck with water which has been boiled and cooled; a thin layer of the best olive or poppy oil is all that is needed, and as this is much lighter than the water, it swims on the top and can be jerked off when the bottle is opened. Salicylic acid is not required.—S. BOTTONE.

[62920.]—**Tomatoes.**—The following is a very good recipe for preserving tomatoes, and is not much known in England, I believe:—Break up he tomatoes in pieces, which squeeze well to ex- et as much seeds and water as possible. Put in arge jar with about a tablespoonful of salt to each d of squeezed tomatoes. Stir now and then a wooden spoon. Next day rub through a a colander. Put the pulp in a clean is well worn, but without holes. Tie to two chairs, put a dish under, and until no more water runs out. This will take probably till next day, then very carefully, and with a teaspoon, put the tomato paste into small glasses to within an inch of the brim. This paste, being exceedingly light, is very difficult to pack on account of air-balls forming as you keep adding. Fill the remainder of the glass with sweet olive-oil, tie a clean rag, not paper, over each glass, and keep in a dry place. This paste goes a long way, and retains the colour and flavour of the fresh tomato.—BLANCHE.

[62924.]—**Steam**.—In a heat-engine, the proportion of heat used, if a perfect engine, is represented by the fall of temperature from generator to condenser divided by the total heat of generator—all reckoned from absolute zero, which is 461° below the zero of Fahrenheit's thermometer. This probably will explain how I get the 461° + 300° = 761°. The actual efficiency of engines is something like 0·17 in a good engine, but more commonly only 0·12. No, the 32° is included in all the temperatures. The correction I gave last week is again wrongly printed; but as you do not appear to want this, I will let it pass.—T. C., Bristol.

[62926.]—**Mechanical Die-sinking.**—It may be of interest to know that some such device exists in the South Kensington Museum.—SHINY BOOTS.

[62930.]—**Literature.**—"Abbeys, Castles, and Ancient Halls of England and Wales," by John Timbs (not Timms) and Alexander Gunn, is published by Frederick Warne and Co., Bedford-street, Strand, London. The work is in three vols., crown 8vo., price 6s. each. It contains much useful and valuable information concerning the history and legendary lore of all the principal ancient edifices in England and Wales.—ORION.

[62931.]—**Caister Castle.**—Caister (not Caistor) Castle was built in the year 1450 by Sir John Fastolfe, the head of an ancient and very powerful Norfolk family.—ORION.

[62932.]—**"Problem" Engine L. & N.W.R.**—L.N.W. "Problem," No. 184, is a 7ft. 6in. single. Chief dimensions: Cylinders, 16in. by 24in.; drivers, 7ft. 7½in. diam.; leading wheels, 3ft. 9½in.; trailing, 3ft. 9in.; wheel-base, 15ft. 5in.; heating surface, 1,098sq.ft.; weight, 27 tons; the tractive force is only 68. I should be much obliged if anyone would give a complete list of this class.—REYMOND.

[62937.]—**Faulty Electric Bell.**—I once had an electric bell handed over to me to discover what was wrong with it. The owner had spent a long time in endeavouring to discover the fault, and had actually, in despair, handed it over to a friend, who, in his turn, handed it over to me. Two minutes was enough for me; the wire was simply broken off close to the contact screw, and a few seconds sufficed to put it right; but, although they had unscrewed all the parts, &c., they never discovered the flaws.—R. A. R. BENNETT.

[62937.]—**Faulty Electric Bell.**—In such a case as this, one can hardly tell what is the trouble without inspecting the bell. Perhaps the set-screw has worked loose, and is not in contact with the spring of the armature, or the platinum has come out and is therefore not making a good contact. Are you sure that the wires are not broken which connect the magnets together and the terminals?—W. GILLETT.

[62937.]—**Faulty Bell.**—Clean the contacts and binding-screws, and see that the s.c. wire does not touch iron frame, except where screwed down to it; if it does not then ring, the wire is broken, and must be soldered.—C. PROVIS, Emsworth.

[62955.]—**Photographic Developing Troubles.**—Does not "H. W." over-expose his plates? and why does he not stick to one kind of plate and one kind of developer and try various exposures with the same lens, stop, and subject until he gets a good result with the proper exposure, upon which success mainly depends? With proper exposure, and the simple directions given with each box of Ilford plates, it is simply impossible to fail. The error is most commonly on the side of over-exposure; but anyone who uses Cartwright and Rathway's systematic exposure book will find much difficulty at once removed. Amateur photographers' work would be much simplified if the sensitometer number of each batch of dry plates were marked on the boxes containing them, and it is to be hoped that this will soon be done by all makers. I have found no difficulty with any makers plates and any developer, provided the exposure be correct. The ammonia developer, perhaps, gives most command over ill-timed exposures; but the carbonate of soda, with no potash, gives as good negatives, and has not the objection of the ammonia fumes. It is difficult to understand how it is possible to fail if you follow the simple directions and give correct exposure. A little ammonic bromide solution gives intense negatives with the soda developer, with the Ilford, or any other plate. The greenish scum "H. W." complains of is probably what is known as green fog, which appears to be most likely to occur with under-exposed plates and a forced development with ammonia; I have found it seldom occur with the soda. "H. W." will see all about this in Abney's "Photography with Emulsions," third edition, page 200. No photographer who wishes to know all about the processes he makes use of should be without this book.—J. G. S.

[62958.]—**Una Boat.**—I give dimensions of Una taken from "Yacht and Boat Sailing." "F. E. A." will be able to reduce them by half, which will give a craft 7ft. 9in. by 3ft. 3in. I have sent to the "E.M." office small tracing; also body plan, reduced in the proportion named, from which moulds can be made.* It will not be necessary to steam the planks, as $\frac{3}{16}$in. or ¼in. stuff will bend with ease if cut the right way of the grain. The timbers or ribs may be steamed or boiled—either will do—if not cut from oak or ash natural bends. Mahogany is the best for planking, but is expensive. Spruce, fir, or yellow pine will do well. Oak or ash ribs: oak, mahogany, or elm stem and stern posts and transoms; pitch-pine keel, straight grained and without knots, or yellow deal if expense be an object; spruce or yellow pine spars. Carvel build is, I think, easier than clinker, for bad seams can be made good when caulking; but this requres at least ½in. and ⅝in. plank. This would make a 7ft. 9in. Una excessively heavy. I should, therefore, advise clinker with $\frac{5}{16}$in. or ⅜in. plank, if of the softer wood, or ¼in. mahogany. Dimensions of 15ft. 6in. Una boat: Length extreme, 15ft. 6in.; beam extreme, 6ft. 6in.; keel sided (width) amidships, 4½in.; keel sided (width) fore-end, 2in.; keel sided (width) after-end, 2in.; Moulding (depth) of keel, 4in.; floors sided, 1in.; floors moulded, 1½in.; timbers sided, 1in.; thickness of plank, ⅝in.; thickness of top strake, ¾in.; mast deck to hounds, 14ft. 0in.; boom, 15ft. 6in.; gaff, 7ft. 6in.; luff of main-sail, 9ft. 9in.; foot of main-sail, 15ft. 6in.; head of main-sail, 7ft. 0in.; leach, 17ft. 8in.; tack to peak earing of main-sail, 16ft. 0in.; clew to throat earing of main-sail, 17ft. 0in.; centre of mast from fore side of stem at load-water line, 2ft. 0in.; diameter of mast at deck, 4½in.; diameter of mast at hounds, 2½in.; weight of displacement (approximate), 14cwt. No. 1 section is 1ft. 3in. from fore side of stem. All others are 2ft. apart, but No. 8 (transome), which is 2ft. 3in. from No. 7. Any other information I possess is at "F. E. A.'s" service.—GOLDEN SLIPPERS.

[62964.]—**Tricycles.**—The "Quadrant," like other tricycles, will throw you out if you take a corner too fast; it is, however, very free from vibration.—PROVIS, Emsworth.

[62965.]—**Cycle Lamps.**—I find colza 2, paraffin 1, burn well with a soft wick. A spiked or toothed piece inside the wick-holder prevents the wick from shaking down; but a violent jolt will sometimes put out the most perfect lamp.—PROVIS, Emsworth.

[62965.]—**Cycle Lamps.**—Try the best colza oil, and add a dessertspoonful of turpentine to half a pint.—A. RIDER.

[62968.]—**Bracing Climate.**—Would not Tonbridge, Kent, suit the querist—though his conditions are rather too much, I fancy?—E. G.

[62968.]—**Bracing Climate.**—"Ubique" should try Mansfield, Notts; 14,000 inhabitants, very bracing air, and healthy. Two good middle-class schools—boys and girls. The situation is open to the Yorkshire and Scotch Moors on the North, and quite shut off from the influence of the Gulf stream by hills on the West. Bleak in winter, but not too humid.—PONTO.

[62968.]—**Bracing Climate.**—The two limits as to population is a poser; sites for towns in England were chosen on streams, and not for commanding views, nor for bracing air. Malvern is probably the most eligible, and has A1 schools for young ladies, sir!—not girls. Clifton, Bristol, stands well; but if the dread of population item is a *sine quâ non*, why not try this locality (I can receive "Ubique" for a few days)?—an hour from Bristol, where pupils go by train as weekly boarders on Monday mornings for 2s. Chepstow is a locality fast becoming popular, but has no first-class schools. Leamington, Cheltenham, Bath, and Winchester will give to "Ubique" ample choice, and the young ladies society—a factor "Ubique" will have to consider some day.—DISPENSER, Free Dispensary, Lydney.

[62969.]—**Pendulum Indicator.**—You must have made a very fair contact between two wires which should not touch each other. See that none of your wires in indicator touch. Induction would not do it. Draw all staples with more than one wire under them, and staple up again separately.—C. PROVIS, Emsworth.

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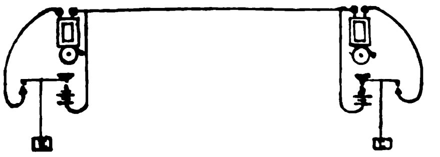
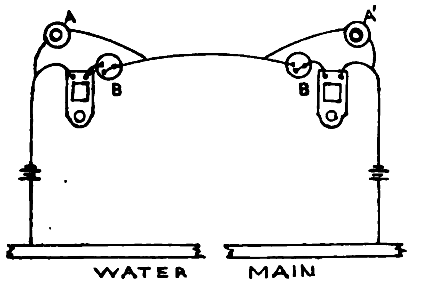
* "F. E. A." can have these by sending two stamps and name and address; but it is against our rules and gives trouble, and we should not do it but that "Golden Slippers" has been at some pains to make the plan, and it is too large to reproduce. We wish, though, correspondents would read our "Hints."—ED.

[62971.]—**Electrical.**—The sketch I send explains itself. You cannot do better than use insulated G.P. copper wire, taped and tarred, and



drawn into lead piping, which may be used as a return; this may be procured of any electrical engineer.—W. PERREN-MAYCOCK.

[62971.]—**Electrical.**—The general way of laying wires underground is of placing the wires in wooden troughs, or, as is now more often the case, in galvanised iron pipes. Of course the wires are well covered with insulating substance; such wires are made purposely for such work at 3d. or 4d. per yard. You can connect up the wire and bells so as to use but one wire with the press button and switch at each end. I inclose rough sketch to show



connections. A A' are the two press buttons, B B' the switches. When the switch B' is closed and switch B open, the bell C' will ring on the button being pressed at A, and when B' is open and B closed, the bell C will ring.—W. GILLETT.

[62980.]—**Engine Conversion.**—Thanks to "T. C., Bristol," for his reply; but the present cylinder would be high-pressure, and the low-pressure cylinder would be 4in. by 4in., which I have no difficulty in fixing. Boiler is 2ft. 6in. by 1ft. 6in., ¼in. thick, which is strong enough for 60lb. or 65lb. What I want is more power without increasing size of machinery. What H.P. should I get from this? and oblige—AN AMATEUR.

[62985.]—**Battery Plates.**—File them to shape with a coarse file, then lay them in a flat dish with a little dilute sulphuric acid (water 8 parts, pure acid 2 parts), and rub rapidly over with an old brush and mercury. Rinse in running water, and rear up to dry.—S. BOTTONE.

[62989.]—**Bicycle.**—Take two flat, oblong pieces of iron about ¼in. thick, place together and drill series of holes corresponding with size of spokes to be used up between the two plates, then well countersink, the spoke to be headed is placed betwen the two plates and then in vice; use ball-pened hammer, and you will find no difficulty in heading spokes. To draw off keyed cranks take two stout iron or steel plates—say, ⅜in. thick and 5in. by 2½in.—one of these must then have a slot cut in the centre of side to allow it to fit in behind crank and on axle; the outside plate is then secured to it by two bolts (one at each end) till the two plates firmly embrace the crank and the bolts are in line with centre of axle; a ⅜in. hole should previously have been tapped in outside plate exactly in centre, and fitted with hardened steel screw, pointed at end; in order to draw off crank it is only necessary to centre this screw on axle end when a few turns will pull all off together; by this means the key is not damaged, and may be replaced by merely hammering home. To build up a wheel it is simplest to start with, say, eight spokes (in four pairs), arranged at opposite diameters; with these get the wheel approximately true, and then add the rest; but do not put tension on until you get all in place, and then by very small degrees work round. It will much facilitate matters if you have a couple of wooden uprights to take the size of wheel required and by cutting V-slots in top, mount the wheel by its axle, as though running between forks; by repeated spinning and marking with chalk you will get a perfect circle; then, lastly, work up the lateral adjustment, being careful not to interfere with the truth of circle. To remove broken spokes by the ordinary method is a tedious operation, requiring much skill and care; it is effected by first drilling a hole down the centre of broken spoke without injuring the thread in hub, and then tap some square-ended instrument into it *by which the spoke* may be turned out. I have just patented a tool for this purpose and also for drilling new hubs, which takes any size wheel and requires no skill in working; it will be on the market shortly, and shall be glad to give further particulars if he will forward his address.—T. H. HAWLEY, Malton.

[62989.]—**Bicycle.**—Get very mild steel for spokes; cut to length and straighten; put in good vice; rivet head on with a small hammer; then get a bit of flat steel, drill hole size of spoke and counter-sink; put spoke in, and give one or two blows with hammer, and it is finished. But my advice is buy them ready-made, any size, at 3d. per pound. For getting keyed cranks off, get some 1in. by ¼in. iron, and make a link 1½in. long and 1in. wide inside; then get 4in. of ⅞in. square and punch a hole ½in. from one end, and tap it $\frac{7}{16}$in. Get 3in. of $\frac{7}{16}$in. round steel, punch a hole through one end for ⅜in. punch, screw it, and harden the end, and screw it in hole in ⅞in. square. To take crank off, take the pedal off, slip the link on the crank, and slip the ⅞in. square in the link with the end of steel screw against end of axle; place link as near axle as possible; drive a bit of iron packing in between ⅞in. square and crank to fasten it; then place a long punch in hole in screw, and turn away, and your crank is off in two or three seconds. I take dozens off. To refix them, make steel key a nice driving fit, drive in with a small hammer, and hold a striking hammer at opposite end of axle; drill old spokes out with a long Archimedean drill. It is the only drill that I know that will get in between the spokes. To true wheel, turn bicycle over, revolve wheel, hold chalk at top of forks, until it touches side of rim; tighten spokes on opposite side; repeat same at other side until true. For tapping holes, get some good steel wire, turn a ring 1$\frac{1}{8}$in. diameter at end, and cut off 5½in. long, screw ⅜in. of end; file three flat sides, and lead the end in; harden and temper to nearly purple. You will find them more useful taps than you can buy. I prefer Stubbs's screw-plates to any in the world. I have screwed thousands of steel spokes in one hole, and it cuts as clean a thread as when new.—WM. TAYLOR.

[62990.]—**Carbonic-Acid Gas.**—Is this querist serious? Surely he knows that aërated waters are charged with carbonic acid, and that the manufacturers adopt any system which may happen to be cheapest in their district. Some use whiting, some chalk or marble chips, with sulphuric acid; others use hydrochloric acid and any cheap carbonate; but the question of cheapness obviously depends to a certain extent on whether you can sell the refuse for anything, or have to cart it away yourself. As a rule, hydrochloric acid and marble chips or chalk give the best results.—NUN. DOR.

[62990.]—**Carbonic-Acid Gas.**—About the cheapest way to obtain this gas is to generate it from a mixture of diluted sulphuric acid and chalk. Hydrochloric acid is better, but is rather more expensive. The first method is the one used by manufacturers of aërated waters. It can also be made by burning coke or charcoal in a free current of air, but it will be contaminated with SO_2, &c.—PRINCIPIA.

[62990.]—**Carbonic Acid.**—It is a pity that "Carbon" did not give some idea as to what he means by "rather large quantities." Pieces of marble and dilute commercial hydrochloric acid would be the best materials for obtaining the gas for experimental purposes, and the cost would be very small. Some years ago I was connected with a manufacturing company who used the gas largely in their business. They made it from chalk and sulphuric acid. A few hundredweights of chalk were placed in a large wooden receptacle shaped like a huge barrel. The acid was raised and gradually added to chalk, by means of a leaden Archimedean screw, kept turning by engine. The gas was stored in gasometer over water. I suppose they found this method the cheapest; but it is certainly not the best—the product, sulphate of lime, being insoluble, and therefore a great nuisance to clear out. How do soda-water manufacturers make their gas?—KENSINGTONIAN.

[62991.]—**Electrical Measuring Instruments.**—I shall be happy to lend you one of my 2s. 6d. Ohm coils, if you will advertise your address, or write to me. See Sixpenny Sale Column. —S. BOTTONE.

[62992.]—**Measurement of Field.**—Quite impossible to give the area of any figure (except a circle or square) from one dimension. In the case you name, if it were known the field was exactly square, it would be then possible and easy to give the area, but not otherwise.—T. C., Bristol.

[62992.]—**Measurement of Field.**—If the field mentioned by "Castletown" is a square one, then the diameter 300 being given, $300 \div \sqrt{2}$ will be length of each side, and $\frac{300^2}{2}$, or 30,000 square units, say yards, will be the answer. If the field is not square it will be necessary to measure its boundary lengths, then by dividing the field into imaginary triangles, finding the area of these, and adding up, the total area will be found.—W. H. WINNY.

[62992.]—**Measurement of Field.**—Given the diagonal of a square field, you can easily find the area by squaring the diagonal and dividing by 2. In your case $(300)^2 \div 2 = 45{,}000$. This follows from the fact that the diagonal of a square is always $\sqrt{2}$ times the side; therefore side of a square is diagonal $\div \sqrt{2}$. But to find area of square, you square the side—that is, $(D \div \sqrt{2})^2$, or $D^2 \div 2$. This method is not applicable to any field which is not a square.—REYMOND.

[62994.]—**Repairs.**—As you undertook no repairing, you are not liable to make good any damages caused by damp from outside or from ordinary tear and wear.—B.SC., Plymouth.

[62995.]—**Lawn Tennis.**—If a player attempts to return the ball, but misses it altogether, and it drops beyond the external boundary line, the stroke counts to him, just the same as though he had not attempted to return it. See Cavendish on "Lawn Tennis," p. 17.—R. GILL.

[62995.]—**Lawn Tennis.**—In playing tennis, if the ball goes out of court during the game, it counts a point to the opponent of the one who sent it out. The fact of attempting to strike it does not alter this rule in the least.—E. E.

[62995.]—**Lawn Tennis.**—The fact of the ball going out of court scores against your opponent, no matter whether you tried to take it or not; but if it touched your racquet or any part of your body, it would score against you.—PHOONGYE.

[62997.]—**Glass-Working.**—"R. S." is quite correct in his description of the apparatus as seen at the Manchester Exhibition. Ordinary coal-gas is generally used, coming through an oblong opening covered with wire gauze; the nozzles may be of glass tube or brass. Practical glass-blowers make these of small glass tube, drawn to a point, the point of blowpipe being bent down over the gauze by a jointed pipe till in a suitable place to produce blowpipe flame. The blowpipes may either be opposite each other or two or three placed together, as suits the work. The point of glass tube should be pointed along, and not across, the gauze opening. A Fletcher bellows does well to supply air through; practical glass-blowers use a foot-bellows and a water pressure.—ROSARIO.

[62999.]—**Dry Plates for Hot Climates.**—I used Dr. Monkhoven's plates in Africa, and had no difficulty with them. If, however, you use pinch developers, any make of plates will frill; to remedy this I run a border of about ⅛in. round the plate, with shellac dissolved in spirit.—B.SC., Plymouth.

[63000.]—**Electrical Measuring Instruments.**—A description of the mode of making an ammeter was given at page 47, Vol. XLV., No. 1,156 of the ENGLISH MECHANIC, and an article on voltmeters will appear shortly.—S. BOTTONE.

[63004.]—**Tracing Paper.**—In reply to Harry Scott Homer, a very simple way is to paint both sides of a sheet of paper with black cyclostyle ink. This, when dry, leaves a good outline on wood.—A. TINKLER, Chester.

[63004.]—**Tracing Paper.**—Harry Scott Homer's query is very indistinct. Does he wish to make red tracing paper, or does he want to know how tracings are transferred to fretwork wood? If the latter, rub the under side of the tracing with blacklead, put on the wood, and trace over the design with any hard point, when a fac-simile will be found on the wood.—B.SC., Plymouth.

[63005.]—**Producer Gas.**—In reply to "J. T. S.," there are several gas-producers in use; those of Siemens are usually adopted for steel melting furnaces. The best known of the other types are the Wilson and the Thwaites producer; all, I believe, are suitable for calcining lime, clay, or bricks. The process consists in the production of carbonic oxide by means of a blast of air through a heated mass of coals.—GENERATOR.

[63007.]—**Welding Mushet's Steel.**—In answer to "Steel," I may state that I have never used any of this steel, and therefore cannot say anything about its peculiarities.—A., Liverpool.

[63008.]—**Size of Accumulator.**—You will need at least four cells, each containing nine plates 9in. by 4in. by 12in., to do this work. The cells must be coupled in series. This will allow you to run a lamp having a resistance of about 8 ohms, and requiring one ampère to light it well.—S. BOTTONE.

[63011.]—**Platinising Carbon Plates.**—Make a dilute solution of platinum chloride in water, say ½oz. to 1 pint of water. Attach metallically one carbon plate to the anode of a two-celled Daniell battery. Connect the plates you desire to platinise to the cathode. Allow both anode and cathode to be in the solution of platinum chloride, taking care that the anode does not touch the plate. The plates will soon become with platinum black.—S. BOTTONE.

.]—**Voltaic Battery.**—The Daniell.—S. E.

.]—**Boring Tubes Conical.**—As the too small to admit of the use of a boring must of necessity rime them. It will be ob then even.—T. C., Bristol.

.]—**Tomatoes.**—I have some tomatoes against a south wall; I started them in a ıse, and planted them out when from 12in. high in some well-manured ground kept stened, and have promise of a good crop. e afraid of giving them too much water, them planted out in good time.— YE.

.]—**Tomatoes.**—Train them against a ing the south, pinch back all shoots above ; when the fruit is once set stop off all water moderately in the day time with nanure; do not water at evening.—S. E.

8.]—**Fast-Sailing Yachts.**—"Ryde" an illustration and description of the n yacht *Volunteer* in the *Illustrated London* r Aug. 20th.—REYMOND.

.]—**Speed of Vessels.**—The "Why of "Atlantis" may be thus answered : that in order to double any given speed , it would require to have the driving power led.—A., Liverpool.

.]—**Speed of Vessels.**—"Atlantis" d on p. 367 of Vol. XLIII. (No. 1,109) full account of this subject. If is unable to get the number, I shall be o give a brief summary of the article. A n the *Engineer* declares that it cannot be d calculates that the crank-shafts of such would weigh no less than 500 tons!— ND.

.]—**Fusible Metal.**—An alloy composed ts bismuth, 5 parts lead, and 3 parts tin 98° C. This is about the most fusible at I know of; but I should think that this ture was rather too much for the average RINCIPIA.

.]—**Screw-Down Taps.**—These taps, re provided with an indiarubber ring, are ug, and not equal to a well-made plug tap. son for their use is that pipes are liable to hen the plug wears loose and is suddenly f, especially by women. It has been ed that this arrangement is the patent of ıeer of a water-supply association. At all some of the men make 'bacca money by in and condemning the frequent leakage, n producing a rubber washer from the t pocket, going through the formula of off the water in the street, &c., and pocket- t the tapster chooses to stand. Memo.— ality of the brass used for steam taps be something very much superior to the usually to be met with in the average 's stock in trade, consisting, as the latter mostly lead, a little zinc, and less copper. verpool.

.]—**Screw-Down Taps.**—The object of er company's regulations with respect to conomy. It is a pretty well-known fact water is wasted by the use of the screw- ıps—hence the preference. The common is peculiarly capable of suddenly turning ll on if left, through carelessness, to drip. ew-down tap, from its construction, can- sibly give way to hydraulic pressure.— D'OR.

.]—**Screw-Down Taps.**—Water com- upply water at a considerable pressure, and plug taps soon get out of order, and have ken off to be repaired, while any person of intelligence can put a fresh washer on a wn tap. The chief reason, however, for rew-down taps is that you are forced in em to "waste time," as "New River" calls sing the tap, and thus avoid the jerk and all the fittings which arises if a plug tap l sharply. On a steam boiler there might ulty in getting a washer that would stand if a screw-down tap was used.—D. H.

.]—**Screw-Down Taps.**—The reason e insisted upon by water companies is, be- sing the orifice as they do gradually, there k-pressure on the supply pipe. In many s would burst the pipe if an ordinary plug used.—LAMBETH.

.]—**Screw-Down Taps.**—As a rule, they eak so much as plug taps, which so soon go nd, of course, the Water Company do not ut people's time, but only their water. where high-pressure service exists, the wn are much better, as it is impossible to m very quickly, and they thus save the y preventing concussion by the sudde of the column of water.—T. C., Bristol.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, C. Provis has replied to 62513, 62517; "Raymond," 62562.

62593. Daguerreotype, p. 376.
62594. Engines for Screw Steamers, 376.
62601. Movement Wanted, 377.
62623. Clock and Sundial, 377.
62632. A Platyscopic Pocket Lens, 377.

62761. Card Wire Machine, p. 472.
62787. Dolls, 473.
62795. Organ Building. To Mr. Audsley, 473.

QUERIES.

[63023.]—**Bees.**—Will some kind bee-keeper give me a little advice? I put two of Benthall's supers on my "Abbott's bar frame," but as I see the bees will not be able to fill them, I want to take them out. I tried to do so yesterday, but found they were so fastened to the frames below that I could only detach one by violent pushing, as I could not insert a knife underneath. I loosened and lifted one up a little way, but although I had given smoke there was such a commotion in the hive and the bees were so lively that I left the super on and withdrew. How must I manage? Must the smoke be given at the door or under the quilt when one wishes to get frames in and out? This is the first year I kept bees. I had never seen a bar-frame hive before I sent for mine, nor had I seen the interior of any hive or skep My knowledge, which is small, has been chiefly gathered from the "E. M.," but although I have read and re-read all the interesting details, I must confess my knowledge speedily departs from me when I stand behind the hive, and I feel that theory and practice are indeed very different. I have "Modern Bee Keeping"; but somehow I constantly find that what I want to know is not in print. I have no one here (South of France) to help me, and so far I have not had sufficient courage to lift a frame up to find the queen. I do not want to give up the pursuit, which I am sure is very interesting in spite of its stings. My bees were hived on May 29. They had a little foundation, but no food, as the weather was fine. As far as I can tell, seven frames are pretty full, but they were not placed straight when the swarm was hived, and they have remained crooked ever since. I see bees working in supers, but they do not get on The summer has been a favourable one, but the bees swarmed late on account of the cold spring. My swarm has been very active and the floor board and porch used to be covered with clusters of bees; now there are not nearly so many to be seen outside. They have a great enemy in the shape of a sort of flying black beetle, the name of which I do not know. They go into the hive, and the bees cannot kill them on account of their shell-like bodies; under the dull black upper wings there are pretty dark blue wings which it uses in flying. For some time I noticed a bee which was half white, it worked like the others, but I have not seen it lately.—BLANCHE.

[63024.]—**Creaking Knees.**—What is the cause of knees creaking when stooping or going up and down stairs? Is there a remedy?—BLANCHE.

[63025.]—**Throat.**—A lady about 35 years of age is afflicted with what appears to be contraction of the throat. She has a great difficulty in swallowing food, even when cut up in the smallest pieces. All remedies have failed. She has tried magnetic appliances in vain. She also applied at the Hospital for Diseases of the Throat. Her general health is good. She is healthy, and not at all hysterical. Her throat seems worse when in a relaxing climate. Can anyone suggest a remedy?—BLANCHE.

[63026.]—**Spinning and Twisting Machines.**—Could any of your many readers inform me where I could obtain a spinning machine or two, a twisting machine, a balling machine, and hackles for making twine? Also where I could get tow already cleaned so I should not have to pay carriage for dust and waste. I emigrated to Brazil nineteen years ago and have seen some rough times, but have got a house and garden in a much neglected suburb of Sao Paulo as part of my savings for the past eleven years, but the source of my employment has failed. To move nearer the city to get work I should have to sell my house and much-loved garden at a great sacrifice. Raw twine as sold in the city is poor and dear, and mostly comes from Germany. That used for fireworks is without any finish and in great demand (they go in for fireworks here). If I could get the above machines with the means at my command, about £100, I could bring myself and family into profitable employment. I wrote to the firm of Barroclugh and Co., of Manchester, but they sent an estimate beyond my means. Added to the above would be required a line shaft, pulley, and a horse gear for one horse.—J. FARMER, Rua Concordia, No. 41, Sao Paulo, Brazil.

[63027.]—**Skrivanow, Holmes-Burke, and Chloride of Zinc Cells.**—Could some one kindly tell me the component parts of the above cells, and also the proportion of water to mercuric sulphate in the "Schanschieff"?—A. K.

[63028.]—**Saddle.**—I hear there is a saddle now in use by which a lady can, without dismounting, alter the length of her stirrup leather. Can any of your readers oblige me with a description?—JANET MACKENZIE.

[63029.]—**Fishing Rod.**—Would some brother-reader give me instructions how to make a fishing rod, the kind of wood used for that purpose, and also the way to make the varnish?—ANGLER.

[63030.]—**Cambrian and North Stafford Locos.** Will some one kindly give me the principal dimensions and weight of new bogie passenger engines, Cambrian Railway? Also name of new passenger engines, North Stafford Railway. A sketch if possible of Cambrian locos would oblige.—CHILLINGTON.

[63031.]—**Water Pumping.**—I have a well 35yds. deep with a constant supply of pure water. There is an engine which lifts the water to the surface, but it is only worked at intervals. I want to convey the water to a dwelling house about 150yds. distant, and about 3ft. higher than surface of well. What is the best way to supply the house with water, i.e., convey the water to the house and store a sufficient supply without destroying its purity?—AQUA PURA.

[63032.]—**Legal Query.**—The exact words of the agreement for a yearly rental are, "The tenant also agrees to leave the said premises (house and grounds) in good and tenantable repair." Does this include painting and papering, repairs to bells, windows, water and gas pipes, &c.? Is not reasonable wear and tear to be considered? ANXIOUS.

[63033.]—**Eastman Negative Paper.**—Can any of your readers give me the sensitometer number of the Eastman negative paper? I have been told it is not so rapid as the Ilford Rapid plates. I have several rolls, and have given them credit for 22½ to 23½, but shall not know the result until my return to England, as I had no opportunity of trying the paper before I left. It seems very strange that the most important factor in the determination of exposure, the most important factor in dry plate photography should be withheld by the manufacturers, and not insisted upon by the buyer. It is all very well to say that ammonia and bromide and soda will enable you to control development. So they will, and you may get a printable negative from an incorrectly exposed plate, but you won't get the best things your materials will produce, and this can only be got by a knowledge (as Cartwright and Rathway inform us) of subjects, light, season, time, lens, stop, and plate. The first four of these are appreciable with a little practice, the next two are invariable, and the last, which is so important, is often the only things we don't know. Perhaps experienced photographers who read your journal would assist one another by detailing their experience of the relative superiority or sensitometer number of various plates and papers through your columns until we can obtain this necessary information from the manufacturers. The Eastman Company advertise that they will not be responsible for defects in their paper that is over six months old. The last I bought, both from a well-known firm and from a co-operative society, was dated August, 1886, and I am told that the date on the packets of paper is now replaced by a number, rendering it impossible for the buyer to know the date of manufacture, and thus making the undertaking of the company to replace faulty paper of no effect. I found transparent horizontal lines run through a whole packet of Eastman's 8½ by 6½ paper, but could not apply for redress, as the paper, bought a week before development, was over six months old. When the paper is good I find it a trifle only slower than rapid plates and quite equal to the best plates in printing qualities.—J. G. S.

[63034.]—**Vanishing Point**—Would any architectural reader of the MECHANIC kindly tell me how to manage the perspective in a large drawing of a building, in which the inclination of the lines is only very slight, and the vanishing points are consequently situated a long way off the board? Also, how are the intermediate points to be obtained? Any hints on the management of perspective without having to draw out in full the structural perspective lines to the respective vanishing points, would be greatly appreciated. I should also be much obliged if anyone could recommend a good handbook on perspective drawing.—PERSPECTIVE.

[63035.]—**Maize Boiling for Stock.**—I am at present using large quantities of ground maize as feeding for cattle and pigs, boiling it in a large open boiler or copper. I would wish to know whether the erection of a steam boiler, and using the steam on the maize meal would be a more economical way of cooking than the way I now have, and if so, what would be the size of boiler required to steam, say, 6cwt. to 10cwt. meal per day. I may say that the meal must be fully boiled, the particles of starchy matter completely softened. I have water at a pressure of 20lb., so could feed my boiler without a pump. What is the H.P. duty of a steam boiler expressed in gallons of water evaporated per hour at say 20lb. pressure?—BOILER.

[63036.]—**Electric Shock.**—Will some reader of the "E. M." kindly assist me? I wish to have an induction coil in connection with a conducting surface, say, a piece of brass, let into a counter top, in such a manner, that anyone touching the brass shall receive a shock. Is it necessary to have a conducting surface to stand upon? I have a coil of six layers No. 24 s.c. and 14 No. 36 s.c. Is that powerful enough? If not, would a condenser added be sufficient? Please say what number of sheets, and about what size for condenser.—SPARK.

[63037.]—**Battery.**—I have a bichromate battery consisting of five cells with one zinc and two carbon plates in each cell. I have been trying to work with it a small 4c.p. lamp. It works very well for about one hour and a half, but then the lamp goes out. What is the cause? The zinc plate also wears thin very fast. Is there too much acid in the solution? Do you know of any cleaner and equally inexpensive solution as the bichromate of potash, and sulphuric acid? I believe the E.M.F. of each cell is one volt. Would you also explain and give the E.M.F. of Marie-Davy and Latimer Clarke batteries?—W. P. B.

[63038.]—**Alcohol and Digestion.**—I have several times seen an illustration of the retarding effect exercised by alcohol on digestion shown by lecturers. Spirit is poured on to the white of an egg producing a curdled clotty mass. A similar effect is produced upon the albumen of egg by boiling, but no one pretends that boiled eggs are unfit for food. Wherein, then, lies the the force of the illustration?—ZERO.

[63039.]—**Oxy-Hydrogen Lanterns.**—Is it dangerous to use oxygen from a cylinder burning the hydrogen from a gas box?—ZERO.

[63040.]—**L.N.W.R. Engines.**—I noticed that Ganymede No. 1670, formerly a 6ft. 6in. Ramsbottom, appeared to have been rebuilt with a high boiler and shorter chimney like the Precedents. Can anyone tell me if it is intended to rebuild the 6ft. 6in. Ramsbottoms in this manner? With what class of engine are the following lines being worked? Chester and Holyhead, Denbigh branches, Car-

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lisle and Penrith. Craven Arms and Hereford district? How many of Webb's four-wheel passenger tanks, 1000 class are out, and what are their numbers? What is being done with Precursor class?—W. H. V.

[63041.]—**Engine Drivers and Locomotives.**—Will any of "ours" kindly inform me what is an ordinary week's work for passenger driver in a running shed? Particulars of the B'ham (M R.) shed would be useful. How the arrangements are made for pilot, and why passenger engines are used to help goods trains up the Camp Hill incline? Some particulars of the links in the above shed and in other M.R. and L N.W.R. sheds would be thankfully received.—W. H. V.

[63042.]—**M.R. Engines.**—Can anyone tell me where No 85 is stationed, and to what class does she belong? What is the latest style of passenger tanks? Is it true that the 1285 class at Bristol are failing to keep time owing to the driving wheels being too small? Why were the 825 class taken away?—W. H. V.

[63043.]—**Evaporation.**—Can any brother-reader of "Ours" describe a few good, striking experiments in illustration of the production of intense cold by evaporation? I have repeatedly tried freezing with ether, but more often than not have failed in producing any effect except that of using up a lot of ether. I believe liquefied sulphurous acid is very volatile. Is it to be bought anywhere?—ZERO.

[63044.]—**Black Heart Iron.**—I understand that this iron comes from America. I have seen some castings made from it—they had been softened; they were broken, and the fracture showed a grey ring just on the outside, perhaps 1-16in. deep, all inside of this ring was black. Can any reader give me any information about this iron?—for instance, what is the difference between this iron and our H.C.M.? Is it black before it is softened, does it come in pig or ingot, what brand does it bear, or any other information will be thankfully accepted?—TOUGHENER.

[63045.]—**Plating Soft Solder.**—Will some reader tell me how to silver-plate soft solder? I have a lot of brooches with joint and catches soft-soldered on, but cannot get the silver to take on the solder. I have tried to copper-plate them with the following solution: Sulphate of copper 1lb., sulphuric acid 1lb., water about 1gal.; but it will only take on the brass, the solder turning quite black.—PUZZLED PLATER.

[63046.]—**Cutting Pipes.**—Would "T C." or others tell me the following? I have some ⅝in. pipes to cut and thread. Now what cutters should be used to do them with? Also how are the stocks and dies to be put on the pipe for cutting threads, and what size of dies and taps are used for ½in. and ⅝in. pipes?—ONE IGNORANT.

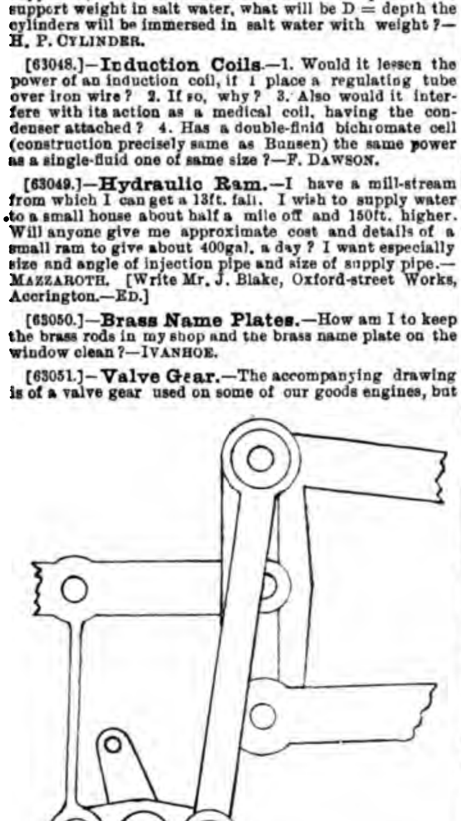
/ [63047.]—**Flotation.**—If W = weight (total) to be supported, S = cubic contents in inches of cylinders to support weight in salt water, what will be D = depth the cylinders will be immersed in salt water with weight?—H. P. CYLINDER.

[63048.]—**Induction Coils.**—1. Would it lessen the power of an induction coil, if I place a regulating tube over iron wire? 2. If so, why? 3. Also would it interfere with its action as a medical coil, having the condenser attached? 4. Has a double-fluid bichromate cell (construction precisely same as Bunsen) the same power as a single-fluid one of same size?—F. DAWSON.

[63049.]—**Hydraulic Ram.**—I have a mill-stream from which I can get a 13ft. fall. I wish to supply water to a small house about half a mile off and 150ft. higher. Will anyone give me approximate cost and details of a small ram to give about 400gal. a day? I want especially size and angle of injection pipe and size of supply pipe.—MAZZAROTH. [Write Mr. J. Blake, Oxford-street Works, Accrington.—ED.]

[63050.]—**Brass Name Plates.**—How am I to keep the brass rods in my shop and the brass name plate on the window clean?—IVANHOE.

[63051.]—**Valve Gear.**—The accompanying drawing is of a valve gear used on some of our goods engines, but



I am unable to find out if it is a separate patent or only a different form of Stephenson's valve gear. Would any of our correspondents be so kind as to give me any particulars of which I am at present ignorant?—G. AND S.W.RY. FITTER.

[63052.]—**Marine Engine.**—Will any reader of "E. M." give the rule for finding the diameter of cylinders for triple-expansion engine, also the size of shaft for same? Supposing the high-pressure cylinder to be 20in. diam. with a stroke of 36in. and steam at a pressure of 160lb. per square inch?—SERRIATIM.

[63053.]—**Ejection.**—The tenant takes a house at a *quarterly rental*. In the agreement signed by the tenant there is a clause to this effect, "If the rent is not paid within 21 days after it is due, the landlord shall be able to eject the tenant and be subject to no appeal to law." Can he do this, seeing it is a 'quarterly rental?—DOUGHTFUL.

[63054.]—**Indiarubber Balls (Small).**—I need 100 or so of rubber or cork balls, 3-16in. and ¼in. diam., for a small gas valve. I have failed to find a maker of such things. Will some one say how these are made, and how I may set about to make them for myself? They must be perfectly round to act as a valve when placed in a prepared tube for same.—VOLT.

[63055.]—**Pedestrianism.**—I wish to enter into a 2,000 yards handicap (foot race), and not having any previous knowledge as to training, &c., I should like to know how to proceed; what time in the day would be best to practice sprinting, morning or noon. I am 25 years of age, 5ft. 3½in. height, 8st. 10lb., and in good health. Any hints regarding exercise and diet would oblige.—READY.

[63056.]—**Prophylactics to Cholera.**—"Eos." (letter 27746) in his most interesting letter, recommends pure sulphuric acid. Does he mean the ordinary pure acid of the laboratory, which is concentrated, or the acid of the B.P., which is, I believe, diluted? Two ounces of concentrated to a quart of water, although afterwards diluted, seems rather strong.—KENSINGTONIAN.

[63057.]—**Pump Puzzle.**—My boiler pressure is 40lb. per square inch, and I have had some trouble lately at this pressure with my pump working dry—that is, will not lift water; but at 20lb. pressure it goes all right. The pump is a 3in. ram and 6in. stroke. I hope some reader will tell me how to remedy this. Also I have some plug taps to grind in. How am I to start on these, and what tools to use?—ONE IGNORANT.

[63058.]—**Cod-Liver Oil Emulsion.**—Will some of our readers inform me how better to emulsify cod-liver oil, so that if can be readily given to a child two years old?—G. MACBETH.

[63059.]—**Wood Pulp.**—Can any of your readers inform me how I can make small quantities of wood pulp?—F. S. G.

[63060.]—**Mottling Breech Blocks.**—I should like to know how the mottling on beech blocks and lock plates in gun barrels is done?—A 19 YEARS' SUBSCRIBER.

[63061.]—**Creasote.**—I want to remove the dark colour and purify the refuse creasote from gasworks. Will any reader kindly help me to do this?—F. G. TUCKER.

[63062.]—**Biddle's Patent Wind Motors.**—How do these work? Are they suitable to drive amateurs' lathes?—E. R. D.

[63063.]—**Bainbridge and Wood's Double Flageolet.**—Was this instrument ever much used? How is it played, as there are keys for cutting off the wind from either whistle? What wood are they made of?—E. R. DALE.

[63064.]—**Shaping Machine.**—Will some mechanical reader oblige by giving working drawings of a shaping machine, 12in. stroke? Also give a few hints on making lathe and planing tools from Mushet's special steel?—S. J.

[63065.]—**Carbolised Oil.**—Will "Eos" kindly give the preparation of this valuable remedy, as I have occasion to use large quantities of the same? I should like the exact proportion of the ingredients.—12 YEARS' READER.

[63066.]—**Thermopile.**—TO MR. BOTTONE.—I am sorry to trouble you again on this subject, but could I not use a smaller number of elements—say, the 150 that you first advised me to use (in five circles of 30), and four times the heat (about 24c.ft. per hour) for the four lamps?—THEROMOPILE.

[63067.]—**Polishing Metal Specula.**—Can any reader inform me of the way to grind and polish a small solid silver speculum for reflecting telescope?—ALBERT MAAS.

[63068.]—**Spongy Platinum.**—What is the explanation of the catalytic action of spongy platinum?—C. A.

[63069.]—**Spinning.**—How many revolutions per minute does the spindle make in spinning? How many twists are there per inch in twist, and also how many weft? I desire that the answer be particularly for cotton; but answers for other materials will be gratefully accepted.—J. R.

[63070.]—**Hardening Spiral Springs.**—If some brother reader would kindly inform me, I should feel obliged. I have been hardening them in water and letting them blaze off with tallow, but I find them sometimes too hard, and more often too soft; they are 1-16in. ⅛in., and ¼in. steel wire. I have tried putting them in oil without letting down, but they are too soft. The springs you buy are hardened very well; but you cannot always get them to suit you?—SPRINGS.

[63071.]—**Depth for Diving Bell.**—I shall feel much obliged to any brother subscriber who will explain to me the greatest depth of water in which a diving bell or diver's apparatus, can be employed, so as not to be injurious to the health of the men engaged therein, by too great a pressure on the air?—E. F. H.

[63072.]—**Registering Thermometer.**—A registering thermometer has two bulbs, one marked "cold" a little larger than the other and filled with a clear white liquid. The other, a small bulb, marked "heat" half full of a pale yellow liquid. What are the two liquids, and is it only registering thermometers that have them?—U.P.B.

[63073.]—**Cement for Iron Stove.**—Can any practical reader give me a good recipe for cement to fill up a large crack in a cast-iron stove? I have tried several, and as soon as the stove gets red hot it all crumbles to dust.—A POOR BLACKSMITH.

[63074.]—**Recovering Indigo.**—I should feel obliged if any of our chemical correspondents would inform me how to recover indigo from other blues, grease, and dirt. I have a great quantity, and it should contain about 25 per cent. of indigo.—J. B.

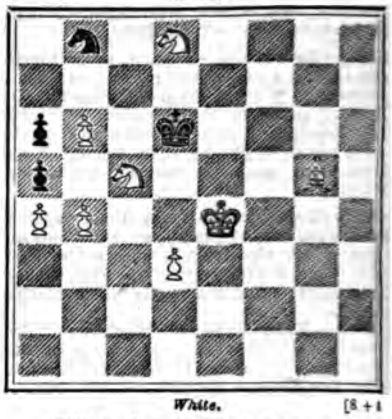
[63075.]—**Rouge.**—Will any kind friend tell me the practical method of preparing rouge or plate powder as made in factories (rouge and putty powder works) from sulphate of iron?—L. T. W.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MLIX.—BY H. F. L. MEYER.

Black.



White. [8 + 4

White to play and mate in two moves.

SOLUTION TO 1,057.

White.	*Black.*
1. Q-R 7.	1. R takes R at B 6 (a).
2. B-B 6 (ch).	2. K moves.
3. Q mates.	
	(a) 1. R takes R at Kt 7
2. R-Q 3 (ch) &c.	
Also 1. R-Q 2 (ch).	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,057 by H. Hosey-Davis, A. Bolas, A. Dean, and Evan Evans; to 1,056 by A. Bolas.

A. DEAN.—In 1,056 there should have been (as stated in next number) a Bishop at Q R sq, which prevents any other solution but the author's. Will you kindly send full solution to 1,054 again, as we have mislaid the other? You are right as to defence 1. $\overline{\text{B-B 5}}$; but how do you proceed if 1. $\overline{\text{Kt (R 4)-B 5}}$?

A. F. M.—Name entered. We still want four more competitors in order to start tourney.

W. T. P.—See notice above to A. Dean.

H. J. FISHER.—Any other point we may have overlooked in relation to Tourney we shall be pleased to answer, if you will let us know.

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